

THE SOCIO-SPATIAL STRUCTURE OF AUSTRALIA'S METROPOLITAN REGIONS

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ABSTRACT: The release of the 2001 Census of Population and Housing by the Australia Bureau of Statistics provides an opportunity to update material relating to the social structure of Australian cities. Using multivariate statistical techniques this paper describes a typology of local areas across Australia's metropolitan regions focusing on how various social, demographic and economic factors can be used to differentiate between areas. Taking its lead from traditional social area analysis approaches, the paper identifies several factors which when combined help to explain the socio-spatial structure of Australia's metropolitan regions.

1. INTRODUCTION

A recurrent research theme within disciplines such as human geography and urban sociology has been an interest in the mosaic of urban areas displayed in any given city and the ways in which the social structure of spatial units such as suburbs, local government areas or statistical local areas can be displayed in terms of collections of social areas or socioeconomic typologies or taxonomies. Examples of these types of studies include the early work by Shevky and Williams (1949), Bell (1953) Shevky and Bell (1955) and later studies by Anderson and Bean (1961), Sweetster (1965), Green (1971) and Cullingford and Openshaw (1982) in the United States, the United Kingdom and Europe. In Australia studies have included those by Timms (1971) and Jones (1965) and the more recent studies by Western and Larnach (1998) into the social and spatial structure of South East Queensland and Baum et al. (1999) who developed a typology of community opportunity and vulnerability of Australia's metropolitan and regional local communities. At the heart of many of these studies is an attempt to understand the outcomes of broader economic, social, demographic and urban processes and the ways in which the social maps (Brindley and Raine 1979) produced as part of these studies can be of use in either testing some theory or as input to further research or policy applications.

The analysis presented in this paper is undertaken in this spirit and considers the social structure or the pattern of social areas across the metropolitan cities of Sydney, Melbourne, Brisbane, Adelaide, Perth, Hobart and Canberra. The analysis takes a long standing theme-social area analysis- and uses a combination of multivariate analytical techniques-hierarchical cluster analysis and discriminant analysis- to consider the social structure of cities and in particular

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the social areas derived by considering Australian Bureau of Statistics statistical local areas.

The intellectual background to studies branded as social area analysis or factorial ecologies is found in the work by sociologists at the University of Chicago during the first half of the 1900s. Significantly, the Chicago School sociologists were interested in understanding the social outcomes that were shaping the industrial city of their time and both the shape of neighbourhoods and the social characteristics of individual areas were the subject of a number of studies. The monographs published by scholars such as Zorbaugh (1929), Wirth (1938) and Hoyt (1939) concentrated on a range of social characteristics including population and household structure, housing type, mobility and employment and attempted to describe the ways in which cities could be characterised as a collection of natural areas or as social areas. While these early explorations of metropolitan social structure were largely impressionistic (Brindley and Raine 1979) and have been criticised for being too simplistic, the basic premise—the importance of understanding the social structure of cities—has remained important.

The first major empirical attempt to understand the social structure of cities using multivariate analytical techniques is credited to the work by Shevky, Williams and Bell during the late 1940s and 1950s who introduced the technique of social area analysis (Shevky and Williams 1949; Bell 1953; Shevky and Bell 1955) and later by the work of Sweetster (1965) who further developed what is referred to as factorial ecology. Influenced by the early Chicago School sociologists this work involved postulating three constructs or independent dimensions of social differentiation. More specifically, the researchers were interested in describing what they saw as the major trends of industrial society—changes in the range and intensity of relations; differentiation of function; and complexity of organisation. These in turn were seen as being reflected in the changing intersectoral division of labour, the changing role of the household and changing population mobility and concentration. The three constructs or indicators developed were social rank (economic status), urbanisation (family status) and segregation (ethnic status). In their study of Los Angeles, Shevky and Williams (1949) reported 18 different social area types across the three constructs, reflecting the main goal of the analysis, which was to understand “the structure of urban society itself” (p. 33). Taking the methodology further Sweetster (1965: 219) undertook a factorial ecology of Helsinki, suggesting that the findings reflected “the method par-excellence for comparing cross-nationally (and intra-nationally) the ecological differentiation of residential areas in urban and metropolitan communities”.

In the wake of this work, other researchers have produced similar results across other urban areas (see for example Jones 1965, Abu-Lughod 1969, Murdie, 1969, Brown and Horton 1971, Timms 1971 and Herbert and Johnston 1976) and despite some serious criticism of the theoretical and analytical background to the approach, have identified similar social area constructs. Generally, these studies used a similar selection of data variables as those adopted in the earlier studies and adopted a similar methodology (usually

principal components analysis) coming up with three or four factors ranging across various dimensions of socio-economic status, family status and ethnicity.

Despite the popularity of the social area analysis and factorial ecology approaches during the 1960s and 1970s, the late 1970s saw these approaches used less often, as other multivariate analytical techniques became more popular. However, recent years have seen a re-emergence of the types of techniques introduced in the earlier work and an interest in understanding the social structure of post-industrial cities more generally. Illustrative of this change in interest are studies which have focused on the social area constructs of individual cities using the methods developed by Shevky, Bell and Williams (Sommers 1993; Western and Larnach 1998), those that have used the social constructs as a basis for understanding various social problems and issues (Cahill and Mulligan 2002; Harries 1995; Mullins et al. 1999; Baum 1999 and Baum, van Gellecum and Yigitcanlar 2004) and those that have taken the basic premise of social area analysis and developed analyses using other multivariate techniques (Hill et al. 1998; Baum et al. 1999; Baum 2004).

The regeneration of interest in both the premise of social area analysis and its techniques and aims reflects the usefulness of the approach in providing researchers and policy makers with a tool or methodology that helps to understand the urban development process and the complexity of urban systems (Western and Larnach 1998). While it is true that social area analysis and approaches with a similar focus generally only provide a descriptive dimension, they do provide an important first step towards a more substantive explanation. As has been shown in the studies by Cahill and Mulligan (2002), Harries (1995), Baum (1999) and Baum, van Gellecum and Yigitcanlar (2004) approaches such as social area analysis do provide a useful basis for further analysis, whether that be simply overlaying other indicators across the mosaic of social areas or by using the scores derived from the analysis in other multivariate modelling.

From a policy perspective, analysis of social areas may be beneficial in identifying areas of need in terms of service provision or social intervention, or might be valuable in providing an empirical legitimation for the placement of pilot programs or to identify areas that warrant further study. The study of community opportunity and vulnerability undertaken by Baum et al. (1999)- essentially a social area analysis- has been used to identify communities for further study, in particular a study of community strengthening (Western et al. 2002) and a study of social capital in regional Australia (Woodhouse 2004).

2. METHODS FOR SOCIAL AREA ANALYSIS

Attempts to define the social structure of communities across metropolitan regions abound in both the academic literature as well as the applied public policy setting. A usual method-associated with social area analysis and factorial ecology- is to use principal components analysis and some form of cluster analysis in order to discern the social structure of a given city. The analysis undertaken for this paper moved away from this typical methodology and adopted a 2-stage approach used by Hill et al. (1998) and later by Baum et al. (1999). Basically, the paper used hierarchical clustering techniques and

descriptive discriminant analysis to group statistical local areas into clusters based on the degree of similarity across several socio-economic indicators and then to analyse which factors differentiated best between the groups.

The use of agglomerative hierarchical cluster analysis has been shown to be a useful and effective procedure when the researcher wishes to classify observations into similar groups that can then be profiled for social and economic similarities and differences (Everitt 1993, Hair and Anderson 1987). The agglomerative method of hierarchical cluster analysis begins with each observation in a separate cluster. At each successive step, clusters that are closest together are combined to form a new aggregate cluster until the final cluster solution is produced which contains all observations. In this case groups are constructed by minimising the variance of the squared Euclidean distances for each variable within observations using the Ward method.

There is no agreed upon method of selecting the most appropriate cluster solution (Aldenderfer and Blashfield 1984, Everitt 1983). However, a number of options have been suggested including analysing the agglomeration schedule to identify 'marked' increases in the value of the coefficient between two stages. Whilst this method was used here to identify possible cluster solutions, the final choice needs to be guided by more pragmatic reasoning. The final cluster solution should be chosen according to the interpretability of the clusters, the manageability of the cluster numbers and the number of observations included in each cluster. In this case, as has been suggested by Hill et al. (1998) and Gittleman and Howell (1995), it is the face validity of the final cluster solution is of most importance.

Descriptive discriminant analysis is an appropriate methodology in this case as there was a categorical dependent variable (cluster groups) and metric independent variables. It focuses on revealing major differences among pre-determined groups (in this case clusters of statistical local areas) (Stevens 1996) and involves producing a linear combination of the independent variables that will discriminate best between the previously specified cluster groups. It allows identification of the variables that drive the classification process. The output from the analysis was used in several ways. First, the discriminant analysis produced correlations between the individual functions and the independent variables. These were reported in the 'structure matrix' in SPSS and were used to identify the properties of each function. The analysis also produced, for each observation, a series of discriminant scores, which were used to identify key differences between the clusters using the centroids for each cluster. This provided a general structure for identifying the way the characteristics of each cluster differed from other clusters.

The data used for this analysis came from the Australian Bureau of Statistics 2001 Census of Population and Housing. A total of 31 variables were used in the initial analysis and included a range of social, economic and demographic indicators that have been identified elsewhere as being useful in describing the socio-spatial structure of cities (see for example Western and Larnach 1998, Baum, van Gellecum and Yigitcanlar, 2004). The final list of variables used in the analysis are listed in Table 1.

Table 1. Variables Used in the Analysis

<i>Family status demographic</i>	<ul style="list-style-type: none"> • % of single parent families • % of couples with children • % of couples without children • Aged person dependency rate • Youth dependency rate
<i>Human capital</i>	<ul style="list-style-type: none"> • % of persons aged 15 and over who left school in year 10 or earlier • % of persons with a degree or above
<i>Income</i>	<ul style="list-style-type: none"> • % of low income households • % of high income households
<i>Race/ethnicity</i>	<ul style="list-style-type: none"> • % of population who had arrived in Australia since 1996 • % of persons with low English skills
<i>Housing</i>	<ul style="list-style-type: none"> • % of households who are owner/ purchasers • % of households who rent privately • % of households who rent from state housing authorities • % of persons who have moved from a different SLA since 1996
<i>Occupation</i>	<ul style="list-style-type: none"> • % of persons in the work force characterised as professionals or managers • % of persons in the work force characterised as associate professionals or advanced clerical workers • % of persons in the work force characterised as labourers or production and transport workers • % of persons in the work force characterised as intermediate or elementary clerical workers or tradespersons
<i>Industry</i>	<ul style="list-style-type: none"> • % of persons in the work force classified in extractive industries • % of persons in the work force classified in transformative industries • % of persons in the work force classified in distributive services • % of persons in the work force classified in producer services • % of persons in the work force classified in social services • % of persons in the work force classified in personal services
<i>Work force engagement</i>	<ul style="list-style-type: none"> • Unemployment rate • Youth unemployment rate • Male labour force participation rate • Female labour force participation rate • % of males employed part-time • % of females employed part-time

Notes: Both the occupation and industry variables were entered into the analysis as a simple index number derived using a principal components analysis.

In determining the appropriate unit of analysis to account for local communities several levels of aggregation were available. Australian Bureau of

Statistics data was available at levels of aggregation from collection districts (CDs) comprising approximately 200-300 households, to state and national level data. The use of the lowest level of aggregation imposed restrictions on the types of data that could be used and the interpretability of the final outcomes. Given this, and given the goal to consider the structure of local communities, statistical local areas (SLAs) were chosen. The exception to this was in Canberra and Brisbane where small population numbers in a large number of SLAs meant that these had to be collapsed into larger spatial units. For Canberra statistical-sub divisions were used, while in Brisbane local council electoral wards were used. In all cases the metropolitan area was deemed to be those localities contained within the respective metropolitan statistical divisions.

3. SOCIO-SPATIAL STRUCTURE OF AUSTRALIA'S METROPOLITAN REGIONS

The hierarchical cluster analysis resulted in ten groups of SLAs while the resultant discriminant analysis provided four interpretable functions with which to differentiate between the clusters. The data in tables two to six present the major analytical findings from the analysis. Table 2 presents the correlations between the discriminant variables and the canonical discriminate functions and is used to assess the separate discriminate functions (structure matrix). Table 3 presents the functions evaluated at their cluster means (centroids). Table 4 shows the ten clusters included in the analysis (a list of the communities included in each of the clusters is presented in an appendix). Tables 5 and 6 present information on individual socio-economic and demographic data for each cluster, providing more in depth information about each group of communities.

The discriminant analysis resulted in ten discriminant functions with the first four providing the largest share of explained variance (91.0 percent) and the most useful factors for determining inter-cluster differences. Each of the 4 functions was significantly different from zero at the 0.01 critical level and the hit ratio provided in *SPSS discriminant* indicated that over 90 percent of the communities were correctly classified. The structure matrix (Table 2) shows the correlations between the variables in the model and the four resultant functions used in the analysis. The analysis illustrates that variables accounting for household or family structure, employment and occupation structure, the presence of aged persons and ethnic background accounted for the majority of the variance. The variables associated with each function were divided into two types- those used in the final model and highly correlated with the function, and those simply highly correlated with the function (in italics).

The first function dominated the analysis (51.8 percent of the variance). Considering the significant variables in the final stepwise model, this function was positively associated with the percentage of home purchasers and outright owners, the measure accounting for youth dependency and the percentage of couple families with children. The function was negatively associated with the percentage of couple families without children, the percentage households in private rental accommodation, and the percentage of persons who moved into the SLA since 1996. This first function distinguished between the presence of

different household or family types- families with children versus families without children- and was labelled *family status*. The second function was associated with *labour force advantage/ disadvantage* or socio-economic status and accounted for 17.9 percent of the variance. The function was negatively associated with the measure of female labour force participation, the percentage of residents with a degree, the measure of male labour force participation, the percentage of high income households and the score accounting for occupation. Positive associations existed with the unemployment rate, the percentage of low income households, the youth unemployment rate, the percentage of single parent families and the percentage of persons with low education. The third function accounted for 14.0 percent of the explained variance and was associated with the presence of aged households. It was labelled the *aging* function. The fourth function accounted for 7.3 percent of the explained variance. Considering the significant variables in the final stepwise model- the percentage of persons with poor English skills and the percentage of persons who arrived in Australia since 1996- it was labelled the *ethnicity* function.

Table 2. Correlations between the Discriminant Variables and the Discriminant Functions (Structure Matrix)

Function 1: family status (51.8%)	% of households who are owner/ purchasers	0.648
	Youth dependency	0.613
	% of households in private rental accommodation	-0.592
	% couples with no children	-0.531
	% of persons living at a different address	-0.408
	% of couples with children	0.585
Function 2: labour force advantage/ disadvantage (17.9)	Unemployment rate	0.749
	Female labour force participation	-0.736
	% of persons with a degree or above	-0.554
	% of low income households	0.726
	Youth unemployment rate	0.631
	% of single parent families	0.515
	% of persons aged 15 and over who left school in year 10 or earlier	0.446
	Male labour force participation rate	-0.656
% high income households	-0.604	
Occupation score	-0.564	
Function 3: aging (14.0%)	Old age dependency	0.678
Function 4: ethnicity (7.3%)	% of persons with low English skills	-0.768
	% of population who had arrived in Australia since 1996	-0.591

3.1 Interpreting the Clusters

The data presented in Tables 3 to 6 can be used to interpret the clusters of communities in terms of the association with the four significant functions

(family status, labour force advantage/ disadvantage, aging and ethnicity) and individual variables.

Table 3. Functions at Group Centroids

Cluster	Function 1	Function 2	Function 3	Function 4
1	1.01	1.432	0.494	-2.87
2	-8.62	-0.218	-2.82	-0.245
3	-2.75	-0.519	1.00	-0.009
4	0.709	-0.726	0.992	0.09
5	1.935	-2.26	-0.794	0.546
6	0.421	1.55	0.874	0.443
7	3.025	-0.746	-1.57	-0.932
8	-0.882	-1.52	3.33	0.598
9	2.126	1.31	-1.49	0.850
10	-0.605	6.72	-0.071	2.42

Table 4. Cluster Numbers and Associated Characteristics

<i>Cluster number</i>	<i>Cluster name</i>
1	Low socio-economic/ethnic background communities
2	Inner city non-family-high ethnicity-transitional communities
3	Transitional life-cycle non-family oriented near-middle communities
4	Middle suburbia
5	Higher SES/ mortgage belt communities
6	Middle/outer suburb disadvantaged communities
7	Mortgage belt battlers
8	Higher SES/ established communities
9	Low socio-economic status mortgage belt communities
10	Outer suburban severely disadvantaged communities

Cluster 1: low Socio-economic/ethnic background communities

This group comprised 23 SLAs located mainly in Sydney (17 out of 23) with others in Melbourne (3) and Brisbane (3) and was labelled a low socio-economic status/ ethnic background cluster. SLAs in this cluster were among those often associated with the settlement patterns of recently arrived migrants especially as these are concentrated in Sydney, Melbourne and Brisbane- the cities with the highest concentrations of recent migrants. The SLAs included Hurstville, Canterbury, Liverpool and Parramatta in Sydney, Sunshine and Broadmeadows in Melbourne and Wishart and Runcorn in Brisbane. The cluster was negatively associated with function 4 (ethnicity) and also negatively associated with function 2 (labour force advantage/disadvantage).

Reflecting these associations this cluster recorded the highest proportion of persons with low English skills (4.79 percent) and the percentage of persons who were recent arrivals (7.29 percent). The group of communities also had above average unemployment rates (8.34 percent) and below average rates of femal

Table 5. Key Discriminating Variables

	1	2	3	4	5	6	7	8	9	10	Total
% households who are owner/ purchasers	62.62	34.81	56.60	75.75	80.95	66.27	77.03	72.83	72.31	53.73	67.33
Youth dependency	30.68	11.08	22.50	27.44	33.05	27.19	28.59	27.76	36.69	33.89	29.04
% households in private rental accommodation	22.76	43.66	31.02	16.05	12.23	20.69	14.02	18.77	15.59	16.50	20.85
% couples with no children	28.50	54.08	40.54	36.25	32.05	38.64	27.19	36.91	32.95	34.17	35.87
Unemployment rate	8.34	6.41	6.29	5.02	4.85	8.01	5.86	4.57	9.75	17.59	6.94
Female labour force participation	49.31	58.40	57.52	54.72	62.25	49.73	58.19	53.30	51.23	36.93	54.74
% of persons with a degree or above	12.50	29.30	27.05	16.88	15.81	11.69	8.23	30.88	5.46	4.20	16.35
Old age dependency	17.24	12.69	19.99	22.66	12.08	26.34	10.64	26.01	15.35	25.54	18.33
% of persons with low English skills	4.79	3.27	2.30	1.59	0.58	1.96	1.14	1.37	0.91	2.11	1.87

Table 6. Additional Variables

Variable /Cluster	1	2	3	4	5	6	7	8	9	10	Total
% persons living at different address	42.59	65.72	50.89	38.37	41.35	42.14	45.09	43.43	44.22	39.83	45.20
% couples with children	52.35	24.59	41.33	48.58	54.79	41.62	57.30	49.19	47.94	36.56	46.61
% low income households	19.62	20.58	19.51	16.97	12.25	25.23	13.63	15.14	22.41	36.49	19.07
Youth unemployment rate	13.76	13.43	12.08	9.5	10.46	14.89	11.18	10.64	17.79	27.77	13.17
% single parent families	16.80	12.85	14.56	13.41	12.11	17.38	14.41	11.69	17.91	26.98	15.10
% persons aged 15+ over who left school in year 10 or earlier	41.89	17.30	25.76	33.49	37.91	41.14	43.98	20.99	49.79	48.43	35.90
Male labour force participation rate	66.21	65.64	69.19	69.94	76.29	64.37	76.24	68.10	68.78	56.65	69.36
% high income households	19.84	30.94	27.05	24.26	26.27	13.89	20.65	34.47	10.86	4.55	21.66
% persons in work force characterised as professionals or managers	22.45	49.11	42.09	31.14	29.89	24.15	19.49	49.00	15.92	12.35	29.76
% persons in work force characterised as associate professionals or advanced clerical workers	14.34	17.91	17.42	17.27	16.99	15.76	14.51	17.71	13.42	10.03	15.95
% persons in work force characterised as labourers or production and transport workers	20.26	5.42	8.01	11.54	12.24	16.72	20.60	5.42	23.68	32.93	14.65
% of persons in the work force characterised as intermediate or elementary clerical workers	40.46	28.88	30.70	38.17	39.14	41.36	43.20	26.07	44.85	42.11	37.66
% population who had arrived in Australia since 1996	7.29	10.51	5.81	3.25	2.49	3.56	2.14	4.05	1.91	1.95	4.17

labour force participation (49.31 percent) and persons with a degree or above (12.50 percent). Furthermore reflecting the disadvantaged position of this cluster the group of SLAs on average recorded above average rates of low income families (19.62 percent), youth unemployment rates (13.76 percent), single parent families (16.80 percent) and persons with low educational attainment (41.89 percent). Additionally, the cluster of communities recorded below average male labour force participation rates (66.21 percent) and proportion of high income households (19.84 percent). In occupational terms this cluster recorded above average rates of persons characterised as labours or production and transport workers (20.26 percent) and persons employed as intermediate or elementary clerical workers (40.46 percent), reflecting the lower socio-economic characteristics of this group of communities.

Cluster 2: Inner city non-family-high ethnicity-transitional communities

Cluster 2 comprised 16 SLAs located in Sydney, Melbourne, Brisbane, and Perth. Specific places include Sydney inner and North Sydney (Sydney), Inner Melbourne and Yarra- Richmond (Melbourne), Adelaide inner, Brisbane inner and Central Brisbane and Perth inner. Geographically all of the SLAs in this cluster were located in the inner city of the metropolitan area and the factors associated with this cluster reflected the nature of inner city localities within the Australian metropolitan structure. The cluster was highly negatively associated with function 1 (family status) and function 3 (ethnicity). Reflecting this, the cluster recorded above average percentages of households in private rental accommodation (43.66 percent) and couples with no children (54.08 percent) – function 1- and below average age dependency rate (12.69 percent)-function 3. While this cluster did not score highly on function 4 (ethnicity), the group of SLAs did have an above average proportion of persons with low English skills (3.27 percent) and when combined with the proportion of recent arrivals (10.51 percent) suggested that the SLAs in this cluster are also differentiated from other clusters by the ethnic background of its population.

One factor that has been associated with inner city localities has been that they are places of transition and have been undergoing socio-economic change over the past decade or so. The factor that reflects the changes undergoing the inner city is the level of population change. The SLAs in cluster 2 recorded the highest proportion of person who had moved in the past five years (65.72 percent), reflecting the high population change commonly associated with these areas which are often referred to as those places undergoing gentrification (Ley, 1986; Baum et al. 1999; Bounds 2004). These are often the areas that have been associated with changing amenity and lifestyle, including the growth of the 'café society'. Also associated with the changing nature of the inner city is the mixed level of socio-economic status. The cluster did not record a high or low mean on function 2 (labour force advantage/disadvantage), a finding that might suggest a mixed outcome on this function. The data reflected this, with the cluster recording high measures of both advantage and disadvantage. For instance, the cluster of SLAs had above average low income households (20.58 percent) and

youth unemployment rates (13.43 percent), while at the same time also recording high proportions of high income households (30.94 percent) and people with high educational levels (29.30 percent).

Cluster 3: Transitional life-cycle non-family oriented near-middle communities

The third cluster comprised a large group of SLAs (41) located in Sydney, Melbourne, Canberra, Brisbane, Adelaide, Hobart and Perth and was labelled the transitional life-cycle non-family oriented near-middle communities. The SLAs in this group reflect the recent changes that have occurred in Australia's near-inner and middle suburbs with among other things the emergence of a new middle class (Forster 1995) and a generational shift in population. Specific places included Randwick and Mosman in Sydney, North Canberra and South Canberra in Canberra, Hobsons Bay-Williamstown and Glen Eira-Caulfield in Melbourne, Dutton Park and Toowong in Brisbane, Prospect and Unley West in Adelaide, Mosman Park and Victoria Park in Perth and Inner Hobart in Hobart. Geographically, these SLAs were either located in the inner city (Inner Hobart) or more often in near inner localities or middle suburbia.

The cluster was not associated highly with any of the discriminant functions, but did record a negative mean on function 1 (family status). Reflecting this, the cluster of SLAs recorded a high proportion of households in private rental accommodation (31.02 percent) and a high proportion of childless couple families (40.54 percent) and below average proportions of owner/purchaser households (56.60 percent) and youth dependency rates (22.50 percent). This association, together with other data suggested that these SLAs could be classified as a group of near inner transitional communities. Like the previous cluster this group of SLAs recorded an above average rate of population in-movement (50.89 percent) and also recorded a mixed level of socio-economic status-high levels of both high and low income households. The SLAs in this cluster also appear to have a high ethnic presence- above average proportion of people with low English skills (2.30 percent) and recent arrivals (5.81 percent). What differentiated this cluster from the previous cluster is the above average age dependency rate (19.99 percent) which points to the aged population that may be present in many of these near-inner communities now under going socio-economic and housing transitions possibly associated with generational shifts.

Cluster 4: Middle suburbia

The fourth cluster contained 19 SLAs located in Sydney, Melbourne, Adelaide and Perth. Localities included Sutherland Shire and Pittwater in Sydney, Moonee Valley West and Monash-Waverley East in Melbourne, Tea Tree Gully-South and Campbelltown-East in Adelaide and Melville in Perth. The cluster did not score highly on any of the four functions and is labelled as a marginal cluster. It has high proportions of owner/purchasers (75.75 percent), couples without children (36.25 percent), couples with children (48.58 percent) and age dependency (22.66 percent) suggesting that the SLAs on average have a

mixed family structure. The cluster did record above average proportions of persons with degrees (16.88 percent), male labour force participation (69.94 percent) and high income households (24.26 percent) suggesting that they were among higher socio-economic status SLAs. Considering the characteristics of occupational structure the cluster recorded above average scores on all classifications except persons classified as labourers or production and transport workers.

Cluster 5: Higher SES/ mortgage belt communities

The fifth cluster contained 41 SLAs located in all cities and was labelled as a group of higher socio-economic status-mortgage belt communities. Localities included Sutherland Shire West and Hornsby in Sydney, Belconnen and Tuggeranong in Canberra, Wyndham-South and Knox-North in Melbourne, Chandler and Pine Rivers in Brisbane, Playford Hills in Adelaide, Adelaide Hills- Central and Onkaparinga-Woodcroft in Adelaide, Kalamunda and Serpentine-Jarrahdale in Perth and Kingsborough in Hobart. Among these SLAs are those that grew rapidly during the 1990s and have been referred to as part of Australia's middle class suburbia (Baum et al. 1999). In addition, some places, such as Onkaparinga-Woodcroft in Adelaide have been sites of significant greenfield development of large housing estates. Geographically many of these places are located in the middle-outer areas of the metropolitan regions. The cluster was associated negatively with function 2 (labour force advantage/disadvantage) and also has a high positive mean on function 1 (family status). Reflecting the high negative score on function 2 the cluster of SLAs had above average female labour force participation rates (62.25 percent), male labour force participation (76.29 percent) and high income households (26.27 percent). Occupationally, the cluster of SLAs had above average proportions of persons classified as managers and professionals (29.89 percent), associate professionals and advanced clerical workers (16.99 percent) and intermediate and elementary clerical workers (39.14 percent). The positive association with function 1 was reflected in an above average percentage of owner/purchasers (80.95 percent), youth dependency (33.05 percent) and couples with children (54.79 percent).

Cluster 6: Middle/outer suburb disadvantaged communities

Cluster 6 contained 41 SLAs located in Sydney, Melbourne, Brisbane, Adelaide, Perth and Hobart. SLAs were located in middle and outer areas of cities and included Bankstown and Gosford in Sydney, Hobsons Bay-Altona and Frankston West in Melbourne, Moorooka and Northgate in Brisbane, Port Adelaide, Enfield East and Mitcham West in Adelaide, Bassendean and Belmont in Perth and Clarence in Hobart. The cluster contains places often considered to be disadvantaged through rounds of economic restructuring and the changing nature of the Australian labour market (Baum and Hassan 1993, Peel 1995, Baum et al. 1999; O'Connor and Healy 2001). The cluster was labelled the

middle/outer suburb disadvantaged communities. This cluster of SLAs was one of two differentiated by a low level of workforce opportunity and socio-economic status (this cluster had a positive association with function 2). Reflecting these outcomes the cluster of SLAs had an above average unemployment rate (8.01 percent) and youth unemployment rate (14.89 percent), an above average proportion of low income households (25.23 percent), single parent families (17.38 percent) and persons with low educational qualifications (41.14 percent). Occupationally, this cluster was characterised by above average proportions of persons classified as labourers or production and transport workers (16.72 percent) and intermediate and elementary clerical workers and tradespersons (41.36 percent).

Cluster 7: Mortgage belt battlers

The seventh cluster of 22 SLAs is labelled as a mortgage belt battlers cluster and was characterised by traditional family structures and mixed socio-economic status outcomes. The SLAs were located in Sydney (Camden, Penrith and Blacktown North), Melbourne (Melton East, Hume-Sunbury and Knox-South) and Brisbane (Acacia Ridge). The cluster was positively associated with function 1 (family structure) and negatively associated with function 3 (ageing). Reflecting the high association with function 1 the cluster had an above average proportion of households who were owner/purchasers (77.03 percent) and couples with children (57.30 percent). The cluster also had a below average rate of age dependency. The SLAs in this cluster differed from the other two clusters labelled as mortgage belt clusters in terms of the level of work opportunity/socio-economic status. The cluster had high female and male labour force participation rate, and in this respect was similar to cluster 5 (Higher SES/mortgage belt communities). Despite these positive labour force outcomes (reinforced by low levels of unemployment), the cluster recorded neither high or low on the other measures of socio-economic status, having both below average levels of both high and low income households.

Cluster 8: higher SES/ established communities

Cluster 8 represented a group of established higher socioeconomic status SLAs. The cluster comprised 16 SLAs located in Sydney (Hunter's Hill and Ku-ring-gai), Melbourne (Boroondara-Camberwell, Boroondara-Kew and Stonnington-Malvern), Adelaide (Burnside-North East, Walkerville and Mitcham Hills) and Perth (Cambridge, Claremont and Nedlands). Some of these localities are among those typically associated with affluence when studies concerning advantage and disadvantage are considered (Hovarth and Tait 1986; Baum et al 1999; 2002). The cluster was positively associated with function 3 (aging) and also had a negative association with function 2 (labour force advantage/disadvantage). Reflecting the positive association with function 3 the cluster had an above average age dependency rate (26.01 percent), suggesting a higher concentration of older households (and hence possibly established

communities). The higher level of socio-economic status (function 2) was reflected in above average proportions of persons with degrees (30.88 percent), high income households (34.47 percent) and persons characterised as professionals or managers (49.0 percent) or associate professionals or advanced clerical workers (17.71 percent). This cluster of SLAs also had high percentages of both couples without children (36.91 percent) and those with children (49.19 percent) and above average proportions of households who are owner/purchasers (72.83 percent). Reflecting the established or stable nature of this cluster, the SLAs recorded below average levels of population in-movement (43.4 percent).

Cluster 9: low socio-economic status mortgage belt communities

The ninth cluster contained 32 SLAs and was characterised as a group of lower socio-economic status mortgage belt communities. The SLAs were located in all cities except Canberra and included Wyong (Sydney), Yarra Ranges Central and Yarra Ranges North (Melbourne), Caboolture and North Gold Coast (Brisbane), Playford East Central and Onkaparinga Hackham (Adelaide), Swan and Armadale (Perth) and Brighton and Sorell (Hobart). Geographically, many of these localities were located in outer areas of the cities and may be among places where affordable housing, combined with low interest rates have contributed to home purchasing communities. None of the scores on the discriminant functions were more than one standard deviation away from the mean for the total, however the cluster did have a positive association with function 1 and 2, and a negative association with function 3. Reflecting these associations, the cluster of SLAs had an above average proportion of households who were owner/purchasers (72.31 percent), an above average youth dependency rate (36.69 percent) and an above average proportion of couple with children families (47.94 percent). Reflecting the association with function 2 the cluster had an above average unemployment rate (9.75 percent), proportion of low income families (22.41 percent), youth unemployment rate (17.79 percent), proportion of single parent households (17.91 percent) and proportion of persons with low education (49.79 percent). Occupationally, the cluster had an above average proportion of persons characterised as labourers or production and transport workers (23.68 percent) and intermediate or elementary clerical workers and tradespersons (44.85 percent). The negative association with function 3 is reflected in a below average age dependency rate (15.35 percent).

Cluster 10: Outer suburban severely disadvantaged communities

The final cluster consists of five SLAs all located in Adelaide and was labelled as outer suburban severely disadvantaged communities. The group was similar to other groups of low socio-economic status and was differentiated by the level of disadvantage. They are among the localities within Australian metropolitan regions that have been hard hit by economic restructuring and the associated social problems and may have never fully recovered from the rapid loss of manufacturing based jobs (Baum and Hassan, 1993, Peel 1995, Fainstein

1996, Baum et al. 1999; O'Connor and Healy 2001). Geographically the SLAs were located in the outer areas of Adelaide and included Playford-Elizabeth and Onkaparinga-North Coast.

The cluster had a high positive correlation with function 2 (labour force advantage/disadvantage) and function 4 (ethnicity). Reflecting the disadvantaged position of this cluster (positive correlation on function 2) the five SLAs on average had high unemployment rates (17.59 percent), percentage of low income households (36.49 percent) youth unemployment (27.77 percent), proportion of single parent families (26.98 percent) and persons with low education (48.43 percent). For many of these variables this cluster had the highest score. The occupational characteristics of the cluster also reflected its vulnerable employment structure with above average proportions of persons employed as labourers or production and transport workers (32.93) and intermediate or elementary clerical workers and tradespersons (42.11 percent). Although the cluster recorded a positive correlation on function 4 suggesting low ethnic background measures it did record an above average proportion of people with poor English skills (2.11 percent). However, the proportion of recent arrivals located in these SLAs was low (1.95 percent) which may be a better illustration of ethnic background.

4. CONCLUSION

This paper presented an analysis of the socio-spatial structure of Australia's metropolitan communities. Specifically, it used a combination of two multivariate analytical techniques to understand the underlying social structure or mosaic of residential localities across Sydney, Melbourne, Brisbane, Perth, Adelaide, Hobart and Canberra. Ten groups or clusters of places were identified and these were differentiated along socio-economic status (occupational advantage/disadvantage), household structure (household type/ tenure and age dependency) and ethnicity (year of arrival/ English proficiency). Although the methodology used here was different from those traditionally used to consider social areas within cities, it did provide similar outcomes in terms of the structure of indicators. While this should not be surprising given the variables included in the analysis, it does still provide an interesting description of the structure of Australian cities. In addition, because this analysis considered all of the cities together, it provided a wider understanding than has been provided elsewhere where studies have tended to consider single cities in isolation.

It is clear from the analysis presented in this paper that the socio-spatial structure of Australia's main metropolitan cities (like cities almost universally) reflects the segregation of places across social, demographic and economic characteristics. Broadly, the multi-layered nature of Australian cities reflects the interplay of socio-economic status, family lifecycle and ethnic background. What the analysis also suggested is that the patterns are not even across all metropolitan areas with some community types being more prevalent in some cities than others. A case to point is the small cluster of disadvantaged outer suburb communities only found in Adelaide (reflecting the city's poor economic performance over the past decade or so) and the concentration of higher

socioeconomic status communities in Sydney (Australia's global city). Clearly Adelaide has advantaged places while Sydney also has disadvantaged places. What is important is that some places are relatively more disadvantaged than others, reflecting a wide range of factors including local development history, the strength of the local economy and the impact of public policy. While it is important not to overstate the extent of socio-spatial divides across the cities in question- Forster (1995) argues that we are less segregated than most US cities- an understanding of the way that divides are being played out is still important. Also important is an understanding of the ways in which the socio-spatial structure might be shifting. In this paper change was only accounted for by considering the extent of residential in-movement. This did however give some indication of the way change may be emerging across suburbs as populations move and the social structure of any given locality undergoes transformation.

The descriptive presentation of 'community types' presented in this paper is of course not new and does reflect the findings to some degree from earlier studies of ABS census data (see for example Western and Larnach 1998; Baum et al. 1999; Baum, van Gellecum and Yigitcanlar 2004). The usefulness of the analysis lies in part in the ability to overlay other indicators across the typology. One example, which has been illustrated in Baum, van Gellecum and Yigitcanlar (2004) is considering the way in which computer and internet use differs across the different clusters of localities. In this example Sydney was used as an illustration, but a similar exercise could be considered in terms of the clusters of SLAs presented in this paper, and may provide some useful information. Moreover, other data including voting behaviour, crime data or quality of life indicators, whether collected through a government department or service provider or obtained through a sample survey or through synthetic means such as micro-simulation modelling could also be considered and would help to construct a more meaningful picture of the social structure of urban areas. These are areas that will extend further the basis for understanding Australia's metropolitan areas that has been presented in this paper.

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APPENDIX: LOCALITIES, CLUSTERS ONE TO TEN

<i>Cluster 1</i>	<i>Cluster 2</i>	<i>Cluster 3</i>
Sydney	Sydney	Sydney
Botany Bay	Leichhardt	Marrickville
Hurstville	South Sydney	Randwick
Kogarah	Sydney - Inner	Waverley
Rockdale	North Sydney	Woollahra
Canterbury	Melbourne	Ashfield
Fairfield	Melbourne - Inner	Drummoyne
Liverpool	Melbourne - Southbank-	Lane Cove
Campbelltown	Dockland	Mosman
Burwood	Melbourne - Remainder	Willoughby
Concord	Port Phillip - St Kilda	Manly
Strathfield	Port Phillip - West	Canberra
Auburn	Stonnington - Prahran	North Canberra
Holroyd	Yarra - North	Woden Valley
Parramatta	Yarra - Richmond	South Canberra
Blacktown - South-East	Brisbane	Melbourne
Blacktown - South-West	Central	Hobsons Bay -
Ryde	Brisbane Inner	Williamstown
Melbourne	Adelaide	Moonee Valley - Essendon
Brimbank - Sunshine	Adelaide	Moreland - Brunswick
Hume - Broadmeadows	Perth	Darebin - Northcote
Greater Dandenong	Perth - Inner	Boroondara - Hawthorn
Brisbane		Whitehorse - Box Hill
Wishart		Glen Eira - Caulfield
Richlands		Brisbane
Runcorn		Dutton park
		Grange
		East Brisbane
		Hamilton
		Morningside
		Toowong
		Walter Taylor
		Adelaide
		Norwood Payneham St
		Peters - West
		Prospect
		Unley - East
		Unley - West

<i>Cluster 4</i>	<i>Cluster 5</i>	<i>Cluster 5 (ctd)</i>
Sydney	Sydney	Adelaide
Sutherland Shire - East	Sutherland Shire - West	Playford - Hills
Pittwater	Blue Mountains	Tea Tree Gully - Central
Warringah	Baulkham Hills	Tea Tree Gully - Hills
Melbourne	Hornsby	Tea Tree Gully - North
Moonee Valley- West	Belconnen	Adelaide Hills - Centra
Banyule - Heidelberg	Canberra	Adelaide Hills - Ranges
Manningham - West	Weston Creek-Stromlo	Marion - South
Monash - Waverley East	Tuggeranong	Onkaparinga - Hills
Monash - Waverley West	Gungahlin-Hall	Onkaparinga - Reservoir
Whitehorse - Nunawading	Melbourne	Onkaparinga - Woodcroft
Whitehorse - Nunawading	Wyndham - South	Perth
Maroondah - Ringwood	Banyule - North	Kalamunda
Bayside - South	Nillumbik - South	Mundaring
Glen Eira - South	Nillumbik - South-West	Joondalup - North
Kingston - North	Nillumbik Balance	Joondalup - South
Kingston - South	Manningham - East	Serpentine-Jarrahdale
Mornington Peninsula - West	Knox - North	Hobart
Adelaide	Maroondah - Croydon	Kingborough
Tea Tree Gully - South	Yarra Ranges - South-Wes	
Campbelltown - East	Cardinia - North	
Perth	Casey - South	
Melville	Brisbane	
	Chandler	
	Jamboree	
	Pullenvale	
	The Gap	
	Bracken Ridge	
	Pine Rivers	

<i>Cluster 6</i>	<i>Cluster 6 (ctd)</i>	<i>Cluster 7</i>
Sydney	Adelaide	Sydney
Bankstown	Gawler	Camden
	Port Adelaide Enfield - East	Wollondilly
Gosford	Charles Sturt - Coastal	Hawkesbury
Melbourne	Charles Sturt - Inner East	Penrith
Hobsons Bay - Altona	Charles Sturt - Inner West	Blacktown - North
Maribyrnong	Charles Sturt - North-East	Brimbank - Keilor
Moreland - Coburg	Port Adelaide Enfield - Coast	
	West Torrens - East	Melbourne
Moreland - North	West Torrens - West	Melton
Darebin - Preston	Campbelltown - West	Wyndham - North
Monash - South-West	Norwood Payneham St	Wyndham - West
Frankston - West	Peters - East	
Mornington Peninsula - South	Holdfast Bay - North	Hume - Craigieburn
Brisbane	Holdfast Bay - South	Hume - Sunbury
Moorooka	Marion - Central	Whittlesea - North
Deagon	Marion - North	Whittlesea - South
Merchant	Mitcham - West	Knox - South
Wynnum-Manly	Perth	Cardinia - Pakenham
Doboy	Bassendean	Cardinia - South
Enoggera	Bayswater	Casey - Berwick
Holland Park	Stirling - Central	Casey - Cranbourne
McDowall	Belmont	Casey - Hallam
Northgate		Frankston - East
	Canning	Mornington Peninsula - East
	Hobart	
	Clarence	Brisbane
		Acacia ridge

<i>Cluster 8</i>	<i>Cluster 9</i>	<i>Cluster 10</i>
Sydney	Sydney	Adelaide
Hunter's Hill	Wyong	Playford - Elizabeth
Ku-ring-gai	Melbourne	Playford - West Central
	Yarra Ranges - Central	Port Adelaide Enfield - Inner
Melbourne	Yarra Ranges - North	Port Adelaide Enfield – Port Adelaide
Boroondara - Camberwell		Onkaparinga - North Coast
Boroondara - Camberwell	Brisbane	
Boroondara - Kew	Caboolture	
Bayside - Brighton	Redcliffe	
Stonnington - Malvern	Ipswich	
Adelaide	Logan	
Burnside - North-East	Redlands	
Burnside - South-West	North Gold Coast	
Walkerville	Adelaide	
Mitcham - Hills	Playford - East Central	
Mitcham - North-East	Playford - West	
Perth	Salisbury- Central	
Cambridge	Salisbury - Inner North	
Claremont	Salisbury - North-East	
Cottesloe & Peppermint Grove	Salisbury - South-East	
Nedlands	Salisbury- Balance	
	Onkaparinga - Hackham	
	Onkaparinga - Morphett	
	Onkaparinga - South Coast	
	Perth	
	Swan	
	Wanneroo - North-East	
	Wanneroo - North-West	
	Wanneroo - South	
	Cockburn	
	Kwinana	
	Rockingham	
	Armadale	
	Gosnells	
	Hobart	
	Brighton	
	Derwent Valley	
	Glenorchy	
	Sorell	

