Centre for Research on Settlements and Urbanism

Journal of Settlements and Spatial Planning

Journal homepage: http://jssp.reviste.ubbcluj.ro

Socioeconomic Segregation in Latin American Cities. A Geodemographic Application in Mexico City

Pablo MATEOS[1, 2], Adrián Guillermo AGUILAR[3]

[1] *University College London, Department of Geography, (UCL), London, UNITED KINGDOM*

[2] *CIESAS Research Centre, Guadalajara, MEXICO*

[3] *National Autonomous University of Mexico (UNAM), Institute of Geography, Mexico City, MEXICO*

E-mail: p.mateos@ucl.ac.uk, adrianguillermo1@gmail.com

Keywords: *socioeconomic segregation, urban inequalities, clustering, geodemographics, Latin America cities*

ABSTRACT

Latin American cities register high levels of residential segregation by socioeconomic group. A recent shift from polarized but compact cities to more dispersed and fragmented urban structures reflects a change in the geographic scale of segregation processes. This can be seen in new exclusionary urban forms at the neighbourhood level. Existing analyses of segregation fail to fully capture these new processes and to look beyond the simplistic affluent-poor duality to the complex multidimensional nature of socio-spatial differences. This paper attempts to bridge this gap by proposing a new methodology to classify very small neighbourhoods by multidimensional socioeconomic groups and thus measure their level of residential segregation. The methodology uses geodemographic classification methods to cluster highly disaggregated data at city block level upon which segregation indices are then calculated. The analysis of Mexico City's Metropolitan Area illustrates the validity of the approach and reveals new dispersed and fragmented patterns of segregation.

1. INTRODUCTION

Over the last three decades (1980-2010) Latin American cities have experienced rapid urban change that is closely related to processes of globalisation and the socio-spatial concentration of disadvantage [32]. Although urban segregation has a long history in Latin America, the characteristics of this period are diametrically opposed to those observed in previous decades of fast urbanisation (1950s-1970s). The breakpoint in urban trends in the Latin American city corresponded to a sharp shift in 'hegemonic models of development in the region, from import-substitution industrialisation to neoliberal "open markets" adjustment' [28, p. 42]. The most remarkable urban outcomes of this transformation is the shift from a relatively compact but socioeconomically polarized city, to a much more dispersed and fragmented pattern with an apparent decrease in polarisation [39], [20], [6], [38]. However, the apparent reduction in spatial segregation at a metropolitan or macro level is hiding local processes of separation at the micro level [20]. These processes are epitomised by new urban forms such as gated communities and gentrified neighbourhoods. New approaches to represent and measure socioeconomic groups and their degree of spatial separation in Latin American cities are required in order to unveil such micro-scale processes of socioeconomic segregation.

This paper presents a new methodology to analyse residential segregation by socioeconomic status (SES) using concepts that draw on the literature on geodemographics, statistical clustering, and urban segregation. This innovative combination is illustrated through the analysis of segregation in the Mexico City Metropolitan Area (MCMA) at very small area level (city block), using the 2000 Census dataset. This exploratory approach opens new avenues of research that permits new understandings of the nuanced processes of SES segregation in Latin American cities.

2. THEORY AND METHODOLOGY

2.1. Socioeconomic segregation in Latin American cities

Most Latin American cities have a similar urban structure that derives from their common colonial roots. The areas where political power and employment opportunities were traditionally concentrated were the city centre, and residential centrality was a symbol of social status. This broad pattern of segregation persisted over centuries, even after independence and industrialization in the 19th and 20th centuries [38]. The period from the 1950s to the 1970s was characterised by state-led economic planning throughout Latin America (populist policies, industrialization and import-substitution), along with a process of accelerated demographic transition [6]. The combined effect of both factors was massive rural-urban internal migration flows that led to rapid urbanization and the growth of informal settlements [28]. These processes created highly compact, but extremely socio-spatially polarized cities, following the 'traditional model' of residential segregation (RS) as represented by Griffin and Ford (1980) [38].

Competition for access to the city centre and the workplaces drove the processes of exclusion during these decades. These are characterized by the absence of co-location or geographic contact between affluent and poorer SES groups that tended to locate on the rapidly growing and marginalised city periphery with insufficient public service provision.

Towards the early 1980s a new economic model based on market freedom and orthodox neoliberalism was abruptly introduced throughout the region. It primarily involved extensive privatisation, market deregulation, and the drastic reduction of public expenditure and led to the rapid insertion of Latin American economies into world markets [31]. The demographic context of these economic changes was the deceleration of population growth, extremely high rates of urbanisation (79.6% in 2009 - UN Population Division, 2010), and increasing international emigration to North America and Europe. Today, after three decades of neoliberal policies and the influence of globalisation, Latin American countries have experienced an expansion of social inequalities [31], which is producing radical transformations in urban socio-spatial differentiation patterns [32], [38]. These transformations are characterised by a transition from a compact city with homogenous SES sectors - the traditional model of RS - to a much more dispersed pattern of segregation [20], [6], [38].

The changes have been brought about primarily by two processes. The first is related to new market forces arising from the deregulation of the economy and land markets. The second has been provoked by the dispersion of infrastructure and the separation of urban land uses across the urban space, which has been permitted and even promoted by local and national governments. Both processes were created by policies that indirectly gave private land owners and real estate developers a much more prominent role in structuring and managing urban space, promoting competition for scare space and the concentration of capital [11]. According to several authors (Sabatini, Cáceres and Cerda, 2001; Janoschka, 2002; Borsdorf, 2003; Sabatini, 2003; Sabatini and Cáceres, 2004), these two general and interrelated processes have produced two major outcomes that are consistent across the continent [6], [37], [20], [38], [36]. The first is a change in the scale of segregation, from the macro or city-wide scale, to the micro or block/street level, and which now characterises the aforementioned dispersed pattern of segregation. The second outcome is the rapid diffusion of new exclusionary urban forms, epitomized by the omnipresence of gated communities, luxury apartment buildings and gentrified neighbourhoods throughout the continent. As a result, the last three decades have seen intense intra-city movement of elite groups towards the wide periphery and into enclaves within deprived areas, including run-down areas of the city centre, the emergence of new suburban town centres, and the growth of poorer groups in informal settlements located on the remote periphery where they enter in conflict with rural uses and naturally protected areas [2].

This change in the scale of segregation has introduced a much more complex and subtle segregation pattern that takes places at the micro level. At first glance segregation indices have decreased at the macro level, but in reality the aforementioned processes have promoted the encapsulation and forting-up of the elites at the micro, street-level scale. In other words, one of the main consequences of the change in the scale in RS results from the insertion of new, highly homogeneous residential developments within more deprived areas, which has led to a reduction in the physical distance between socioeconomic groups, although not necessarily in social distance between them [36]. This change has been possible through the introduction of new urban forms that deter social interaction between neighbouring residents, favour privatised public space and the expulsion of established working class families through different forms of gentrification.

The new building forms that accompany the process involve higher population densities and their encapsulation into SES-homogeneous cells. This contrasts sharply with the low density and 'open city' model of urban settlement of previous decades [36]. Typical examples of these new forms in the residential space are gated communities, tall luxury residential towers, and gentrified inner city apartments. In terms of the location of work and entertainment the new forms are out-of-town corporate office complexes,

suburban shopping malls, and a variety of suburban leisure-education-business complexes, all of which have been termed new "*islands of modernity*" [20]. All these forms have increased the spatial division of urban functions for elite groups, separating the time-spaces of residential, consumption and production activities into distant places of residence, work and services. The result is the de-concentration and scattering of affluent groups and economic activity across the city, as well as the fragmentation and privatization of public space [43]. At the same time, the location of the of low-income population on the periphery of the urban area has continued, helped by central and local government measures that favour the construction of social housing in areas where land is cheap. This has reinforced the concentration of poverty and imposed extremely long commute-to-work journeys upon poorer groups on scarce public transport services. Sometimes such publicly subsidized housing developments for the working class resemble the gated communities type of urbanisation [15]. Although social groups can now find themselves geographically closer to one another, they are physically separated by walls, gates, barriers and security technologies. All of this is aimed at preventing pedestrian or vehicular circulation and personal interaction in common areas [9]. The fear of violence is one of the main justifications of these new urban forms of exclusion [10]. Another reason for their appeal is because they represent an affordable symbol of social status, in times of a deterioration of the 'value for money ratio' in contemporary Latin American land and housing markets [36]. The resulting pattern is a polycentric city structure where "islands of affluence and modernity" are found scattered everywhere but presenting very asymmetric access for different types of citizens. Through these new urban forms of isolation, the city now functions as an archipelago of islands of richness, production, and consumption in a heterogeneous sea of discontinuous and generally deprived urban space [35], [19].

These profound transformations have reinvigorated the debate on the model of urban segregation in Latin American cities. The traditional model of segregation has been challenged and alternative ones characterised by urban discontinuities and the atomization and scattering of functional urban units have been proposed [35], [19]. However, in this paper we argue that the new model of segregation partially overlaps with the traditional model of concentric zones and sectors, through parallel processes that operate at different scales.

2.2. Analysis of residential segregation. Approaches and methods

The literature on residential segregation has been traditionally preoccupied with determining the degree of spatial separation between racial or ethnic groups, mainly in developed countries, since these are the key destinations of international migration flows, and therefore conform the hosts of subsequent ethnic diversity. The main thrust of research on residential segregation is dominated by the preoccupation of finding ways to best capture the essence of the different dimensions of spatial integration between racial or ethnic groups [23]. However, most of these studies take the divisions between human groups for granted (race or ethnicity classifications) [24], and as a consequence, the methodologies they develop to measure residential segregation focus solely on improving existing segregation indices where the dependent variable (ethnicity or race) is more a less fixed. However, studies of socioeconomic segregation have the additional burden of having to create and defend a plausible division between human groups based upon commonly accepted socioeconomic indicators, and only then can they go about measuring their degree of spatial separation.

Most studies on SES segregation focus on one or a set of single socioeconomic dimensions, such as income, education, or occupation. They subdivide a population into distinct groups and then separately measure the level of segregation between the different groups in a city using traditional segregation indices (for a recent example in Mexico City see Villareal and Hamilton, 2009) [46]. A few studies go a step further and consider several socioeconomic dimensions at once by extracting a few manageable dimensions out of a wealth of socioeconomic variables (such as age structure, housing, employment type, etc) using a range of multivariate data reduction techniques such as factor analysis, principal component analysis (PCA) or multidimensional scaling (MDS). They then subdivide the population according to 'arbitrary' thresholds that are applied to the main dimensions or factors in order to calculate segregation indices for each separate factor or component. These are typically the first three components of a PCA, since together they usually explain a significant proportion of the variance between groups. Each of these factors tends to describe a dimension that reflects different gradations of socioeconomic status such as occupation, social class, qualifications, consumption, aging, marginality, etc. These factorial methodological approaches have been the most favoured method of analysing residential segregation research in Latin America over the last decades (for a recent example in Mexico City see Ariza and Solis, 2009) [4].

There are a series of problems with using the single SES variable approach or the factorial approaches in the measurement of segregation. Firstly, they treat each variable or factor independently of all the others. They measure segregation between population groups that are independently defined according to each socioeconomic axis. It is as if they were comparing different personal characteristics, but

not the individuals themselves. In doing so, they ignore the underlying actors that suffer the consequences, or benefit from segregation, that is, the people themselves. They also ignore the characteristics of the areas and neighbourhoods where the people live. Secondly, they do not account for the fact that the relationships between the factors or components in the factorial approach are intrinsically hierarchical. Since the discriminatory power of each factor or component diminishes from the first to the second and so forth, the importance of the weighting assigned to each of the dimensions in the resulting segregation patterns is not even, and therefore they are not directly comparable. Thirdly, factorial approaches overlook the strength of the links that might operate between all these factors at neighbourhood level, which together perhaps conspire to create the observed segregated patterns in cities.

As an alternative to the factorial or single variable tradition, this paper argues for a classification of populations according to socioeconomic status (SES). This approach inherits the advantages of the racial and ethnicity classifications, that is, that populations are subdivided into homogeneous groups according to a single criterion, what enables segregation patterns to be measured in an integrated way. This paper argues for a single classification of populations that encompasses all available SES measures, with the purpose of measuring residential segregation. We do so through the use of geodemographic classifications of very small areas in order to measure their degree of residential segregation.

2.3. Geodemographics and lifestyle analysis in the study of segregation

Social Area Analysis [41] used to be a deductive methodology for classifying areas in a city based on theories of socio-spatial differentiation developed by the Chicago School of urban ecology [26]. In the 1950s and 60s, the Chicago School's original ideas blossomed on the basis of the application of factorial analysis and data reduction techniques to the analysis of urban socioeconomic patterns, constituting the field of factorial urban ecology. Today, factor analysis is still considered to be the most widely used method to study urban socio-spatial differentiation [21]. The literature mentioned above has followed this factorial tradition in its approach to the measurement of SES segregation in Latin America.

Geodemographics has been defined as 'the study of population types and their dynamics as they vary by geographical area' [5, p. 88]. As a methodology to classify populations geodemographics has been around since the early 1980s in the Anglo-Saxon world, primarily in the private sector. It has only recently received increasing attention in the public sector as well as in academic circles [22]. The roots of geodemographics can be also traced back to the Chicago School and Social Area Analysis tradition in urban geography [17]. However, the area classification techniques used in geodemographics differ substantially from the aforementioned factorial tradition, and belong to a family of classification techniques know as cluster analysis [13].

Clustering is a method of classification "for unsupervised pattern recognition" [14, p. 169] whose objective is to automatically sort objects into classes so that similar objects end up assigned to the same class. In geodemographics, the objects to be classified are neighbourhoods or small areas (for example a postcode, a census tract or a street segment). These areas are then clustered according to their similar socioeconomic, demographic or lifestyle characteristics. The resulting classes or clusters are termed geodemographic types or groups [17].

The final result is a classification of neighbourhoods into clusters with homogeneous 'lifestyles', implying not only the traditional socio-economic indicators (income, occupation, education, and housing tenure) but also demographic structure and life stage of the neighbourhood, consumption patterns, job market participation, household composition, housing morphology and age, centrality, leisure time activities, and so on, all comprising distinct 'lifestyles' that tend to be very contrasted at small area level. In this paper the authors consider that residential preferences in Latin America are clearly marked by a series of decisions or constraints related to the types of population characteristics or 'lifestyles' that are studied in geodemographics.

Therefore, the methods developed in geodemographics are appropriate for the study of SES segregation at the neighbourhood level. After an exhaustive revision of the literature, the authors found no other study that combines these two methods of urban analysis – geodemographics and residential segregation. Our findings are encouraging and lead us to propose it as a useful technique to understand the fragmented urban patterns in cities. The results for one Latin American city are presented here, but the method can clearly be applied to other world regions.

2.4. Methodology

The proposed methodology has been applied to a case study of the Mexico City Metropolitan Area (MCMA), using special access datasets from the 2000 Census (with a total population of 17.9 million at that Census year). Our innovative proposal consists of creating a geodemographic classification of very small areas in the MCMA at the city block level (called 'manzana' in Mexico), of which 142,291 units were registered in the 2000 Census. These have an average population of 126.1 residents, and hence are likely to be more socioeconomically homogenous than the Census districts, with an average of 3599 residents.

The blocks were classified into six clusters of similar geo-demographic characteristics, and a range of segregation indices was calculated to measure the degree of spatial separation between these geodemographic clusters according to each of the five dimensions of residential segregation [23]. Although our initial intention was to compare trends over time using census results from earlier periods, our attempts did not bear fruit. The results of the 1990 Census are not available at the city-block level. Although we had access to this level for the mid-decade 2005 population enumeration (Conteo de Poblacion), it only included a very limited set of SES variables. These proved of little use in terms of their discriminatory power, failing to produce clearly distinctive clusters. For these reasons the present analysis is circumscribed to data from the 2000 Census.

Geodemographic clustering. In order to create a geodemographic classification of our study area we followed Vickers and Rees (2007) clustering approach with slight variations that are specified below. The raw data consisted in population counts at block level for a total of 170 Census variables.

Firstly, the raw counts were converted to percentages and these were transformed and standardised so that the frequency distributions of the variables were comparable. This was achieved through z-score transformation and resulted in variables with a mean value of zero and a standard deviation of 1 [33].

Secondly, the most appropriate Census variables were selected for further analysis. In clustering techniques it is preferable to work with a small number of indicative variables, each of which introduces enough discriminatory power between areas, rather than with a large number of variables that are strongly auto-correlated, which could bias the resulting classification. A correlation matrix between the 170 variables was produced to inform this process. On the one hand, this matrix was fed into a principal component analysis (PCA) that suggested three predominant dimensions explaining 84.5% of the variance, in addition to six other dimensions that together explained most of the variance.

At the same time, a minimum spanning tree (MST) was created from the correlation matrix, visually depicting the closest relationships between variables, following the technique proposed by Harris, R. et al. [17, p. 155]. Interestingly, the variable that is most closely related with all others and hence appears at the centre of the MST is the "number of persons per room, an indicator of overcrowding. From this variable eight main branches stemmed out constituting groups of variables that point to different directions in the socioeconomic spectrum.

Thirdly, using this visual aid and the distance of each variable from the three first components in the PCA analysis, a total of 35 variables were selected where those that presented less correlation with all others were favoured, and were situated in different parts of the MST (table 1).

Although we considered reducing the number of variables further, we decided to keep all 35 as the key input for the clustering technique. Taken together, they pick up much subtler differences between city blocks than by just using the core PCA or MST dimensions. They also provide a much richer backdrop for interpreting the resulting clusters.

Fourthly, the classification of city blocks (manzanas) was carried out using a clustering technique known as *k-means* [13]. This is an inductive classification technique that is most frequently used in geodemographic analysis [17], [45]. It starts with an imperfect division of the units to be classified (in this case city blocks) into a pre-specified number of clusters. Progressing through multiple iterations, movements between clusters are proposed until an optimum solution is reached that minimises the internal distances within a cluster (in terms of the k-dimensional space of variables) and maximises those between clusters. In this study we specified a number of six clusters to classify the 142,291 city blocks. Although this is a small number of SES clusters, compared to traditional geodemographic classifications, it is in line with similar subdivisions of SES groups used in the Latin American segregation literature (e.g. Rubalcava and Schteinghart, 2000), and hence can be easily understood and interpreted as well as compared with previous studies. The k-means clustering was applied using 100 iterations in order to achieve the optimum solution within a single run of the algorithm. Furthermore, in order to avoid cases where a local minimum solution is reached, the clustering technique was repeated 1000 times.

Finally, the best solution out of these 1000 runs was selected, and defined as the one with the lowest sum of squares of differences within the clusters. It is worth noting that during the clustering process each variable was weighted by the population size of each city block, in order to avoid any effects in the clustering derived from blocks with contrasting population sizes.

3. RESULTS AND DISCUSSION

The final result of the methodology developed for this study was the classification of the 142,291 city blocks into six clusters. Each cluster has more than 1 million people and with comparable sizes in terms of total population and number of blocks, except for cluster 5 that presents a small number of densely populated blocks. The results are presented in a series of tables and figures.

Table 2 lists the main descriptive statistics for the six clusters.

From these tables and figures eight predominant features or dimensions clearly emerge as

the key organising axes that articulate socio-spatial divisions in MCMA. These could be summarised as: 1) education; 2) occupation; 3) income; 4) age and household composition; 5) internal migration; 6) access to health insurance / formal employment; 7) quality of housing and urbanisation / overcrowding; and 8) geographical distribution (peripheral vs. central and south-eastern vs. northern and western locations). Traditional SES studies in Latin America and in Mexico in particular, are typically only concerned with the first three of these dimensions - especially just income- generally ignoring the other five. A rare exception in Mexico is Ariza and Solis (2009) which apart from the aforementioned dimensions 1, 2 and 3, also include 5) "internal migration" [4].

However, this and the majority of studies examine urban segregation separately along each one of these dimensions, and, more worryingly, organised in a hierarchical way, since they predominantly rely upon factorial analysis techniques.

Table 1. List of Census variables selected for clustering analysis.

Short name	Description
Density	Population density
Pop 0 14	Population aged 0-14
Pop_>=60	Population aged 60 or over
Depend ratio	Dependency ratio
Child p woman	Children per woman
Pop_w/o_healt_ins	Population without health insurance
Pop with IMMS	Population entitled to public health insurance (IMSS)
Pop_born_outside	Population born outside Mexico City Metropolitan Area
Pop_mid&high_educ	Population aged 15 and above with medium or higher education
Pop high educ	Population aged 18 and above with higher education
Years in educ	Number of years in education
Ec_inactive	Economically inactive population
Occup second	Population occupied in the secondary sector
Occup_terciary	Population occupied in the tertiary sector
Occup day labour	Population occupied as day labourers
Self employed	Self-employed population
Occup w/o income	Occupied population without a work-related income
Occup_<1_salary	Occupied population with a work-related income below one minimum salary
Occup_>5_salaries	Occupied population with a work-related income above five minimum salaries
Dwell poor roof	Dwellings with precarious roof materials
Dwell 1 room	Dwellings with a single room (one living space)
Dwell_2_5_rooms	Dwellings with 2 to 5 rooms (including kitchen)
Dwell 1 bedroom	Dwellings with a single bedroom
Dwell n excl kitchen	Dwellings with non-exclusive kitchen (in a bedroom or shared room)
Dwell_drain_not_network	Dwellings with drainage connected to septic tank, creek, crack, river, lake or sea
Dwell no drain	Dwellings without drainage
Dwell_ownen	Owner-occupied dwellings
Dwell ownen paid	Owner-occupied dwellings fully paid
Dwell_w_heater	Dwellings with a hot water heater
Dwell w comput	Dwellings with computer
Dwell all goods	Dwellings with all goods (radio, TV, video, food mixer, refrigerator, washing machine, telephone, water heater, car and computer)
Peop_p_dwell	People per dwelling ratio
Peop p room	People per room ratio
Fem_head_hsld	Female headed households
Pop fem head hsld	Population in female headed households

Table 2. Sizes of the six clusters (population size and number of blocks).

Cluster	Nr. blocks	Total population	Avg block population
1. Marginal rural periphery	17,952	2,055,797	114.5
2. Office workers in tower blocks	19,743	1,587,619	80.4
3. Peripherial proletariat	49,504	6,816,571	137.7
4. Urban elites	18,618	2,234,257	120
5. Mixed areas	993	1,067,682	1,075.2
6. Educated middle class	34,927	4,152,252	118.9
Total	141,737	17,914,178	126.4

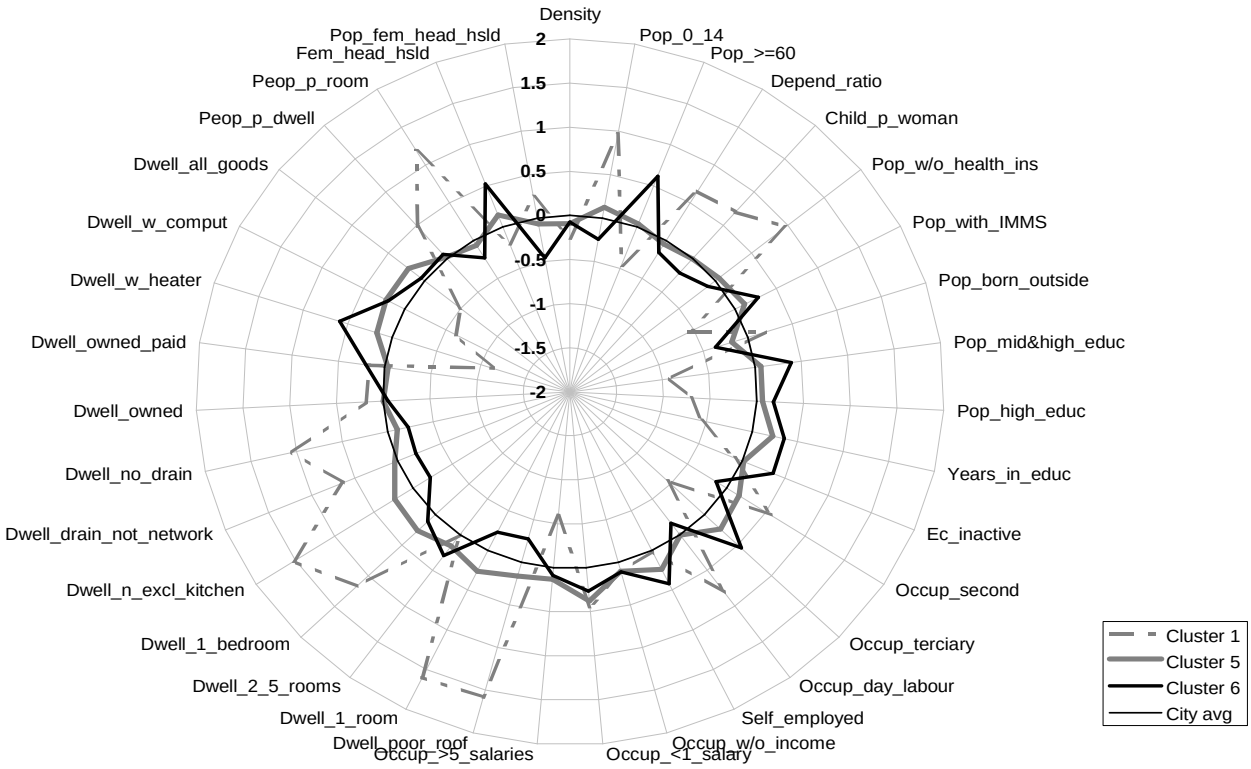

Fig. 1. Distribution of Census variables. Clusters 1, 5 and 6. *See Table 1 for a long description of each variable* [1].

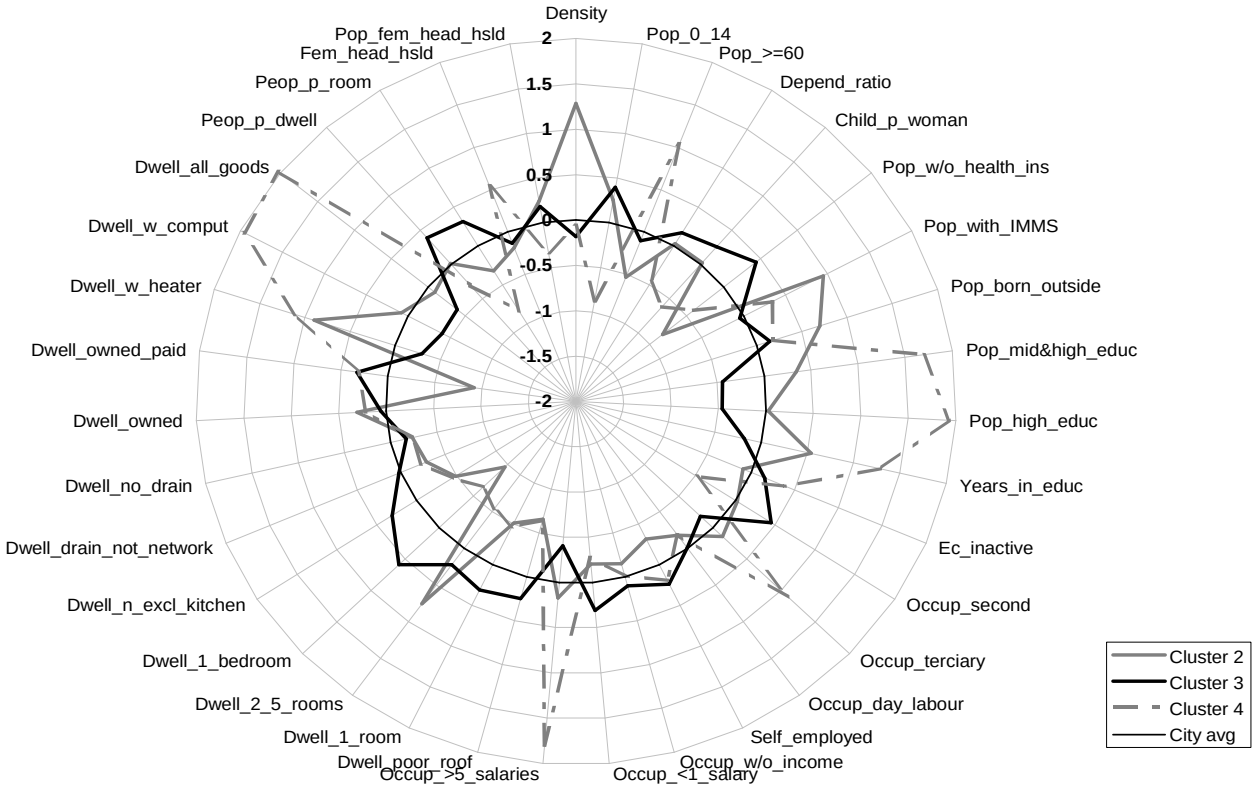

Fig. 2. Distribution of Census variables. Clusters 2, 3 and 4. *See Table 1 for a long description of each variable* [1].

These six clusters and their geographical distribution are shown in Figure 3. They are consistent with the previous literature on socioeconomic classifications of Mexico City. For example, there are important analogies between the SES spatial patterns found in this paper and those published by Peter Ward in his diagram of "ecological zones" of Mexico City [48, p. 147].

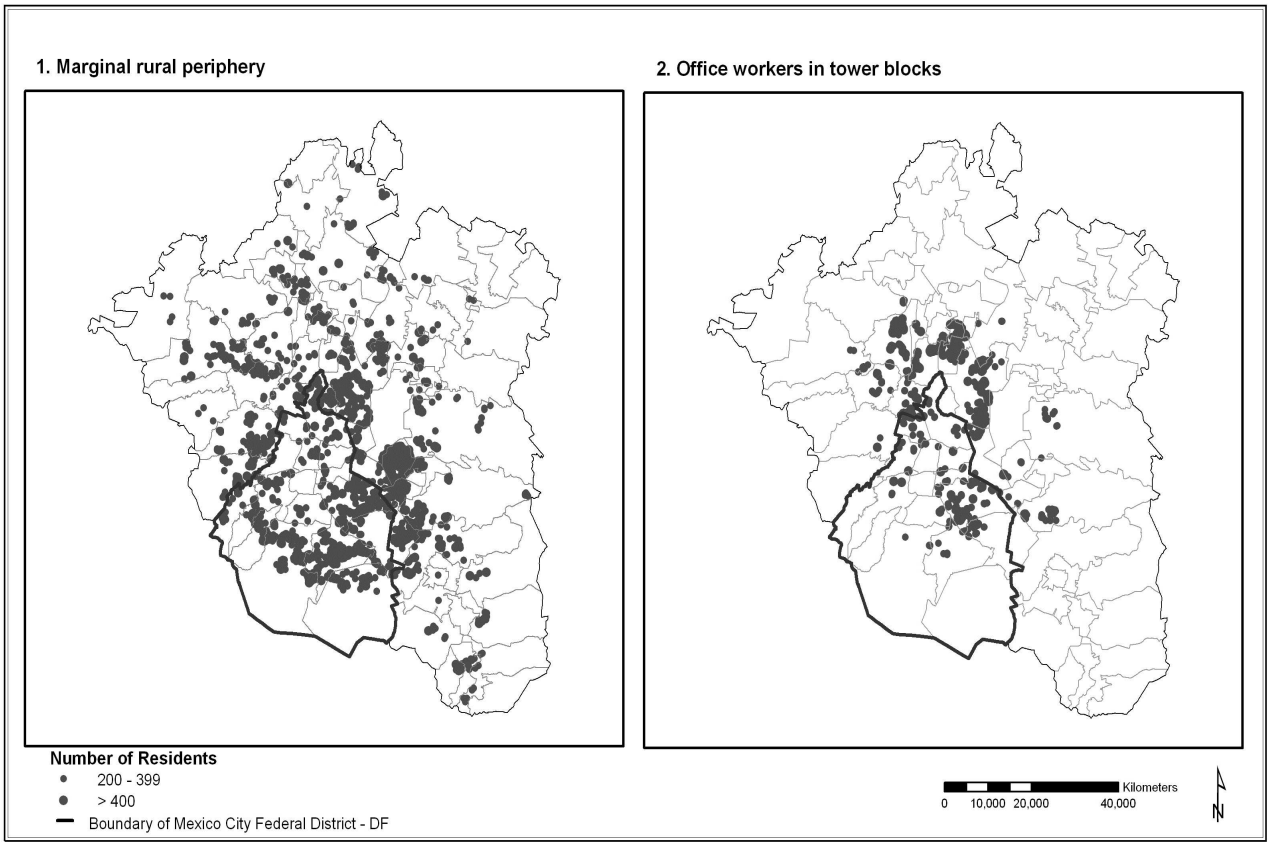

Fig. 3 (a). Maps of the geographical distribution of the clusters in Mexico City (clusters 1-2).

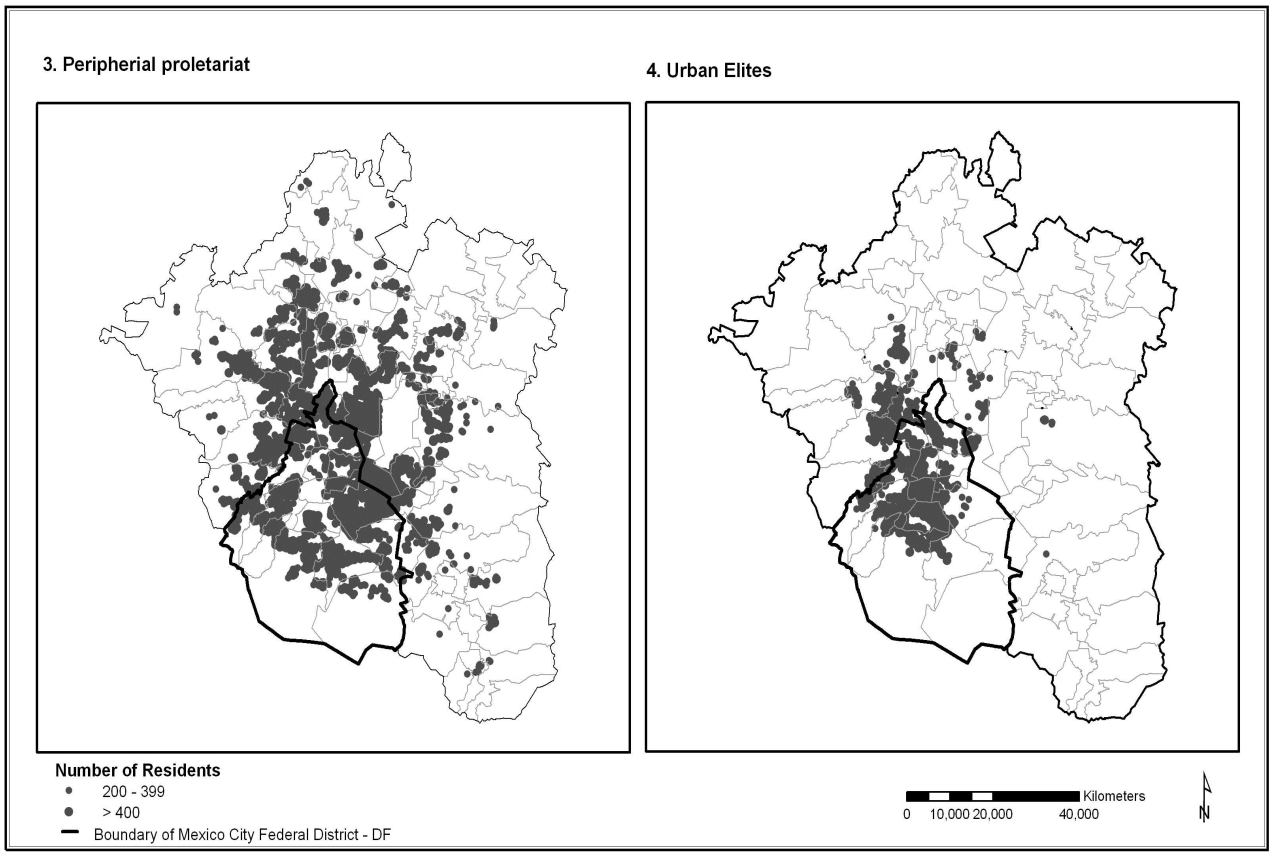

Fig. 3. (b). Maps of the geographical distribution of the clusters in Mexico City (clusters 3-4).

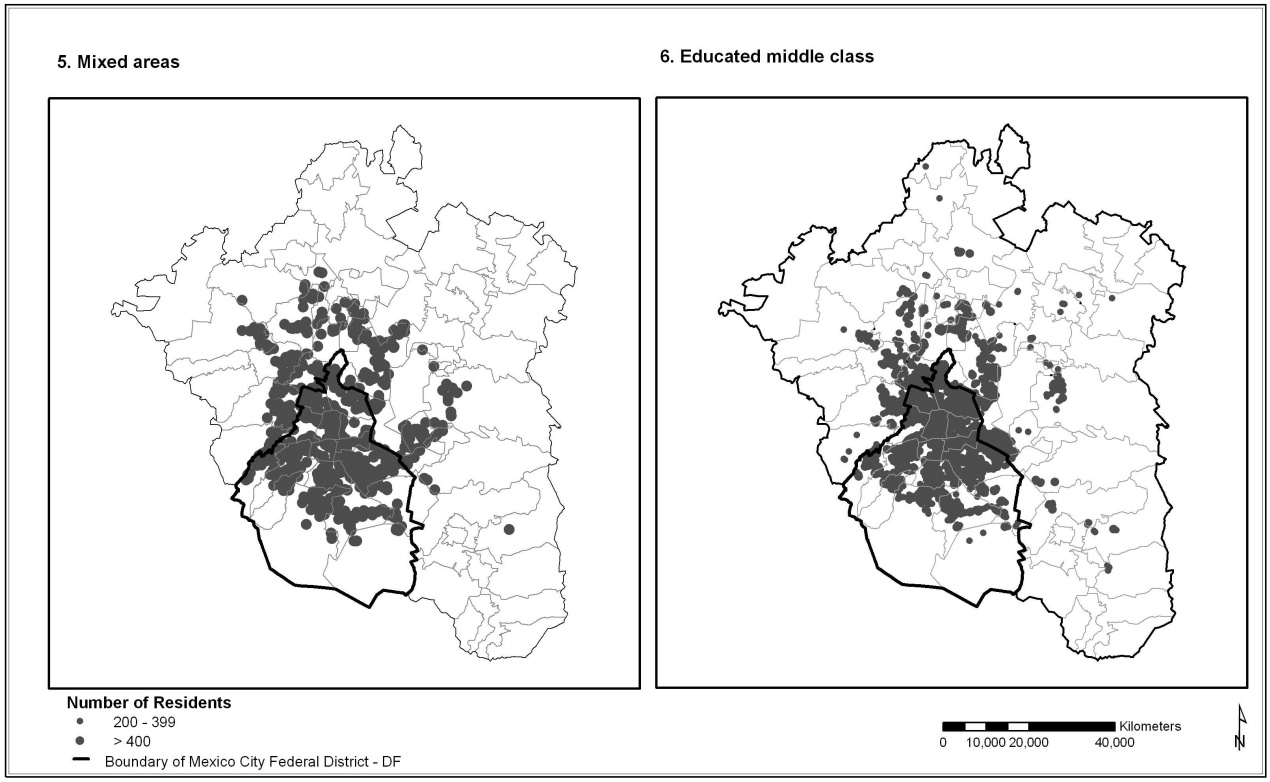

Fig. 3. (c). Maps of the geographical distribution of the clusters in Mexico City (clusters 5-6). *Each map depicts the geographic distribution of the blocks classified under each cluster (1-Marginal rural periphery; 2-Office workers in tower blocks; 3-Peripherial proletariat; 4-Urban elites; 5-Mixed areas; 6-Educated middle class). Each city block is represented by a circle proportional to its population size. Only blocks with 200 people or more are shown in order to improve clarity.*

3.1. Segregation indices

Once the city's 142,291 blocks had been classified into a geodemographic classification of six clusters, the final stage of the methodology was to calculate segregation indices between these 6 clusters in order to measure their degree of spatial integration in the city. Therefore, the basic unit of analysis in this study is the city block (as opposed to individuals or households).

The authors assume that the geodemographic typology assigned to each block is representative of the characteristics of all of its residents, although we are aware of the effects of the ecological fallacy that this approach might entail. However, Mexico City blocks present a small population (126.1 residents on average), and are compact both in terms of their physical extension and density. In addition, each block was typically developed during the same period, and hence generally contains similar types of housing. All of these factors support our assumption of internal SES homogeneity. Further analysis using individual level data within blocks should be performed to measure the degree of internal demographic and SES homogeneity.

In order to measure the degree of integration or separation between each city block and its neighbouring blocks, there is a need to specify a neighbourhood or local area within which integration or segregation is to be measured. We initially explored the use of "*colonias*", a geographical area encompassing the original extent of development when the area was first urbanised. *Colonias* are still highly significant socio-spatial reference points in Mexican cities, for example in determining residential preferences, house prices or the level of urban services and amenities. In many areas, the *colonias* are underpinned by a legally constituted residents associations. However, the exact boundaries of the *colonias* are difficult to delineate outside the Federal District of Mexico City (D.F.), and more worryingly, they vary enormously in population size and areal extent. Therefore it was decided to use the Census statistical small areas termed AGEB [18], of which there are 4,974 in the MCMA, each with an average of 28.6 city blocks and 3,601 residents. AGEB areas are homogenous in terms of population size and they are widely accepted as a valid representation of local neighbourhoods [12].

Within each AGEB we calculated the number of people assigned to each geodemographic cluster (i.e. the total population of the blocks within the AGEB assigned to the same geodemographic cluster). If the geographic distribution of the geodemographic clusters across the city and within AGEBs was random, there would be no segregation, and if it was not, some degree of spatial separation according to SES could be expected.

A total of five different segregation indices were calculated, capturing four out of the five dimensions of residential segregation; evenness (D), exposure (Px), concentration (ACO) and clustering (ACL) [23], as well as a measure of entropy or diversity (the Information Theory Index or Theil's H) [30]. These first four indices were calculated as two-group indices, in which each geodemographic cluster was compared to the rest of the population, while the diversity index (H) takes all six clusters together to measure diversity. The resulting values for these five indices are shown in Table 2. Finally, the Dissimilarity index (D) was also computed between all combinations of pairs of clusters and results shown in Table 3. We acknowledge the problems associated with using a single index in this pair-wise comparison. Therefore, the multi-group comparison shown in Table 4 should form the basis for a discussion about the results. For details about the equations and implementation of these indices into algorithms please refer to Apparicio, P. et al. [3].

Table 3. Segregation indices for each geodemographic cluster [1].

Cluster	D Dissimilarity	Px Isolation	ACO Absolute Concentration	ACL clustering	H Entropy
1. Marginal rural periphery	0.75	0.54	0.6	0.34	0.51
2. Office workers in tower blocks	0.82	0.63	**0.85**	0.34	0.63
3. Peripherial proletariat	0.65	0.69	0.52	**0.52**	0.41
4. Urban elites	**0.86**	**0.71**	0.77	0.46	**0.68**
5. Mixed areas	0.83	0.38	0.71	0.17	0.52
6. Educated middle class	0.66	0.59	0.8	0.4	0.42

Table 4. Matrix of dissimilarity indices between all pairs of clusters [1].

Cluster	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
1. Marginal rural periphery	-	-	-	-	-	-
2. Office workers in tower blocks	**0.93**	-	-	-	-	-
3. Peripherial proletariat	*0.65*	0.87	-	-	-	-
4. Urban elites	**0.98**	0.88	**0.95**	-	-	-
5. Mixed areas	**0.9**	0.89	0.84	0.87	-	-
6. Educated middle class	**0.91**	0.82	*0.72*	*0.79*	0.81	-

The highest values (>=0.90) are highlighted in **bold** and the lowest (<=0.80) in *italics*.

3.2. Discussion

The methodology presented in this paper is comprised of two separate analyses; i) a geodemographic classification of city blocks into SES clusters, and ii) residential segregation analysis of the SES clusters. The key results and implications will be discussed here combining the relevant results from each of these two steps in the analysis.

The distribution of the 35 Census variables for each of the six clusters is represented in the radar graphs shown in Figure 1 and Figure 2. In these graphs, each variable's mean value across all blocks in the city is zero (central circle) while the positive and negative values indicate the number of standard deviations (s.d.) from the mean (ranging between -2 to +2 s.d.). These radar graphs depict very well the disparities between SES groups in MCMA. For instance, in fig. 2, the variable "population with medium and higher education" shows values of 1.93 and -0.67 s.d. for Cluster 4 and Cluster 1 respectively, indicating a wide difference between these two clusters. Moreover, interesting linkages can be established between the different demographic, occupational, economic, educational, housing or geographical indicators used in this analysis. These combinations are much more rich and complex than the common representations of SES that dominate in the segregation literature, which are typically comprised of a simple classification along a unidimensional affluence or social class scale, as represented by each single factor or component in the factorial approach. Such a rich combination of salient characteristics is fully described in Table 5 for each of the six clusters, as indicated by the most salient patterns in the radar graphs and the maps in Figure 3.

From these tables and figures eight predominant features or dimensions clearly emerge as the key organising axes that articulate socio-spatial divisions in MCMA. These could be summarised as: 1) education; 2) occupation; 3) income; 4) age and household composition; 5) internal migration; 6) access to health insurance / formal employment; 7) quality of housing and urbanisation / overcrowding; and 8) geographical distribution (peripheral vs. central and south-eastern vs. northern and western locations). Traditional SES studies in Latin America and in Mexico in particular, are typically only concerned with the first three of these dimensions - especially just income-

generally ignoring the other five. A rare exception in Mexico is Ariza and Solis (2009) which apart from the aforementioned dimensions 1, 2 and 3, also include 5) "internal migration" [4]. However, this and the majority of studies examine urban segregation separately along each one of these dimensions, and, more worryingly, organised in a hierarchical way, since they predominantly rely upon factorial analysis techniques.

Table 5. Description of key geodemographic and SES characteristics per cluster.

Cluster	D Dissimilarity	Px Isolation	ACO Absolute Concentration	ACL clustering	H Entropy
1. Marginal rural periphery	0.75	0.54	0.6	0.34	0.51
2. Office workers in tower blocks	0.82	0.63	0.85	0.34	0.63
3. Peripherial proletariat	0.65	0.69	0.52	0.52	0.41
4. Urban elites	0.86	0.71	0.77	0.46	0.68
5. Mixed areas	0.83	0.38	0.71	0.17	0.52
6. Educated middle class	0.66	0.59	0.8	0.4	0.42

In this paper the selected 35 Census variables depict in detail these eight dimensions. Through the geodemographic clustering of city blocks along these 35 variables, we intend to identify new types of SES socio-spatial divisions in MCMA. The result is a simple classification of city blocks into 6 SES clusters that clearly synthesise at once the predominant combinations of these variables at such fine geographical scale across the city, and that are much more complex and subtle than just income, education or occupational stratification. For example, the two lower SES groups, represented by clusters 1 and 3, although both with low income and education levels, they actually register significant differences with respect to other of the aforementioned eight dimensions. These differences include age and household composition, access to health insurance, proportion of internal migrants to MCMA, economic sectors of occupation, peripheral location, and the quality of urbanisation. Furthermore, the middle classes, represented by clusters 2 and 6, despite presenting similar mid-range income and education levels, also differ substantially between them with respect to their level of domestic migration, housing tenure, occupation and centrality, alongside some of the other key variables.

All of these differences, outside the traditional income-education-occupation triad, reflect important disparities in the demographic composition of the households and neighbourhoods, the timing of urbanisation and arrival of internal migrants, access to formal economic sector and welfare services (primarily health insurance and public housing), type of housing and tenure, and quality of infrastructure and its location with respect to public transport networks and job centres. In Latin American countries where income and education inequalities are so stark and socioeconomic polarisation has increased over the last three decades [28], these differences relate to the key factors behind structural and internal constraints affecting the residential location decisions of urban SES groups. For example, housing in Mexico City prior to the 1990s was heavily subsidised for military families, civil servants and members of some powerful unions [27], privileges in residential location that persist today and cannot be captured by the aforementioned income-occupation-education triad. Therefore, the multidimensional nature of SES groups cannot be fully represented using the simplistic rich-poor duality with which segregation in Latin American cities have been traditionally analysed. Moreover, beyond the direct effects of residential segregation, such SES factors in turn also place important constraints on the social mobility opportunities and life chances that different population groups experience across the city.

Moreover, besides the multidimensionality of the classification, the other prominent contribution of this study is in relation to the analysis of SES segregation at city block level, instead of the usual Census geo-statistical area (AGEB). Figure 4 shows a detailed map of the cluster classification for an area in Western Mexico City, known as "Santa Fe". As it can be clearly seen, the cluster classification at block level has captured the complexity of new forms of segregation at the micro scale and within the AGEB boundaries. The area of Santa Fe is well known for its stark socio-economic contrasts where the aforementioned "islands of modernity" have been built in a traditionally poor and marginal area.

Having justified the division of the MCMA urban space into six geodemographic clusters, it remains to reflect on the results of the segregation analysis. As indicated above, segregation indices were calculated between these six SES clusters of city-blocks at the neighbourhood level as represented by the (larger) AGEB units.

The values of the different segregation indices are summarised in Table 4 and Table 5. The most segregated group is undoubtedly cluster 4, termed "*Urban Elites*", which presents very high values of dissimilarity and isolation indices (respectively D=0.86, Px=0.71) from the rest of the population, as well as from each of the other individual clusters (see table 5). This is the cluster with the highest level of income, education, and general quality of life, and according to the urban literature hence the group with the greatest power and flexibility to decide where to locate in the city. The geographical distribution of Cluster 4 in the Mexico City Metropolitan Area clearly supports the argument that access to greater choice is translated in a stark physical separation from the other five clusters, at least in residential terms.

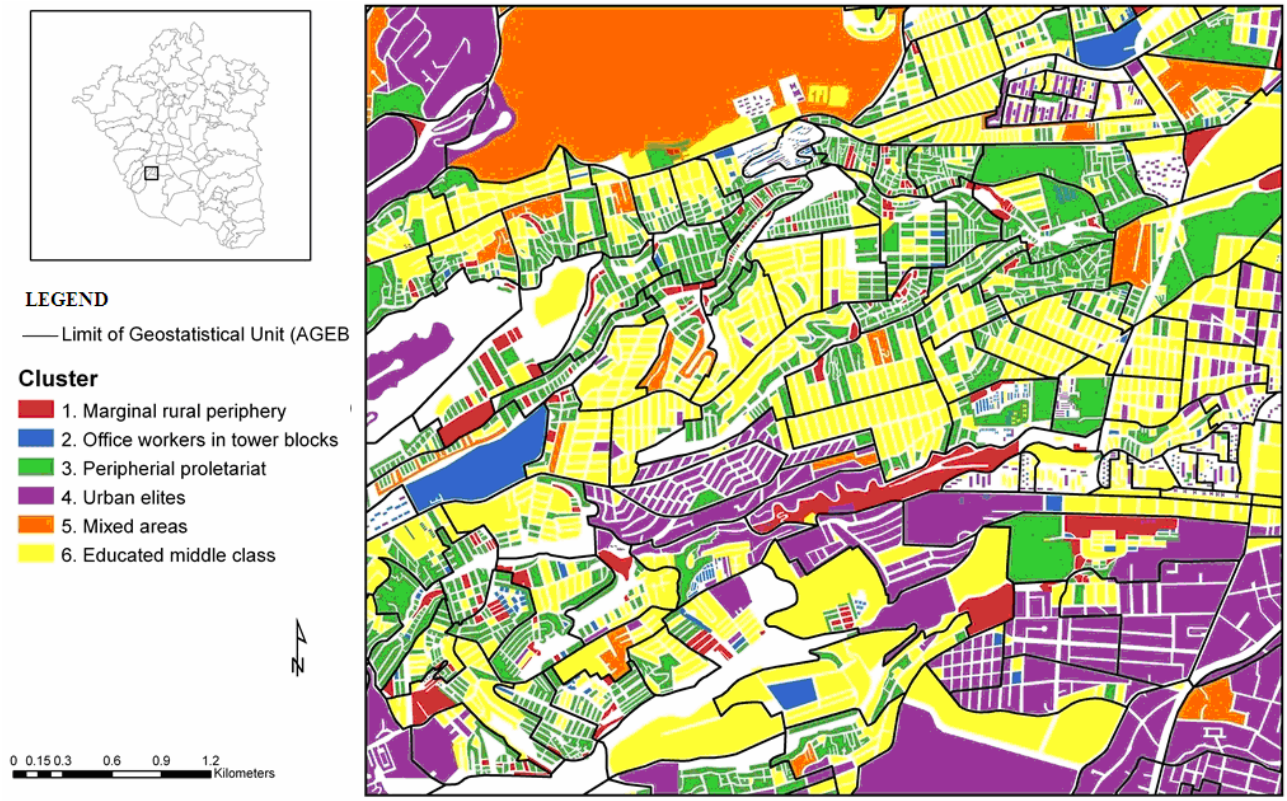

Fig. 4. Map of the cluster classification by city block showing an area with a complex socioeconomic mix at block level. *The map depicts an area called "Colonia Santa Fe" in Western Mexico City (Districts of Cuajimalpa and Alvaro Obregón).*

Cluster 2, termed "*Office workers in tower blocks*", presents much higher population densities at the city block level since most of them live in flats (hence the group's label). Therefore, they register a high level of concentration (ACO = 0.85) as well as dissimilarity (0.82), since several tower blocks tend to be clustered in the same AGEBs. Cluster 5, termed "*Mixed areas*", shows high values of dissimilarity and clustering, although low levels of isolation. However, as previously mentioned this cluster is very heterogeneous and encompasses very large AGEBs that are hiding the internal variations of its constituent populations. The clusters with the lowest levels of segregation in terms of dissimilarity and isolation are Cluster 6 ("*Educated middle class*") and Cluster 3 ("*Peripherial proletariat*"), which are the two "middle-income" groups. However, the latter shows the highest level in the clustering dimension (ACL=0.52) since it is geographically located on the periphery and tends to be surrounded by AGEBs were the same cluster predominates, while the rest of the clusters show low levels of spatial clustering. This finding shows one of the advantages of this analytical method in detecting the processes of fragmentation of urban space mentioned in the literature, initially validating the presence in Mexico City of the new model of residential segregation in Latin American cities [20].

With respect to the measure of entropy (H), all six clusters show medium to high levels of segregation (0.41- 0.68), indicating differing degrees of mixing between SES groups across neighbourhoods. Cluster 4 *Urban Elites* again shows the highest levels of entropy and clusters 3 and 6 the lowest. Once again, this supports the contention that the elite neighbourhoods (Cluster 4) are the most segregated group. In spite of their more central location within the metropolitan area, and because of the aforementioned processes of urban encapsulation and fragmentation -through gentrification and gated communities- they remain physically distant from other SES groups.

Finally, a different reading of segregation is presented in table 5 where the dissimilarity index (D) has been calculated between pairs of clusters (as opposed between one cluster and the rest of the population). The pairs that appear most segregated

between themselves are clusters 4 and 1, followed by 4-3, 1-2, and 1-6. Therefore, Cluster 1 ("*Marginal rural periphery*") and Cluster 4 ("*Urban Elites*") are the most segregated with each of the other clusters along this index. However, whereas Cluster 1 is expected to be most segregated from all others, because of its remote location in the outer periphery and hence its physical distance from all others, it is surprising to find high levels of dissimilarity between Cluster 4 ("*Urban Elites*") and all the other clusters. Once again this proves the high degree of socio-spatial separation of the elite groups, a fact that although identified by the SES segregation literature, has not been given sufficient prominence, since analyses tend to concentrate on the segregation of poor and marginal groups. This is typically the case not only in Latin American studies but also in studies undertaken in more developed countries [25]. In comparative terms, the level of segregation of cluster 4 "*Urban elite*" shows much higher indices than those of the equivalent higher SES groups that are analyzed in the literature. For example, Ariza and Solis (2009) calculate dissimilarity indices for groups independently defined for separate SES dimensions at AGEB level [4]. They show that all the groups with the highest levels of income, education and occupation in the MCMA present dissimilarity indices (D) of 0.38 to 0.48 and isolation (Px) of 0.20 to 0.29 [4] (see Table 3). The disparity between these index values and those reported here seems to indicate differences in the methodology, namely in the geographical scale and dimensionality of the analyses. With respect to scale effects, smaller geographical units of analysis (blocks vs. AGEBs) introduce higher levels of segregation than those registered in the segregation literature [47].

As regards to dimensionality, the fact that 35 census variables are simultaneously used in this paper to classify blocks into similar clusters, produces more homogeneous SES groups than in previous studies where some of these census variables or factors are separately used to classify the population and neighbourhoods. However, a few methodological differences between the approach presented here and those commonly used in the literature need to be explicitly highlighted, to allow for future comparative work.

First, we must insist that we classify city blocks into a single SES class, hence carrying the risks associated with the ecological fallacy in assuming that all city-block residents are equal. Second, we measure indices of residential segregation between types of city-blocks within the Census geo-statistical Areal Unit (AGEB) they share with other blocks, as a proxy for their immediate neighbourhood. The relationship between those two scales is made clear in the example provided in Figure 4. Therefore, the resulting segregation levels are necessarily higher than those calculated in other studies which only used a single variable to classify space, and whose unit of analysis are individuals or households, as opposed to amalgamating them into city-blocks. Such difference is derived from a trade-off between geographical detail (city-block vs. AGEB) and the number of SES dimensions considered in a single analysis of segregation. Finally, our analysis necessarily refers to a single point in time and hence temporal changes cannot be tracked using this methodology until the necessary datasets for the 2010 Census become available at the block level.

4. CONCLUSIONS

Throughout their history Latin American cities have presented high levels of residential socioeconomic segregation. However, a significant shift in the patterns of segregation has occurred since the 1980s; moving from a socioeconomically polarized but compact city to a dispersed and fragmented urban pattern with an apparent decrease in segregation levels [6], [34]. This transition has been characterised by two intertwined processes; a change of scale in RS (from the macro to the micro or local level), and the rapid diffusion of new exclusionary urban forms (such as gated communities and gentrified apartment blocks). Previous studies in the segregation literature typically ignore these scale effects, which are actually disguising entrenched levels of segregation at the neighbourhood level, and typically adopt a unidimensional representation of socio-economic difference over space (even after applying factorial data reduction techniques).

In this paper we have proposed a new methodology to represent SES groups and to measure their level of residential segregation. This approach is based upon the geodemographic classification of very small neighbourhoods, clustered simultaneously along a large number of SES variables, which we have borrowed from the geodemographic literature. Without introducing any pre-conception of their 'degree of difference', or prioritization of one SES variable over others, nor implying a hierarchy of factors, those neighbourhoods have been automatically classified into clusters of similar 'geodemographic profiles'. These clusters constitute the building blocks for the calculation of traditional segregation indices. An application of such methodology in Mexico City Metropolitan Area (MCMA) has been presented here to illustrate the validity of the approach, using SES data at city block level for the first time. We consider that this spatial unit best represents the socio-spatial scope of interactions and relationships of individuals and households as well as the residential preferences in the housing market in Latin American cities.

The overall findings for the MCMA support the aforementioned transformations identified in Latin American cities, presenting traces of both the traditional and new models of RS. The elite groups still occupy a relatively compact sector emanating from the historic city centre, while different layers of middle and

lower social classes are distributed around quasi-concentric rings with diminishing SES with increasing distance from the centre. However, the analysis presented here also shows signs of the new fragmented model of RS, with the different middle class clusters dispersed in the inner city and proximal suburbs where they are in close contact with the more marginal groups and less frequently the elite cluster. Within this framework the evidence presented here clearly points to the most affluent group (4: *Urban elites*) as the most segregated along most of the indices, as identified as well by Sabatini, 2003 and other Latin American scholars. Moreover, we have also shown that within the lower SES groups as well as within the middle classes, stark differences exist that have to do with their demographic structure and life cycles, housing type and tenure, geographic location, domestic migration, and access to welfare and the formal economy, and not just with the traditional income-occupation-education triad of factors. One significant result is that the lower class group has been split into two clearly distinct geo-demographic clusters (1: *Marginal rural periphery* and 3: *Peripherial proletariat*), and so has the middle class (2: *Office workers in tower blocks* and 6: *Educated middle class*). This subdivision of traditional social classes has proved invaluable to represent a more nuanced view of neighbourhood difference and measure the fragmented pattern of residential segregation previously identified by the literature. Finally, it should be clarified that the results presented here for the MCMA are not necessarily representative of general trends in Latin American cities, and have to be interpreted as indicative of the local trends that reflect some of the global processes discussed earlier in this paper. Through the combination of geodemographic clustering and segregation analysis methods, together with the use of highly spatially disaggregated data, we hope to have demonstrated the usefulness of a methodology that captures part of the complex socio-spatial segregation processes in Latin American cities. The forthcoming results of the 2010/11 population censuses present a unique opportunity to apply this, and other research methods, to making comparisons over time and between countries in order to ascertain the actual impact of the so-called new model of residential segregation in Latin American cities.

5. ACKNOWLEDGEMENTS

Parts of this work are based on a research project previously published in Spanish (Aguilar and Mateos, 2011). Reference to previously published illustrative material has been appropriately acknowledged.

REFERENCES

[1] **Aguilar, A. G., Mateos, P.** (2011), *Diferenciación Socio-Demográfica del Espacio Urbano de la Ciudad de México* [Urban socio-demographic differentiation in Mexico City], EURE (Santiago), 37(110) pp. 5-30.

[2] **Aguilar, A. G.** (2008), *Peri-urbanization, illegal settlements and environmental impact in Mexico City*. *Cities* 25(3): 133-145.

[3] **Apparicio, P., Petkevitch, V., Charron, M.** (2008), *Segregation Analyzer: a C#.Net application for calculating residential segregation indices.* Cybergeo 414 (on-line http://cybergeo.revues.org/16443).

[4] **Ariza, M., Solís, P.** (2009), *Dinámica Socio-económica y Segregación Espacial en Tres Areas Metropolitanas de México, 1990 y 2000,* Estudios Sociológicos XXVII, 79, pp. 171-209.

[5] **Birkin, M., Clarke, G.** (1998), *GIS, Geodemographics, and spatial modelling in the UK financial service industry*. Journal of Housing Research, 9(1): pp. 87-111.

[6] **Borsdorf, A.** (2003), *Como Modelar el Desarrollo y la Dinámica de la Ciudad Latinoamericana,* Revista EURE, Vol. 29, No. 86, pp. 37-49.

[7] **Borsdorf, A.** (1991), *Population growth and urbanization in Latin America.* GeoJournal, 2(1), pp. 47-60.

[8] **Cabrales Barajas, L. F.** (2002), *Nuevas Formas y Viejos Valores: Urbanizaciones Cerradas de Lujo en Guadalajara,* en Cabrales Barajas L. F. (Coord.) Latinoamérica: Paises Abiertos, Ciudades Cerradas, Universidad de Guadalajara, UNESCO, México, pp. 93-116.

[9] **Caldeira, T. P. R.** (2000), *City of Walls. Crime, Segregation and Citizenship in Sao Paulo,* University of California Press, Los Angeles, London.

[10] **Caldeira, T. P. R.** (1996), *Fortified Enclaves: The New Urban Segregation*. Public Culture, 8(2), pp. 303-328.

[11] **Ciccolella, P., Baer, L.** (2008), *Buenos Aires tras la Crisis: Hacia una Metrópolis más integradora o mas excluyente?,* Ciudad y Territorio-Estudios Territoriales, Vol XL, No. 158, España, pp.641-660.

[12] **Consejo Nacional de Poblacion (CONAPO)** (2009), *Indice de Marginación Urbana 2005,* Consejo Nacional de Poblacion: Mexico D.F.

[13] **Everitt, B. S.** (1993), *Cluster Analysis*. Hodder Arnold: London.

[14] **Everitt, B. S.** (1979), *Unresolved Problems in Cluster Analysis*. Biometrics, 35(1), pp. 169 - 181.

[15] **Garcia-Peralta, B., Hofer A.** (2006), *Housing for the Working Class on the Periphery of Mexico City: A New Version of Gated Communities.* Social Justice 33 (3) pp. 105–120.

[16] **Griffin, E., Ford, L.** (1980), *A Model of Latin American City Structure,* Geographical Review, Vol. 70, No. 4, pp. 397-422.

[17] **Harris, R, Sleight, P., Webber, R.** (2005), *Geodemographics: neighbourhood targeting and GIS*. Chichester, UK: John Wiley and Sons.

[18] **Instituto Nacional de Estadística y Geografía (INEGI)** (2000), *Distrito Federal, XII Censo General de*

Población y Vivienda, Aguascalientes, Instituto Nacional de Estadística y Geografía.

[19] **Janoschka, M.** (2002), *El Nuevo Modelo de la Ciudad Latinoamericana: Fragmentación y Privatización,* Revista EURE, Vol XXVIII, No. 85, pp. 11-29.

[20] **Janoschka, M.** (2002), *El nuevo modelo de la ciudad latinoamericana: fragmentación y privatización*. EURE (Santiago), 28, pp. 11–20.

[21] **Knox, P., Pinch, S.** (2010), *Urban Social Geography. An Introduction, sixth edition,* Prentice Hall, England.

[22] **Longley, P.A., Goodchild, M. F.** (2008), *The use of geodemographics to improve public service delivery*. In: Hartley, J. D.C., Skelcher, C., Wallace, M. (eds.), Managing to improve public services, Cambridge University Press: Cambridge, pp. 176-194.

[23] **Massey, P., Denton, K.** (1988), *The Dimensions of Residential Segregation,* Social Forces 67, pp. 281-315.

[24] **Mateos, P., Singleton, A. D., Longley, P. A.** (2009), *Uncertainty in the analysis of ethnicity classifications: some issues of extent and aggregation of ethnic groups*. Journal of Ethnic and Migration Studies, 35 (9) pp. 1437-1460.

[25] **Ostendorf, W., Musterd, S., Vos, S. D.** (2001), *Social mix and the neighbourhood effect. Policy ambitions and empirical evidence*. Housing Studies, 16(3), pp. 371-380.

[26] **Park, R. E., Burgess, E. W., Mc Kenzie, R. D.** (1970), *"The City."* The University of Chicago Press (First edition 1925), USA.

[27] **Pezzoli, K.** (1995), *Mexico's Urban Housing Environments: Economic and Ecological Challenges of the 1990s.* In: Aldrich, B. C., Singh Sandhu, R. (eds.) Housing the Urban Poor: Policy and Practice in Developing Countries, London: Sage Publications. pp. 140-167.

[28] **Portes, A., Roberts, B.** (2005), *The free-market city: Latin American urbanization in the years of the neoliberal experiment*. Studies in Comparative International Development (SCID), 40(1), pp. 43-82.

[29] **Prevot-Schapira, M., Pineda, C.** (2008), *Buenos Aires: la fragmentación en los intersticios de una sociedad polarizada.* EURE (Santiago), 34(103) pp. 73-92.

[30] **Reardon, S., Firebaugh, G.** (2002), *Measures of multigroup segregation*. Sociological Methodology, 32(1), pp. 33–67.

[31] **Roberts, B. R., Portes, A.** (2004), *Empleo y desigualdad urbanos bajo libre mercado*. Nueva sociedad, 192, pp. 76-96.

[32] **Roberts, B. R., Wilson, R. H.** (2009), Urban *Segregation and Governance in the Americas,* New York: Palgrave Macmillan.

[33] **Robinson, G. M.** (1998), *Methods and Techniques in Human Geography*. Chichester: John Wiley and Sons. Rubalcava R. M. and Schteingart M. (2000) La División Social del Espacio en las Grandes Metrópolis Mexicanas. Un estudio comparativo, El Mercado de Valores, Abril, pp. 20-33.

[34] **Sabatini, F.** (2003), *La Segregación Social del Espacio en las Ciudades de América Latina,* Departamento de Desarrollo Sostenible, División de Programas Sociales, Banco Interamericano de Desarrollo, Washington D.C., USA.

[35] **Sabatini, F., Brain, I.** (2008), *En Social Urbana: Mitos y Claves,* Revista EURE, Vol. XXXIV, No. 103, pp. 5-26.

[36] **Sabatini, F., Cáceres, G.** (2004), *Los Barrios Cerrados y la Ruptura del Patrón tradicional de Segregación en las Ciudades Latinoamericanas: el caso de Santiago de Chile,* in Cáceres G. and Sabatini F. (Eds.) Barrios Cerrados en Santiago de Chile. Entre la Exclusion y la Integracion Residencial, Lincoln Institute of Land Policy and Instituto de Geografia, Pontificia Universidad Catolica de Chile, pp. 9-43.

[37] **Sabatini, F., Cáceres, G., Cerda, J.** (2001), *Segregación Residencial en las Principales Ciudades Chilenas: Tendencias en las Tres Últimas Décadas y Posibles Cursos de Acción,* Revista EURE, Vol. XXVII, No. 82, pp. 21-42.

[38] **Sabatini, F.** (2003), *La segregación social del espacio en las ciudades de América Latina*. Cuadernos de Instituto de Estudios Urbanos, Universidad Católica de Chile, Serie Azul, 35, pp. 59–70.

[39] **Sabatini, F., Cáceres, G., Cerda, J.** (2001), *Segregación residencial en las principales ciudades chilenas*. EURE (Santiago) 27 (82) pp. 21-42.

[40] **Sassen, S.** (1991), *The Global City*. Princeton University Press: Princeton, NJ.

[41] **Shevky, E., Bell, W.** (1955), *Social Area Analysis*. Stanford CA: Stanford University Press.

[42] **Simpson, E. H.** (1949), *Measurement of diversity*. Nature 163, pp. 688.

[43] **Solinis Loyola, G.** (2002), *Introducción, en Cabrales*, Brajas, L. F. (Coord.) Latinoamérica: Países Abiertos, Ciudades Cerradas, Universidad de Guadalajara, UNESCO, México, pp. 17-27.

[44] **UN Population Division** (2010), *World Urbanization Prospects, the 2009 Revision*. New York.

[45] **Vickers, D., Rees, P.** (2007), *Creating the UK National Statistics 2001 output area classification*. Journal of the Royal Statistical Society: Series A (Statistics in Society) 170(2): pp. 379-403.

[46] **Villareal, A., Hamilton, E. R.** (2009), *Residential segregation in Mexico City Metropolitan Area 1990-2000*. In B. Roberts and Wilson (eds.) Urban Segregation and Governance in the Americas, New York: Palgrave Macmillan. pp. 73–96.

[47] **Voas, D., Williamson, P. D.** (2000), *The Scale of Dissimilarity: Concepts, Measurement and an Application to Socio-Economic Variation Across England and Wales*. Transactions of the Institute of British Geographers, 25(4), pp. 465.

[48] **Ward, P. M.** (2004), *México megaciudad: desarrollo y política 1970-2002*. México City: Miguel Ángel Porrúa/El Colegio Mexiquense.