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URBAN SPRAWL IN THE PERIURBAN COASTAL ZONES OF ATHENS[1]

ABSTRACT

Urban sprawl has for quite a long time been a central issue in urban and regional analysis and planning practice. Most of the theoretical and empirical work however, has focused on urban sprawl in North European and North American city regions. Recent work has brought to the fore some of the crucial differentiating elements of Southern European, Mediterranean, urban settlement structure. The history of spatial development in the European South and in particular in the Mediterranean basin has often been characterized as "idiosyncratic". A settlement space characterized by a small number of large scale urban-industrial agglomerations, and a plurality of agricultural rural areas, extensive internal and external migration, coupled with an increasing concentration of popular tourist destinations. In these latter areas, issues like "coastalization", "tourist urbanization" of periurban coastal zones have come to the forefront of urban sprawl analysis and policy-making.

The paper argues that there is a need to develop novel conceptual and methodological tools, in order to understand, explain and plan for these "urban sprawl" aspects of the Mediterranean periurban regions. The changing socio-spatial facets of the settlement development process in these areas are investigated by focusing primarily on the changing population and housing distribution as well as on the composition of land use patterns and the evolution of the socio-professional structure of the resident population.

The main observation is that in the wider Athens area the bulk of the population and of the build up area is concentrated in the central urban quarters and their immediate neighbours; there are, however, strong indications of a "sprawling" process, filtered through a rapidly emerging and highly commodified private housing market. The latter

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1. An initial version of this paper has been presented at the 7th ESA Conference, Torun, 11th September 2005.

affects mainly the Northeastern part of the urban edges and coastal areas. The coastal areas of the region are being transformed from "vacation" areas, which were, by and large, the outcome of "spontaneous" housing provision mechanisms, to primary residential ones, usually the outcome of a highly standardized and commercialized housing market. The observed population shift is stronger among "higher" social strata. The urban social matrix though does not become any simpler as a result.

1. OBJECTIVES AND STRUCTURE OF THE PAPER

The aim of this paper is to examine the changing sociospatial structure of the wider metropolitan area of the Greek capital, Athens, placing particular emphasis on the identification of emerging "decentralisation-suburbanisation-coastalisation" tendencies.

The paper is organised in three sections. In the first section a brief outline of the conceptual and methodological tools is presented. The techniques used are explained and the variables selected for the analysis are described.

In the second section, a summary of the main stages of development of the Athenian metro-area is presented, the data analyses are elaborated and the research findings are presented.

The concluding section discusses the agenda for further research in urban analysis of metropolitan areas.

1.1. Setting the scene

Urban structure, and in particular sprawl, has for quite a long time been a central issue in urban and regional analysis and planning practice. The Chicago School/Ecological models are still the main focus of analysis and debate. Despite the shift from Chicago to Los Angeles or to the global arena, issues of "invasion' and "succession" (migration, decentralization, gentrification) are still at the forefront of urban theory and policy (Maloutas 2004; Dear, 2002; Soja, 2000). Moreover, issues of social and spatial polarization, land use and settlement planning and policy are the key concerns of development policy.

Most of the theoretical and empirical work however, has focused on urban sprawl in North European and North American city regions. Recent work has brought to the fore some of the crucial differentiating elements of Southern European, Mediterranean, urban settlement structure (Allen et al., 2004). The history of spatial development in the European South and in particular in the Mediterranean basin has often been characterized as "idiosyncratic". A settlement space characterized by a small number of large scale urban-industrial agglomerations, and a plurality of agricultural rural areas, extensive internal

and external migration, coupled with an increasing concentration of popular tourist destinations. In these latter areas, issues like "coastalization", "tourist urbanization" of periurban coastal zones have come to the forefront of urban analysis and policy-making. These processes are considered "a spectacular phenomenon blending permanent habitat with tourism [and second home settlement development]" (Blue Plan, Regional Activity Centre, 2001).

Recently, F. Munoz (2003) identified a new model of production of built space, which he terms "lock-living". He asserts that many Mediterranean cities witness a significant increase of low-density housing construction in the periphery of major metropolitan areas. This type of production has assumed "in the last two decades, a fundamental role in explaining the metropolitan processes at work in the so-called «Mediterranean compact cities»" (Munoz, 2003 emphasis in the original). Moreover, because of this new settlement growth in "functional and morphological terms, the traditional Mediterranean model of the dense and compact city is subsumed into more diffuse urban sprawl–a model of localisation of dispersed housing that "selects" territories and landscapes for this growth, on the basis of how well they are connected to the metropolitan motorway network, and, simultaneously, how near they are from the less or non urbanised areas of the region" (Munoz, 2003).

The effects of this form of urban development have brought about a variety of outcomes related to the geography of metropolitan regions in the South, as well as, significant changes to the prevailing social structure. Again Munoz argues that a simpler urban matrix has emerged in the "new" periurban areas, which is coupled with a simplification of the social structure. A social structure made up of a population "with common trends in reference to their professional skills". In other words, in a more segregated sociospatial reality.

The paper will argue that there is a need to develop novel conceptual and methodological tools, in order to understand, explain and plan for these "urban sprawl" aspects of the Mediterranean periurban regions. The case study of the research presented in this paper is the Attiki region, the wider metropolitan area of Greece's capital. The changing socio-spatial facets of the settlement development process in these areas will be investigated by focusing on the changing characteristics of the resident population (density, socio-professional structure), the composition of major land use patterns and the evolution of the settlement structure and of the housing stock.

1.2. Spatial econometrics and urban structure

Despite the differences (conceptual and methodological) between the various strands of urban social theory, most urban analysts stress the importance of incorporating spatial relations in the study of social relations (Soja, 1989). The

history, on the other hand of economic geography's great half century (Scott, 2000) is full of examples of both serious neglect of quantitative methods and of fetishising spatial (geometric) relations.[2] The research presented here aims at utilizing recent advances in computational techniques in spatial econometrics to uncover important facets of the sociospatial dialectic of urban development. The results of the analysis are not seen as final formulations, but rather as portals to further development of both theory and techniques. Only then it is possible to truly move away from "chaotic" conceptualizations towards identifying and explaining the structures, mechanisms and relations springing from the logic of capitalist accumulation which are the main factors producing contemporary socio-spatial realities.

If "Geography matters!" we need to put a stronger emphasis on the why and how of location, in other words on spatial interaction (spatial autocorrelation), and on the dynamics of geographical structure (unequal development, spatial differentiation).

The fact that (social) data from areas near to each other are more likely to be similar than data from areas remote from each other, creates serious problems to conventional statistical analysis, as this existence of spatial association violates an important statistical assumption: that of the independence of observations. Therefore, in studying spatial attributes we need spatial statistical methods, i.e. we need to incorporate this spatial autocorrelation in model-building. In spatial econometrics the geographical attributes of the data play a key role in model specification (Anselin, 1999).

In the research presented here, spatial association among geographical units in terms of specific variables is examined. For that purpose Moran's I Index is used as a measure of spatial autocorrelation.

The values taken by Moran's I index indicate the strength of the spatial association between a variable in neighbouring locations. Positive values represent positive autocorrelation, while conversely negative ones indicate negative autocorrelation. The presence of positive spatial autocorrelation arises when neighbouring areas have similar variable values, while negative spatial autocorrelation occurs when values of neighbouring areas vary considerably. The values of the index can range form +1, indicating strong positive spatial autocorrelation, 0 indicating a random distribution to –1 indicating strong negative spatial autocorrelation.

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2. Only fairly recently efforts have been made to construct explicitly spatial indices of inequality like the Gini coefficient (Dawkins, 2004), or a spatial dissimilarity index for the measurement of social segregation (Wong, 2004), and operationalize these with the use of GIS and mapping software.

Moran's index can also be thought of as a measure of the degree of clustering of variable values in spatial terms. The usefulness of Moran's index is enhanced by its ability to be used as a Local Indicator of Spatial Autocorrelation (LISA) (Getis and Ord, 1992; Anselin, 1993; Anselin, 1995). Such a use of Moran's I facilitates the classification and mapping of locations into five categories (clusters):

Locations with high values with neighbours where similar values are recorded: high-high-"hot spots".

Locations with low values where similar values are recorded: low-low, sometimes also termed "cold spots".

Locations with high values with low-value neighbours: high-low- "spatial outliers".

Locations with low values with high-value neighbours: low-high- "spatial outliers".

These two "spatial outlier" locations can be considered as "pockets of local non-stationarity" (Cressie, 1993).

Locations with no significant local autocorrelation.

It should be noted that when "Moran's I statistic is computed for rates or proportions, the underlying assumption of stationarity[3] may be violated by the intrinsic variance instability of rates" (Anselin, 2005). This means that the values that a variable (event) can take vary considerably across observations (spatial units). In simpler terms, stationarity is violated when it is known that the spatial distribution of the "base"/"reference" population is uneven due to the "spatial characteristics" of the units (size related to administrative boundaries). To overcome this problem Moran's index can be calculated using the empirical Bayes (EB) standardization as suggested by Assuncao and Reis (1999), by assigning an appropriate "base" variable.[4]

In sum then, the research presented in this paper utilizes spatial econometric modeling, more specifically spatial autocorrelation, in investigating the development of the sociospatial structure of the Athens metropolitan region by looking at the evolution of spatial clustering for a number of thematic topics for the period 1981-2001, in 123 local authority units. These topics are:

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3. On the issue of the stationarity assumption in spatial data see Haining, 1993, and regarding the problem of stationarity in factorial ecology see Johnston, 1976.

4. In what follows Empirical Bayes (EB) standardization was frequently used, due to the considerable variation in the "size" of the spatial units examined.

- Resident population: Density and evolution
- Residential mobility: Internal and from abroad
- Land use distribution: Housing, Manufacturing, Local service and trade functions
- Buildings' construction period
- Housing: Housing stock, Empty dwellings
- Occupational structure: Aggregate socio-occupational groups.

The specific variables used are presented in detail below.

2. SOCIO-SPATIAL EVOLUTION OF THE URBAN STRUCTURE IN THE ATTIKI REGION

2.1. Post-war housing pratices, housing construction regimes

In the following sections, data from a variety of thematic areas are examined using Population and Building Censuses for 1981, 1991 and 2001. A brief aggregate examination of the current "state of the art" literature on the urbanization trajectory in the Athens region and the modes of its production and reproduction will set the findings of this paper in perspective.

There have been numerous studies of the wider metropolitan region of the Greek capital, both research and policy orientated (Auriac, Deslondes, Maloutas, 2003; Maloutas, 2004; Sayas, 2004; Vaiou et al., 1999; Εμμανουήλ, 1999; Tsoulouvis, 1996; Hastaoglou-Martinidis, Kalogirou and Papamichos, 1993). Some researchers have found a strong tendency of urban sprawl (dispersal of population to the outskirts of the urban agglomeration) and social segregation while others argue for the opposite.

Maloutas (2003) argues that one of the main characteristics of Athenian urbanization in the post-war area is that it is more affected by push factors rather that pull factors. In particular, it is not directly linked to industrialization, as in most West European and North American cities, but rather "to political repression during and following the civil war, with the big cities offering more protection through anonymity against political discrimination and more possibilities compared to the exacerbated perpetual crisis of the rural economy". The huge influx of population in Athens (almost 1,5 million in a city of 1,2 million inhabitants) coupled with an anemic development of the welfare state and the absence of large scale social housing projects has led to the emergence of a "dual" housing market (Leontidou, 1994) to cater for housing needs. This "dual" market was not characterized by the public-private dichotomy, but rather by a "formal-informal, capitalist and speculative owner-building constructor" dichotomy. These mechanisms -

modes- of housing production allowed for the co-existence of "piecemeal urban redevelopment and illegality". The emerging urban tissue has been a disorderly one, with the prevalence of mixed land uses, the absence of zoning regulations, the gradual "thickening" of inner city areas, where upper and lower social strata interact. This urbanization processes should not, according to Leontidou (1994), be viewed only as the outcome of unplanned development, but also as the result of "spontaneous" development, of self-promoted housing solutions in Maloutas's terminology.

In the immediate post-war era and up to the 1970s, informal-self promoted housing became one of the dominant modes of housing production, Maloutas argues, because a] it was affordable, and b] it was technically and organizationally accessible to the incoming rural population. However, as can be expected, the emerging housing stock consisted mainly of individual low quality houses. "Basic amenities were often lacking (such as plumbing and electricity) but the buildings were generally solid constructions that were bound to house several generations through progressive improvement and the construction of additional housing space" (Maloutas, 2003). Some of this housing stock is still present in contemporary Athenian space, concentrated mainly in the center of the agglomeration and in the municipalities surrounding it. It has been argued that by the end of the 70s self-promoted development gradually lost its dominant position as a mode of housing production. It is now utilized mainly for housing production by upper-middle social strata and for second-home construction (Gortsos et al., 2000).

Popular strata in the post-war era, but more so in the late 50s to early 70s, gained access to the formal housing market via the *quid pro quo* system of "antiparochi" (Tsoulouvis, 1996), whereby a plot of undeveloped land is exchanged for apartment(s) build by small constructors.

The appeal of this system, according to Tsoulouvis (1996), consisted of its capability to respond effectively to a rising demand for housing with minimal or no cost for the state; its "function" as a substitute for welfare policies of "wealth and income redistribution and social policy"; its ability to provide a great variety of dwellings, different sizes, low-high cost, covering therefore a wide spectrum of effective housing demand.[5]

5. We should note however that the quid pro quo system owes its viability not only to the high demand for housing, but also to some significant conjunctures and structural characteristics of the Greek economy in the post-war era, affecting the supply side of the housing market. In particular, to the aforementioned lack of noteworthy public housing projects, we should add the very low liquidity of the construction sector and the underdevelopment of the state-controlled banking sector.

The aforementioned systems of housing provision had significant effects on the urbanization process in Greece.[6] On the positive side they led to a very high level of owner-occupancy and to a plurality of mixed land uses. On the negative side, we can identify the very high densities in central city areas, the lack of public spaces and a rapid diminution, through parceling out of rural land at the urban fringe (Tsoulouvis, 1996).

The "antiparochi" system however has also gradually lost its dominance as the stock of build-able land has diminished and land speculation offered less rewards as compared to other financial products. Since the 1990s the banking sector has become a powerful actor in the private housing market. Lower interest rates, deregulation of the credit market, increased scope and volume of financial markets, allowed for the expansion of housing loans thereby triggering a widespread increase in building activity fuelling further expansion and thickening of the urban agglomeration (Εμμανουήλ, 2002).

These different housing market mechanisms –modes of housing production– however, have not been/are not socio-spatially neutral. Their imprint can be detected both on the urban form and the emerging urban social structure. Increased residential mobility of upper social strata is taking place while a socio-spatial entrapment of lower strata persists; second home development is combined with "coastalization"-"suburbarisation" of primary residences. The following sections of the paper will examine some of the socio-spatial configurations of these changing housing market regimes and the urbanization process.

This paper shows that urban development is by no means linear and stresses the need for more detailed investigation, both in terms of the spatial unit of analysis and in terms of "disaggregated" socio-occupational groups. Moreover, the modifiable areal unit problem (MAUP) and its implications for the study of urban socio-spatial structure is very seldom analysed and tackled in the aforementioned studies, i.e. most studies do not explicitly address the effect of spatial scale of analysis on measures of dispersal/concentration. "This problem is pervasive in almost all analytical measures and techniques adopted to analyse spatial data" (Wong, 2004). These two strongly correlated issues point to the direction for future research that emanate from the findings of the research presented here.

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6. And to the Greek economy as a whole through the very high multiplier effects of the construction sector (Βαΐτσος, Γιαννίτσης, 1987; Βελέντζας Κ. κ.ά., 1993).

2.2. The evolution of the Resident population, 1981-2001

TABLE 1

Total resident population, Attiki region, 1981, 1991,2001

	1981	1991	2001
N	3.347.051	3.502.616	3.738.865
CV*	3,075	2,596	2,359
I**	0,1385	0,1464	0,1386

Source: NSSG, Population Census, 1981,1991, 2001, calculations by author.

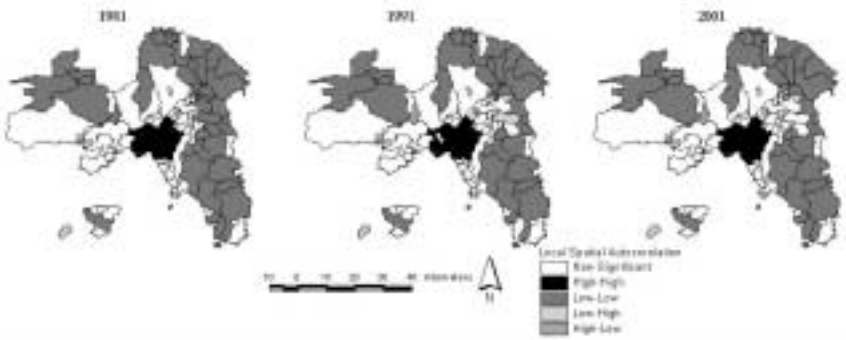
* *Coefficient of variation (σ/μ).*

** *Moran's I index.*

Comparing the values of the coefficient of variation and Moran's I index in Table 1 two prima facie conflicting trends can be identified: a considerable decrease in the concentration of the total resident population in the 123 spatial units of the Attiki region is indicated by the decrease of the Coefficient of Variation. On the other hand, the spatial index of correlation of similar values, the Moran index, shows a significant spatial autocorrelation -concentration of the resident population, which moreover exhibits a considerable stability over the twenty year period 1981-2001.

FIGURE 1

LISA, "Hot spots" and "outliers", Resident population with Empirical Bayes standardization using total area (hectares) as the base variable, 1981, 1991, 2001



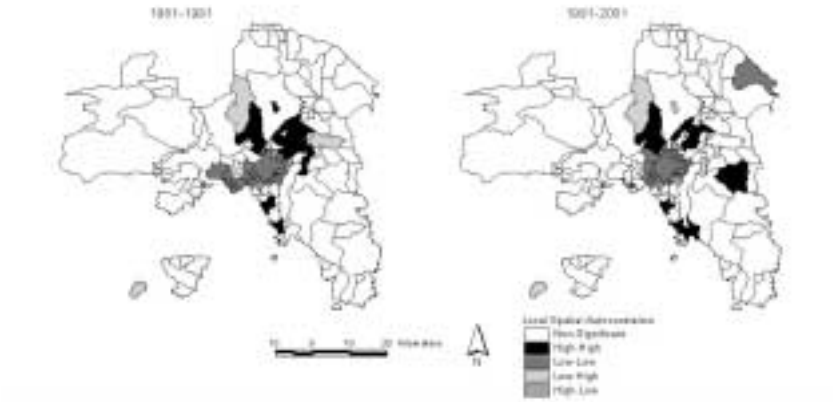
2.2.1. Resident population density

Figure 1 maps the LISA[7] analysis results regarding the total resident population standardized using as a "base" variable the total area of each spatial unit. This figure indicates that in the study region the central municipality (Athens) and its immediate neighbours constitute the dominant spatial cluster, a "hot spot" of high/high values in terms of population concentration and that the majority of the population lives in densely populated areas. This is explained by both the work-related housing choices and by the "entrapment" of middle and lower strata in areas where "spontaneous" and "antiparochi" regimes of housing production offered access to the housing market in previous decades.

2.2.2. Resident population change 1981-1991 and 1991-2001

FIGURE 2

LISA, "Hot spots" and "outliers", Resident population change 1981-1991, 1991-2001



In order to investigate the tendencies for expansion or for further concentration of the population in the wider Athens area it is important to examine the changes of the resident population in the period 1981-2001. Comparison of changes over time, of course, is only a first step of moving

7. LISA: Local Index of Spatial Autocorrelation. The maps and calculations presented here were performed with the GeoDa 0.95-i5, August, 3, 2004 software developed by Luc Anselin. Areas in white do not exhibit significant spatial autocorrelation with their neighbours. The spatial weights matrix was constructed by adopting a Queen's contiguity schema.

away from static spatial patterns and towards identifying spatial processes. In the following thematic areas (variables) changes overtime will seek to clarify further the existence or absence of decentralization/concentration processes at work in the period under investigation.

Figure 2 illustrates very explicitly the tendencies for expansion of the urban settlement of the Greek capital and the parallel [relative] demise of the centre and its immediate neighbours which constitute a "hot spot" of low/low values. "Hot spots" of high/high values appear not only in the so-called "good suburbs" of the North and the South, but affect also the so-called "working-class" areas of the West. It can be argued that the effects of two different processes of housing production are evident in these "hot-spots": "antiparochi" in land recently made available, through changes in building regulations and fully commercialized housing production via housing constructed by middle-size land developers. A highly significant tendency is also evident in figure 2: a "hot spot" of high values appears in the eastern coastal area, indicating a shift of population to these areas in the period 1991-2001.

These changes however need to be put into perspective. Namely population change needs to be standardized by the total population of the areas at the end of the period (1991 and 2001 respectively).

FIGURE 3

LISA, "Hot spots" and "outliers", Resident population change 1981-1991, 1991-2001with Empirical Bayes standardization using total Resident population at the end of the period as the base variable

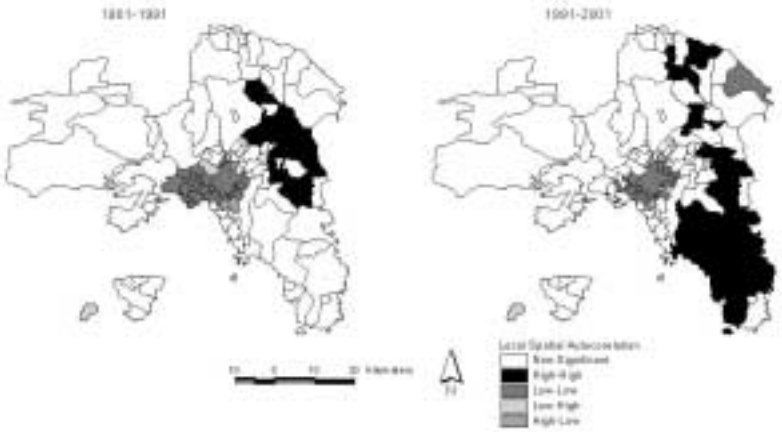


Figure 3 suggests that the population shift, observed above, takes two distinct spatial forms in the two time intervals. In the first period, 1981-1991, the increase in population is mainly concentrated in the northeast of the region in, mostly, periurban local authorities where the "hot spots" of high/high values is concentrated. A distinct ring of high values-"spatial outliers" of high-low values- is also formed though around the declining centre of the region. In the second period, these tendencies of population increase are still present, but the most marked change is the shift, of high values of population increase, to the northern and southern coastal areas.

In sum then, despite the continuing strong concentration of population in the densely populated center of the region, there is a marked tendency of dispersal to coastal areas in the North and South of the region. This tendency is present from the start of the 20-year period, but is intensifying in the last decade 1991-2001. These results can support both a "center domination" thesis and a "suburbanization" thesis, since in terms of absolute numbers the centre is dominant, while the coastal areas do attract a growing number of residents, forming thus a distinct "spatial cluster".

2.3. Residential mobility: Internal and external

TABLE 2

Resident population residing in another Greek Area in 1985, 1995, Attiki region

	1991	2001
N	353.009	407.566
CV	3,213	2,197
I	0,1453	0,1621

Source: NSSG, Population Census, 1981,1991, 2001, calculations by author.

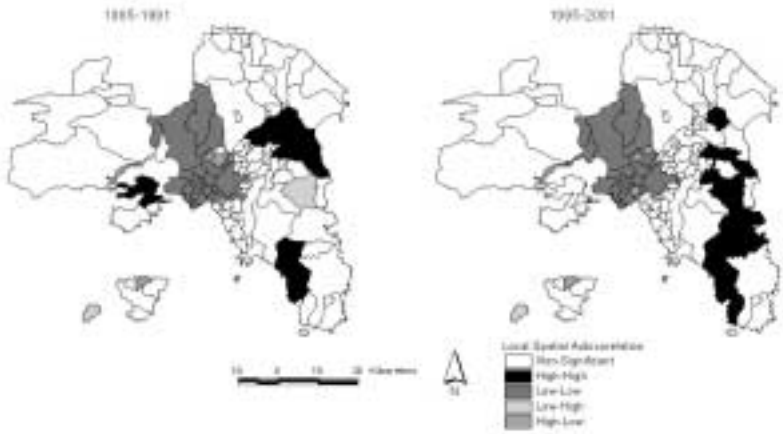
Residential mobility in the study area can, unfortunately, only be measured for the period 1991-2001. The data used come from the decennial population census registering the place of residence 5 years before the census date. The data are divided into residents from "another area" of Greece, or from "abroad".

The values of the coefficient of variation in Table 2 shows a high concentration, among the 123 spatial units, of the resident population

residing in another Greek area in the two censuses, which decreases overtime while Moran's I index shows an increase in spatial concentration in neighbouring units overtime. The results of the LISA cluster maps of these variables seem to be in line with the findings of the previous section.

FIGURE 4

LISA, "Hot spots" and "outliers", Population resident in a different Greek local authority in 1985 and 1995, with Empirical Bayes standardization using as the base variable total Resident population, 1991, 2001



In figure 4 two different spatial processes can be identified. Firstly, an "invasion" of areas at the north-eastern edge of the urban agglomeration and of some coastal areas in the South, by "internal migrants", is registered-"hot spots" of high/high values. These coastal areas are more heavily affected in the second period, 2001. Secondly, there are a number of important "outliers" located in local authorities around the center, and in western parts of the region. This suggests an "invasion" of working class strata in "working class" areas, as is shown below (section 2.6). It should be noted however, that in terms of raw numbers, the centre is "hosting" most of the invasion (14% of all "internal" migrants are concentrated in the Municipality of Athens alone, both in 1991 and 2001). So there seems to be some evidence that even in the fully commercialized era of the nineties, the center of the agglomeration still attracts the majority of in-migration to the Attiki region. The concentration of jobs in the center, the lower cost of housing and the availability of relatively smaller flats are possibly some of the factors, affecting this trend.

Turning to "external" migration, as registered by the resident population that resided abroad in 1985 and 1995, a spatial pattern that differs significantly from that of internal migration[8] is revealed.

TABLE 3

Resident population residing abroad in 1985, 1995, Attiki region

	1991	2001
N	69.395	125.312
CV	3,745	2,643
I	0,0759	0,0495

Source: NSSG, Population Census, 1981,1991, 2001, calculations by author.

In Table 3 the coefficient of variation and Moran's I index both indicate spatial dispersal of "external" immigrants overtime. The Moran index however indicates considerable spatial dispersal in neighbouring areal units, when the coefficient of variation indicates concentration in a small number of spatial units. More specifically in terms of LISA, in 1991, a high number of "external" migrants is concentrated in the North and South of the urban agglomeration, the so-called "good suburbs". This is in line with the prevailing trends of legal international migration flows of the era. These flows consisted mainly of foreign embassy staff and some house assistants from the Philippines, employed by upper social strata. A spatial concentration in the western part of the region is quite significant and could be the result of some returning emigrants, since the host areas are mainly "working class" areas.

In 2001, the spatial pattern of "external migration" changes considerably. Apart from the three flows identified above (diplomatic corps, house-assistance, return migration) a new flow can be identified. This comprises largely immigrants from Eastern Europe and Albania, who are mainly wage-labourers. These seem to be concentrated in the north and northeast peri-urban areas, as a lot of agricultural and construction activity is located there.

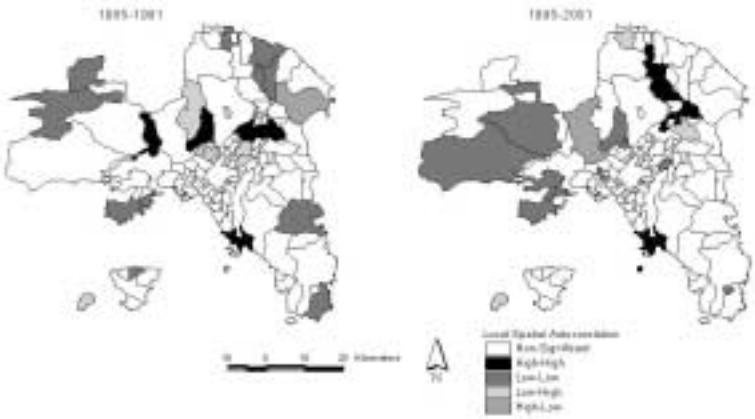
In sum then, the spatial patterns of internal and external residential mobility differ substantially both between them and overtime. The first, internal, seems to be in line with the population shifts of the period, and the

8. In the case of "external migration" data show that the Municipality of Athens attracted 27% and 36% of those residing abroad in 1985 and 1995.

second, external, in line with the occupational structure of international migrants and the location of economic activity.

FIGURE 5

LISA, "Hot spots" and "outliers", Population resident abroad in 1985 and 1995, with Empirical Bayes standardization using as the base variable total Resident population, 1991, 2001



2.4. Land use distribution

The land use data used in this section come from the land use study conducted by the Athens Metro (Attico Metro), in 1995, as part of a wider transportation planning study. The variables used in the following section are the total area covered, in each spatial unit, by the aggregate land use categories of: Housing, Manufacturing and Local service and trade functions (i.e. small scale retail trade, lower and secondary education, local health and welfare establishments as well as small parks). The data were available for 113 out of the 123 local authority units of the region. All the variables were standardized using as a "base" the total area of each spatial unit in hectares.

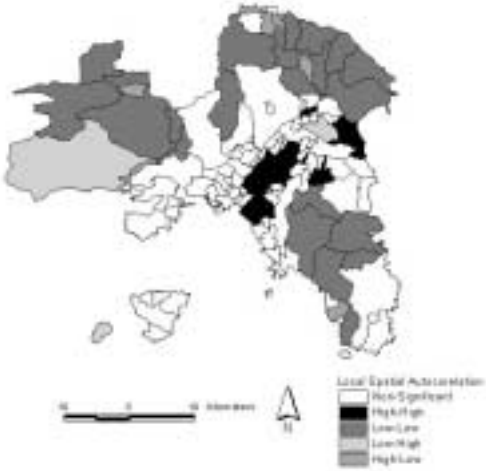
2.4.1. Housing

The total housing area in the Attiki region, according to the Metro study data is 225.572.004 sq. meters registering a coefficient of variation of 0,897, meaning that there is a considerable dispersal of values in the 113 spatial units. The Moran I value (0,567) however, in conjunction with the LISA map, indicates considerable spatial concentration in a South to Northeast axis. Important "outliers" are identified in the northern and southern coastal regions. These spatial concentrations corroborate the findings of a significant

population shift to these areas, as well as a continuous growth of their housing stock, as will be shown in a following section.

FIGURE 6

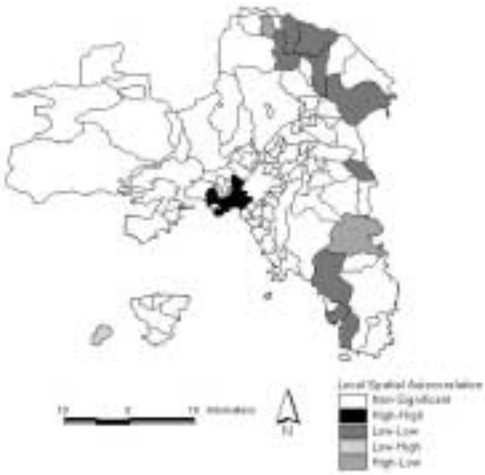
LISA, "Hot spots" and "outliers", Total Housing area, with Empirical Bayes standardization using as the base variable total area (hectares), 1995



2.4.2. Manufacturing

FIGURE 7

LISA, "Hot spots" and "outliers", Total area of Manufacturing use, with Empirical Bayes standardization using as the base variable total area (hectares), 1995

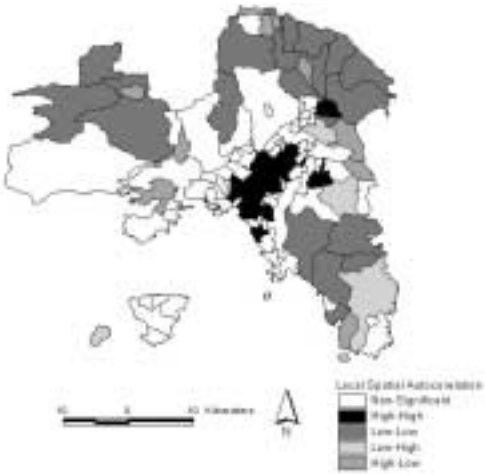


The total area of manufacturing use in the Attiki region is 2.4053.753 sq. meters registering a coefficient of variation of 1,843, meaning that there is a considerable concentration of values in the 113 spatial units of analysis. The Moran I value (0,349) is lower than the housing I value above and this is indicated also in the LISA "hot spots" map which shows the location of this a spatial concentration in areas neighbouring Athens-Piraeus axis. This concentration corroborates the findings of earlier studies where it was argued that, despite some decentralization tendencies, there is still considerable concentration of manufacturing activity in the "traditional" manufacturing zones of the region (Sayas, 2004).

2.4.3. Local Service and Trade functions

FIGURE 8

LISA, "Hot spots" and "outliers", Total area of Local Service and Trade functions, with Empirical Bayes standardization using as the base variable total area (hectares), 1995



The total area of locally-oriented service and trade activities in the Attiki region is 29.134.233 sq. meters, registering a coefficient of variation of 1,067, meaning that there is a medium concentration of values in the 113 spatial units of analysis. The Moran I value however is very high (0,608) indicating strong clustering of similar values. The LISA map shows that the urban agglomeration's local authorities and the centre of the city are the main "hot spots" of spatial concentration of high values, as is expected, bearing in mind the considerable concentration of population there. A

significant "hot- spot" and some important "outliers" of high values are also identified in the eastern and northern coastal areas. This shows the growing importance of these areas as local "consumption" centres.

In sum, the examination of the major land use patterns has shown a strong decentralisation tendency towards the edges and the coastal areas of housing use coupled with locally oriented services and retail trade activities.

2.4.4. Build up area: Building construction periods

TABLE 4

Buildings by construction period, Attiki region

TOTAL BUILDINGS		CONSTRUCTION PERIOD					
		Before 1919		*1919-1945*		*1946-1960*	
N	737340	N	5.098	N	29.805	N	105.831
CV	1,2689497	CV	3,876999	CV	3,230202	CV	1,844072
				I	0,2585	I	0,6623
		1961-1970		*1971-1980*		*1981-1985*	
		N	158.830	N	177.325	N	86.569
		CV	1,543888	CV	1,321813	CV	1,096406
		I	0,61740	I	0,2201	I	0,5351
		1986-1990		*1991-1995*		*1996-2000*	
		N	63.394	N	49.832	N	40.846
		CV	1,097992	CV	1,065911	CV	1,324968
		I	0,5391	I	0,5295	I	0,4634
		Under construction					
		N	15.359				
		CV	1,011157				
		I	0,2796				

Source: NSSG, Buildings' Census, 2000, calculations by author.

As can be observed from the table above the majority of buildings (64%) has been constructed before 1980. After that period building construction in the Greater Athens Area decreases, indicating a low rate of "housing stock replacement". The Coefficient of Variation over the area's municipalities in the various time periods decreases over time, indicating a "spread" of the build-up area. The Moran I index values indicate a more complex picture: they indicate high spatial concentration of buildings constructed in specific time periods (1946-1960, 1961-1970, 1981-1985, 1986-1990, 1991-1995, 1996-2000) indicating that the building process exhibits considerable spatial association. This spatial clustering is further illustrated by the LISA analysis maps.

FIGURE 9

LISA, "Hot spots" and "outliers", Buildings per construction period, with Empirical Bayes standardization using as the base variable Total Building stock, 1946-1980

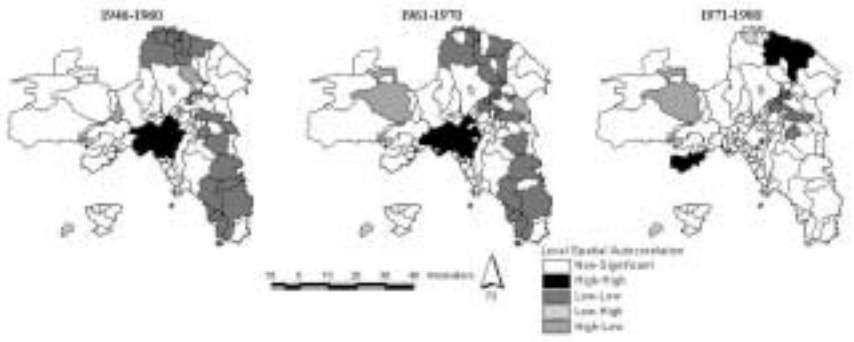


FIGURE 10

LISA, "Hot spots" and "outliers", Buildings per construction period, with Empirical Bayes standardization using as the base variable Total Building stock, 1981-1995

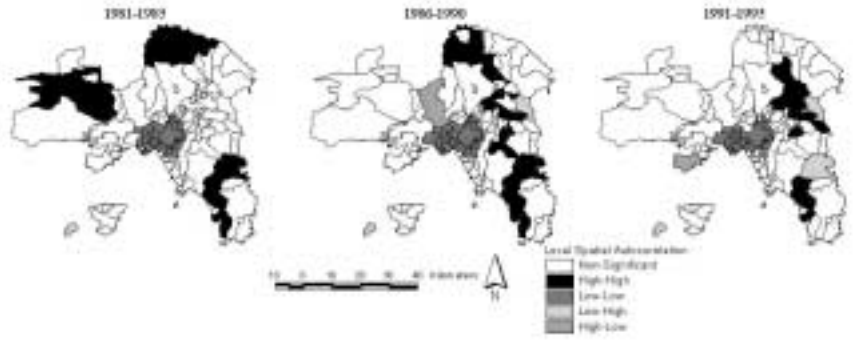
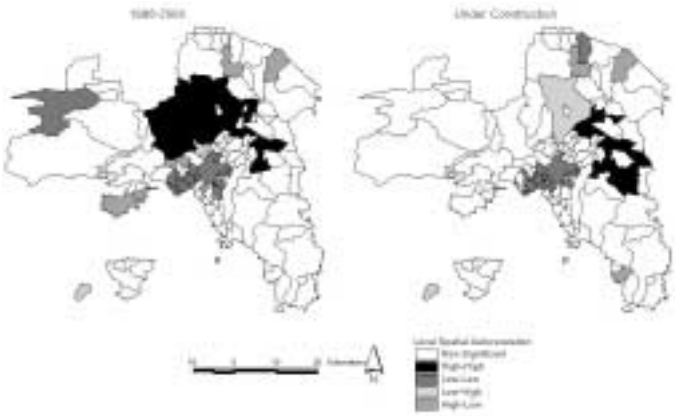


FIGURE 11

LISA, "Hot spots" and "outliers", Buildings per construction period, with Empirical Bayes standardization using as the base variable Total Building stock, 1996-2000, Buildings under construction



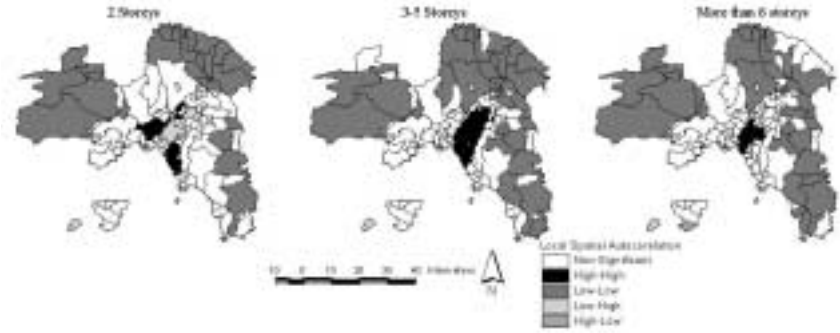
The LISA maps of the buildings constructed during a particular time period, standardized in terms of each area's total building stock, show that the buildings constructed in the 1960s and 1970s, mainly individual, single family or two-storey houses and multi-storey apartments (Figure 12) are concentrated in the Athens and Piraeus municipalities and their immediate neighbours. In the period following the 1980s, building construction has moved to the northern and north-eastern areas of the agglomeration. In the last decade, 1990-2000, building construction is also concentrated in the northern and north-eastern areas, but a significant "hot-spot" emerges in the Western municipalities, most likely a result of in-migration, coupled with industrial and commercial building expansion and housing reconstruction after the September 1999 earthquake. The spatial pattern of buildings which were found to be under construction in 2000 indicates the further "thickening" of the northern and north-eastern part of the Attiki region, a trend which will be further investigated in the following sections.

Regarding the "replacement rate" of the building stock, the evidence of the LISA maps (low-low clusters) and the data of the 2001 census, show that it is mainly the central areas" building stock which has not undergone serious "replacement" in the last 20 years.

However, despite the gradual decrease of building construction, and the "stagnant" stock of the central areas, as we will see in the following section,

FIGURE 12

LISA, "Hot spots" and "outliers", Building height (storeys), with Empirical Bayes standardization using as the base variable Total Building stock, 2000



total housing stock is increasing in the period 1981-2001, reflecting the aforementioned decrease in the importance of "spontaneous" housing development and the rise to prominence of more commercialised mechanisms of housing provision.

2.5. Housing

2.5.1 Housing stock

TABLE 5

Total dwellings, Attiki region, 1981, 1991, 2001

	1981	1991	2001
N	1.396.942	1.578.957	1.809.095
CV	3,199	2,819	2,544
I	0,1043	0,1049	0,1073

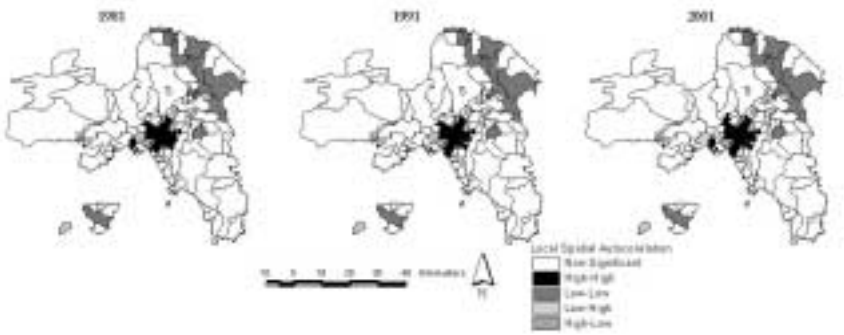
Source: NSSG, Population Census, 1981,1991, 2001, calculations by author.

Table 5 shows a steady increase of the housing stock of around 30% over the twenty year period, 1981-2001. At the same time a lessening of the concentration of this stock is observed in the spatial units of the Attiki region as indicated by the decrease in the value of the coefficient of variation. This is not fully supported however, by the values of the Moran's I index. The later show that, in terms of spatial concentration, the spatial pattern of total dwellings' location is only slightly affected. The pattern is one of heavy concentration in the Central areas of the conurbation (Figure 13).

Another important spatial pattern is emerging though. There are a significant number of "low-high" outliers, pockets of low density residential areas, surrounded by high values of housing density. The centre is surrounded by these pockets all through the twenty year period. At the same time, the coastal and city-edge areas are "hot-spots" of low concentration of dwellings, meaning that the volume of housing stock is low over the whole period in these periurban areas.

FIGURE 13

LISA, "Hot spots" and "outliers", Total dwellings, Attiki region, 1981, 1991, 2001

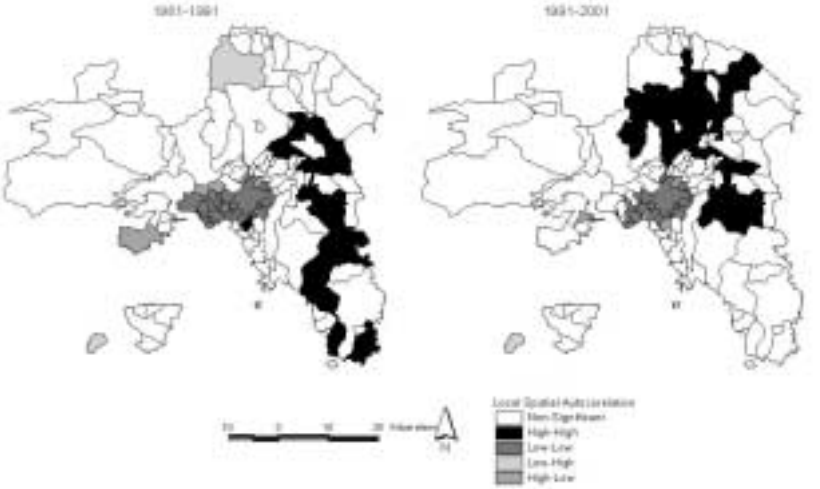


An interesting picture however, emerges if the changes of the housing stock overtime are examined. Figure 14 shows the LISA maps for the changes in total dwellings with Empirical Bayes standardization, using as a "base" variable the total dwellings at the end of the period (1991 and 2001 respectively).

A spatial process emerges which is in line with the total population shift, but spatially more dispersed. In the first period 1981-1991 almost all of the eastern area of the Attiki region is a "hot spot" for high values, i.e. significant concentration of increases in the number of dwellings, "clustered" in neighbouring spatial units. This spatial pattern exhibits a spread to the North in the second period, 1991-2001. The emerging picture and its relation to the shifts in population can be better understood if we examine the spatial pattern of empty dwellings and its evolution over the twenty year period.

FIGURE 14

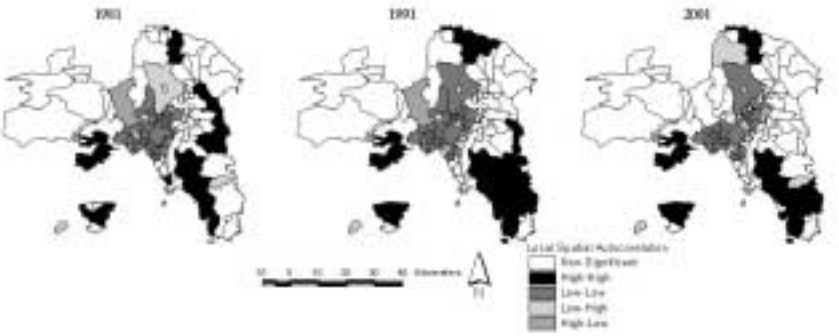
LISA, "Hot spots" and "outliers", Change in Total Dwellings 1981-1991, 1991-2001 , with Empirical Bayes standardization using as the base variable Total Dwellings 1991 and 2001



2.5.2. Empty dwellings

FIGURE 15

LISA, "Hot spots" and "outliers", Empty Dwellings 1981, 1991, 2001, with Empirical Bayes standardization using as a base Total Dwellings 1981, 1991, 2001



The LISA maps in Figure 15, depict the housing stock that was found empty on the day of the census in 1981, 1991, 2001, standardized in terms of each area's total dwellings. They illustrate quite clearly the transformation of the coastal areas in the East and in the South of the region from second home-vacation areas into primary residence areas over the twenty year period. These are are in 1981 "hot spots" for high values of empty dwellings and in 2001 they exhibit non significant concentration of empty dwellings. This, course can only be described as a tendency since the bulk of the housing stock and of empty dwellings are still concentrated in the heavily build up areas of the urban agglomeration. Coastal areas in the North still maintain their "vacation area"/ "exopolis" profile, at least in terms of housing stock.

Another crucial spatial pattern can also be identified in Figure 15. That of the increase in the primary residencies in the northern residential areas of the conurbation, represented by the spread of the "low-low" hot-spots to the North. It must also be stressed that during the whole period the centre and western part of the conurbation, where the majority of working class strata reside, form the nucleus of the primary residence areas of Attiki, i.e., they constitute the center of the "low-low" clusters. This is a further indication of the "socio-spatial entrapment" characterizing these areas, partly the result of the modes of housing production of previous decades.

In sum then, the evolution of the housing stock in the Attiki region, in the period 1981-2001, is characterized by both decentralization tendencies (significant albeit weak) and heavy concentration of primary residences in the "traditional" working class areas. Some of the periurban coastal areas exhibit a tendency towards transformation from vacation areas to primary residential areas. Finally, there is also a strong tendency of "thickening" of residential space in the so-called "good suburbs" in the North and South of the urban agglomeration.

2.6. Occupational structure: Aggregate socio-occupational groups

It should be stressed at the outset that this section does not present a study of the changes in socio-spatial segregation, in the Attiki region. Such a task is beyond the scope of the paper. The identification and explanation of mechanisms and processes at work both in the case of the study region, and in other contemporary cities of the world is a subject of an ongoing dialogue among sociologists, economists, geographers and policy makers. The issues involved are both composite and complex. Moreover, I sympathize with the view expressed by Wong that "it is possible that spatial autocorrelation measures, such as Moran's I are not effective in capturing population

distribution with a local clustering pattern. It is because spatial autocorrelation measures, such as Moran's I, are global measures that summarize the overall magnitude of spatial autocorrelation within the study area. Local clustering, if not widespread cannot be revealed unless local measures are used. Nevertheless, it will be difficult to relate local clustering of population to the global measures of segregation" (Wong, 2004).

For all the above reasons in this section a small part of the investigation into socio-spatial distribution of different occupational groups in the Attiki region will be presented. The wider implications of using spatial autocorrelation investigating social and spatial segregation are part of an on going research, which is informed, among other things, by the results presented here.

In what follows the evolution of the spatial pattern of the location of residence of some major occupational groups is presented, recognizing the need for a more detailed classification.

The active population of the Attiki region was grouped into 7 discrete groups consisting of:

I: Professional, Technical and Related Workers and Administrative and Managerial Workers, who are employers, self-employed or salaried.

II: Clerical and Related Workers and Sales Workers who are either employers or self-employed.

III: Clerical and Related Workers, and Sales Workers who are in salaried employment, as well as Service Workers who are employers, self-employed or salaried.

IV: Agricultural, Animal Husbandry and Forestry Workers, Fishermen and Hunters, who are either employers or self-employed.

V: Production and Related Workers, Transport Equipment Operators and Labourers who are either employers or self-employed.

VI: Agricultural, Animal Husbandry and Forestry Workers, Fishermen and Hunters who are in salaried employment, and

VII: Production and Related Workers, Transport Equipment Operators and Labourers who are in salaried employment.

TABLE 6

*Proportion of occupational group in the total active population, Attiki region, 1981, 1991, 2001**

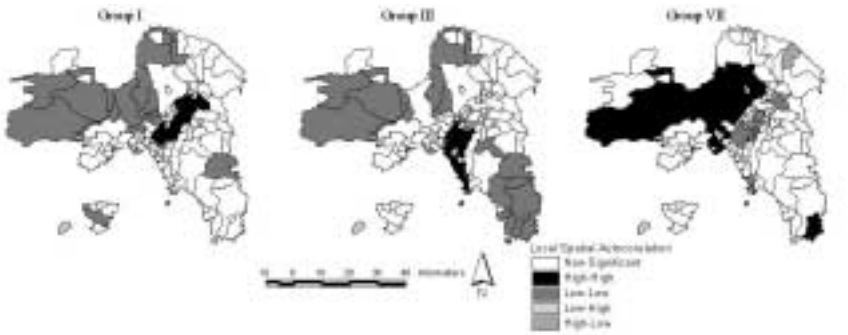
	Group I	Group II	Group III	Group IV	Group V	Group VI	Group VI
1981	17,0%	7,0%	29,2%	0,9%	9,6%	0,4%	29,1%
1991	19,6%	8,3%	31,3%	0,9%	8,2%	0,3%	21,8%
2001	24,6%	10,4%	27,0%	0,5%	5,2%	0,4%	29,6%

Source: NSSG, Population Census, 1981,1991, 2001, calculations by author.

** The shares do not sum to 100% because non-remunerated family members and persons who did not declare their profession or position in employment were not included in the occupational groups.*

FIGURE 16

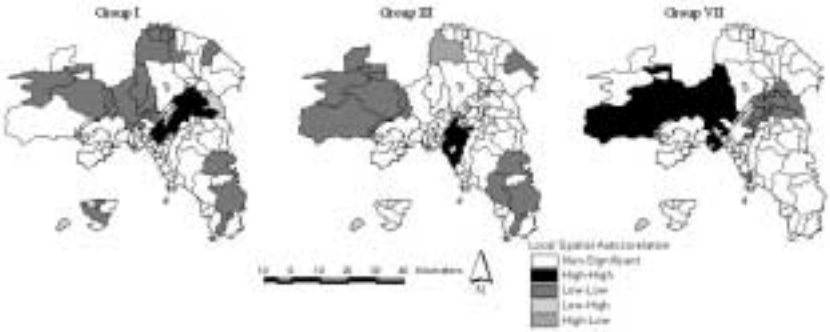
LISA, "Hot spots" and "outliers", Occupational groups I, III, VII, 1981, with Empirical Bayes standardization using as the base variable Total Active Population 1981



Some quite vivid "spatial polarisation" schemas can be observed in the LISA maps in figure 16. Namely, the West is "dominated" by salaried Production Workers, Transport Equipment Operators and Labourers (group VII), while Professional, Technical and Related Workers and Administrative and Managerial Workers (group I) are concentrated along a South-North axis passing through the centre. At the same time a heavy concentration of group III occupational group (Clerical and Related Workers, and Sales Workers who are in salaried employment, as well as Service Workers who are employers, self-employed or salaried) can be observed in the centre and its immediate neighbours as well as in southern "suburbs" of the conurbation, a result of heavy concentration of (retail) trade and services and [relatively] accessible housing stock there. These patterns conform, albeit in very aggregate terms, with spatial patterns described in studies of spatial segregation by Maloutas (1997, 2004).

FIGURE 17

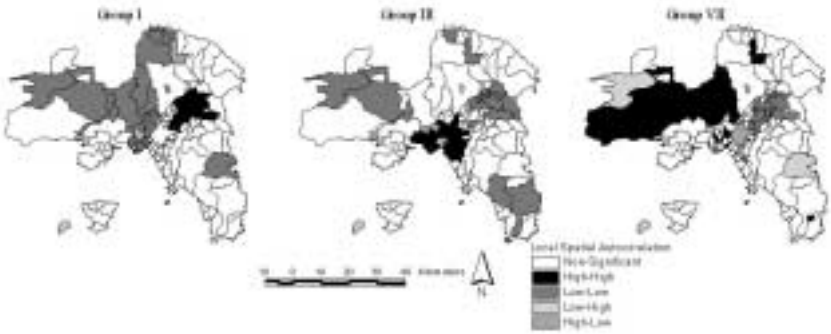
LISA, "Hot spots" and "outliers", Occupational groups I, III, VII, 1991, with Empirical Bayes standardization using as the base variable Total Active Population 1991



The spatial pattern of the residence of the occupational groups I, III and VII in 1991 is characterized by the persistence of the west/east divide of lower/higher strata. It should be noted however that the spatial "hot spots" for Group I (Professional, Technical and Related Workers and Administrative and Managerial Workers) is consolidated in the northern urban areas and appears to be spreading further to a Northeastern direction along the city edges. The concentration of group III (Clerical and Related Workers, and Sales Workers who are in salaried employment, as well as Service Workers who are employers, self-employed or salaried) is also "consolidated" in the central areas and its eastern and southern neighbours.

FIGURE 18

LISA, "Hot spots" and "outliers", Occupational groups I, III, VII, 2001, with Empirical Bayes standardization using as the base variable Total Active Population 2001



Spatial differentiation of residential location decisions of the three groups I, III and VII in 2001 is characterized by a) a further shift to the north-eastern edges of the conurbation by the higher social strata in group I, b) the continuation of the east/west divide with respect to groups I and VII, "higher" social strata, and "working class" salaried workers. c) a change in the status of the central municipality of Athens, from a "hot spot" of group I ('higher" social strata), to an "outlier" (increased presence) of wage-labourers (group VII). This "invasion" by the "working class" of central locations requires further detailed research in order to cater for classification changes as well as for the "migration" effects. This phenomenon cannot be explained at this level of analysis, both in terms of spatial scale and occupational classification. d) The persistence of the concentration of clerical workers in the central and southern areas coupled with a noteworthy spread to the West - in and around the Piraeus municipality.

To recapitulate then, the examination of the residential location of some major occupational groups in the Attiki region has shown a tendency for consolidation coupled with dispersal of the "higher" social strata in the northern-eastern part of the urban agglomeration and some coastal areas. Moreover, the pattern of "socio-spatial polarization" along an east/west divide was reaffirmed.

These trends can be investigated further by examining the dynamics of change in two time intervals 1981-1991 and 1991-2001. The change in the residence of the different occupational groups was standardized using an Empirical Bayes approach with the total active population of each spatial unit serving as the "base" variable.

FIGURE 19

LISA, "Hot spots" and "outliers", Change by Occupational group I, III, VII, 1981-1991, with Empirical Bayes standardization using as the base variable Total Active Population 1991

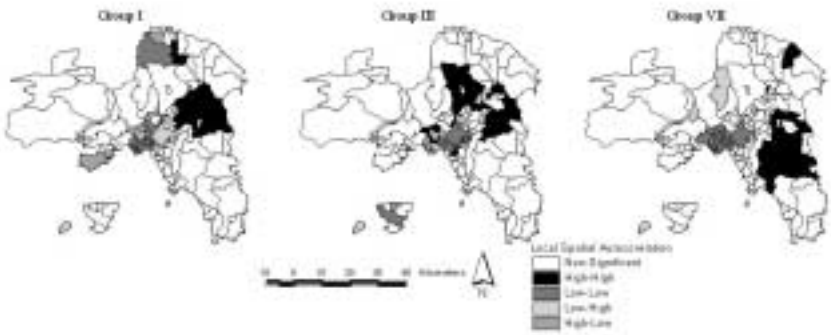
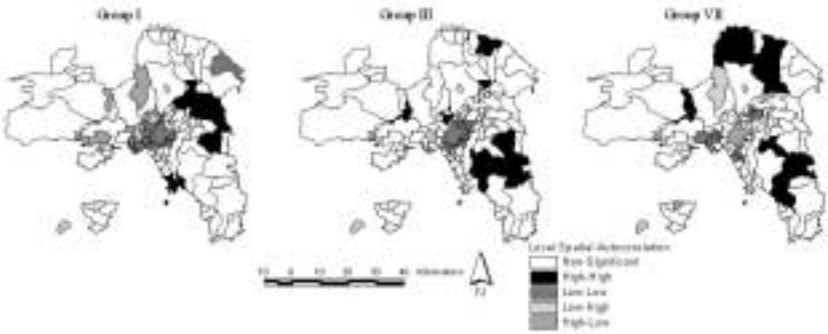


FIGURE 20

LISA, "Hot spots" and "outliers", Change by Occupational group I, III, VII, 1991-2001, with Empirical Bayes standardization using as the base variable Total Active Population 2001



By examining the LISA maps in Figures 19 and 20 showing the spatial assosiation (spatial clustering) of changes in the resident population classified by occupational group in the municipalities of the study region, it is evident that the "decentralisation" tendency of the "higher" social strata (group I) does indeed occur in the north-eastern edge of the urban area and the neighbouring coastal areas. In the second period, 1991-2001, a "hot spot" of high values for group I also appears in the southern coastal areas at the edge of the conurbation. A further very interesting process is presented by the "decentralisation" of group III. In the first period 1981-91 their movement is concentrated in north-eastern municipalities of the urban agglomeration and in municipalities at the north-eastern edge of the conurbation, where jobs in the trade and service sector were relocated (Sayas, 2003). However, some very interesting "hot spots" and "outliers" of high concentration of group III still appear in the immediate neighbours of the Athens and Piraeus municipalities. These two municipalities maybe loosing their attraction as places of residence for this particular group, but maintain a central role as centres of retail activity and services (FIRE) of the metropolis (Sayas, 2003). In the second period 1991-2001, the "hot-spots" of group III growth are concentrated more in the northern, southern and eastern periurban local authorities, indicating the aforementioned transformation of these areas into primary residence areas (see sections 2.4.4 and 2.5). Finally, a parallel movement of wage labourers, group VII –consisting mainly of external migrants– is also evident in those coastal areas, all through the 20 year period, most likely the result of increased construction activity there.

Thus, based on the above evidence, a more composite and complex urban social matrix seems to be emerging in the periurban zone as whole. An increased population shift of professionals and clerical and sales staff, is evident in these areas, coupled with a movement of some "working class strata" there.

3. SOME INITIAL CONCLUSIONS, AND THOUGHTS FOR FURTHER RESEARCH

The examination of the sociospatial structure of the Athens metropolitan region focusing on the evolution of spatial clustering for a number of thematic topics for the period 1981-2001 has identified several significant tendencies. The bulk of population and of the build up area is still concentrated in the central urban areas and their immediate neighbours; there are however strong indications of a "sprawling" process, filtered through a rapidly emerging and highly commodified private housing market. The latter affects mainly the Northeastern part of the urban edges and coastal areas and to a lesser degree the southern periurban areas. The coastal areas are being transformed from "vacation" areas, which were, by and large, the outcome of "spontaneous" housing provision mechanisms, to primary residential ones, usually the outcome of a highly standardized and commodified housing market. The observed population shift is stronger among "higher" social strata. The urban social matrix though does not become any simpler as a result. There are indications of a more composite urban social and spatial landscape. The scope of this paper though was not to examine social and spatial segregation per se, therefore these conclusions remain at a very aggregate level.

The spatial scale of analysis is also aggregate. The administrative boundaries of the local authorities in the region were used. A more disaggregated approach of spatial data is needed, in order to examine the possible effects of the modifiable areal unit problem (MAUP) and its implications for the study of urban socio-spatial structure using spatial econometrics methods.

The analysis of the urban sociospatial structure should also widen in scope in terms of the variables used. The location of jobs is one very crucial element for urban development as it affects many residential location decisions. Land and property values and their evolution are factors, which influence the supply side of the real estate market and should also be incorporated into the analysis.

Moreover, explicitly spatial measures of social segregation should be used and the findings compared to the spatial autocorrelation "hot spots", in order to assess the utility of spatial econometrics in this field of research.

Finally, empirical findings based on correlations should not be confused with the identification of "causal" mechanisms and structures (Sayer, 1984). Extensive research is an exploratory tool to be used to guide both abstract conceptualisation and intensive research. The findings presented here suggest that both are needed in order to compare and contrast the development of urban sprawl in the South to that of the industrialised North of Europe.

APPENDIX: FORMULAE FOR SPATIAL AUTOCORRELATION INDICES

Moran's I (Anselin, 1999)

$$I = \frac{n}{\sum_i^n \sum_j^n w_{ij}} \bullet \frac{\sum_i^n \sum_j^n w_{ij}(y_i - \bar{y})(y_j - \bar{y})}{\sum_i^n (y_i - \bar{y})^2}$$

Where, w_{ij} are the elements of the spatial weights matrix, y_i and $\bar{y}$ are the values of the variable in the ith location and the mean of the variable in the study region, respectively, while n is the total number of observations.

Generalised Local Moran (Anselin et al, 2002)

$$I_{kl}^d = z_k^d \sum_j w_{lj} z_l^j,$$

Where

$$z_k = [x_k - \overline{x_k}]/\sigma_k \text{ and } z_l = [x_l - \overline{x_l}]/\sigma_l$$

and w_{ij} are the elements of the spatial weights matrix.

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