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Local Labour Markets in New South Wales: Fact or Fiction?

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1. Introduction

Local Labour Markets represent one form of spatial disaggregation of economic activity. Economists define a Local Labour Market (LLM) as a geographical area within which a high percentage of commuting by residents occurs. It is the site for the interplay between labour supply and demand and, in principle, should be the appropriate area over which the rate of unemployment should be defined (Coombes, 2002:1). These spatial markets result from both costs of mobility between jobs and the limitations of information networks (Hasluck, 1983). Employers and workers within a LLM are assumed to be well informed and able to respond quickly to changes in market conditions. So each LLM is considered to be largely self-contained (closed) from the rest of the economy, even though trade flows will cross boundaries.

An algorithm developed by Coombes *et al* (1986) which utilises Journey to Work (JTW) data has been adopted with some amendments to identify spatial LLMs in a number of recent international studies, including Spain (Casado-Diaz, 2000), New Zealand (Papps and Newell, 2002) and Denmark (Andersen, 2002), in addition to Britain (Coombes et al 1997). Regional labour market statistics are based on the British LLMs. A generalisation of the algorithm, which is known as the European Regionalisation Algorithm, is recommended by Eurostat (1992) as the standard approach for defining LLMs in European countries (Coombes, 2000:1506). Eurostat (1992), quoted in Coombes (2002:8), argues that the principles for defining LLMs should be in declining order of priority, (1) autonomy: maximised self-containment; (2) homogeneity: minimised geographical area; (3) coherence: recognisible boundaries; and (4) conformity: alignment with administrative boundaries. Labour market policy which is directed towards an individual LLM would be expected to impact primarily within that LLM, due to its high rate of closure (Coombes and Openshaw, 1982, quoted in Papps and Newell, 2002:2).

Comprehensive JTW data covering commuting journeys between all Statistical Local Areas (SLAs) in Australia, by gender, occupation and other characteristics, are available for the first time in the 2001 Census. JTW data were only available for urban areas in earlier Censuses.

In this paper we shall utilise an amended version of the Coombes algorithm to engage in a preliminary exploration of the 2001 JTW Census data to establish whether it is possible to group NSW SLAs to form LLMs that satisfy particular closure, job ratio and interaction index criteria. A sensitivity analysis of the critical parameters utilised in the algorithm will then be conducted. We shall also employ Coombes' (2000) synthetic data approach to identifying LLMs, based on five occupational groups and contrast them with the LLMs constructed from the use of total employment data. Finally, we shall compare the spatial classification of these LLMs with the ABS Statistical Regions and also the regions devised by the Bureau of Transport and Regional Economics (BTRE, 2003) with respect to the measurement criteria.

In the next section we review the use of JTW data in the conceptualization and identification of local Labour Markets. This will be followed by a review of the broad approaches to regionalisation and a brief outline of the algorithm in Sections 3 and 4. The next sections discuss the data and outline the results. Concluding comments and future research directions are found in the final section.

2.   JTW and Local Labour Markets

The early Australian literature which drew on JTW data generated additional insights about the operation of urban labour markets. For example, O'Connor (1978) examined the changes in the commuting patterns of Melbourne's inner city residents based on the 1966 and 1971 Censuses and, in particular, the extent of reverse commuting out of the inner city. O'Connor and Maher (1979) explored changes in the spatial structure of the Melbourne metropolitan region, drawing on (non-exclusive) labour sheds which were based on Markov Chain analysis. In a later study of the Melbourne Metropolitan area, Howe and O'Connor (1982) found differences in the commuting patterns of men and women, with there being a marked spatial-occupational association within the female workforce. Forster (1999) also examined the trends in commuting patterns and noted the increased commuting into suburban centres, the greater use of the automobile and the rise in the average commuting distance travelled (see also Watts, 2003).

There have been limited attempts to identify LLMs. DEET (1993) outlined an *ad hoc* urban-centred approach and identified 216 'Natural Labour Markets'. This was superseded by a new organisational structure in which 450 LLMs were defined within DEET regions and reflected the organisational imperatives of the DEET Network, training providers, educational institutions, regional development agencies *etc*. In a commissioned review of the Job Network, Access Economics (2002: 36) noted that the DEWR should 'review the definition of the boundaries of local labour markets, to reflect more accurately the area within which a resident may find employment'.

Since LLMs define relatively self-contained areas, the LLM concept assists in the understanding of the migration process because different definitions of origin and destination impact on the measure of migration and the interpretation of its motivation (Papps and Newell, 2002:1). Migration within large rural LLMs may be based on job access however (Papps and Newell, 2002:25).

A labour market accounts framework can be employed with any spatial demarcation of data, including LLMs. For example, Bailey and Turok (2000) employed regression models to examine the relative strength of different adjustment processes, in particular migration and commuting patterns, across Britain's major cities between 1971 and 1996 in response to persistent employment decline, particularly in manufacturing.

Papps and Newell (2002:25) point out that, if heavily reliant on a particular industry, individual LLMs can be subject to adverse shocks, particularly if labour market groups with low skills predominate. Given that the identification of LLMs is founded on actual commuting patterns, these mutually exclusive areas can assist in the understanding of job accessibility, which may contribute to an explanation of the spatial pattern of unemployment. An alternative approach, utilising the concept of Job Proximity, sidesteps the need to identify LLMs by measuring access to jobs via the use of a distance or travel time based decay function (see, for example, Shen, 2001; Watts, 2003).

The derivation of exhaustive and mutually exclusive LLMs has been challenged in four major respects (Hasluck, 1983; Webster, 1997; Newell and Perry, 2003). First, the imperfections separating the LLMs may not be as significant as is claimed, because employees cross the geographical boundaries which creates interdependence between contiguous LLMs. Second, researchers often consolidate adjacent LLMs to overcome the problem of boundary crossing, but this usually creates a new problem in

that the defined LLM becomes too large for commuting purposes. Consequently, the LLM can lack internal cohesiveness and integration between the constituent areas. Third, the LLM unemployment rate can hide spatial pockets of high and low unemployment, so that the areas are not homogeneous with respect to labour force statistics. On the other hand, Green (1997) defends the construction and use of LLMs in British research as providing 'an alternative geography' for labour market analysis which reflects commuting clusters. Fourth, boundaries of LLMs may exhibit a lack of continuity over time due to investments in housing and transport, as well as the prevailing local economic conditions. On the other hand, reform of administrative areas is less frequent (Newell and Perry, 2003:4).

These potential shortcomings point to a fundamental question with respect to LLMs, namely the strength of their internal adjustment processes. The impact of job loss and job growth in different areas within a LLM should be that commuting patterns get reconfigured within the LLM, so that labour market measures across areas become more uniform following the initial shock. If job seekers closer to the zone of job growth are more successful in securing jobs, then the area formally defined by the LLM is too large. Corvers and Hensen (2003) note that work commuting patterns are not just dependent on the underlying labour market conditions, but also reflect the demographics of individual commuters.

Finally the economic interrelationships between distinct sub-areas of LLMs, such as the urban core and the hinterland can be analysed, drawing on the typology of spread and backwash (Barkley et al, 1995), through the calculation of spatial statistics, including Moran's measure of spatial autocorrelation, the G measure of spatial concentration and Anselin's Local Moran statistic (Anselin, 1995). An understanding of these relationships would facilitate the design of effective targetted regional policy, to address localised pockets of unemployment, which took into account the potential loss of jobs to commuters from other locations.

3.   Regionalisation Approaches

The use of numerical techniques for the identification of locality boundaries has a long history in the literature, starting with the American concept of the Standard Metropolitan Area which described the activity during the typical working day utilising commuting data (Casado-Diaz, 2000:844). Coombes (2002:1500) notes that comparing areas that have not been consistently defined creates major problems in comparative spatial analysis due to the modifiable areal unit problem.

Coombes (2002:1503) identifies three approaches to regionalisation, namely clustering, hierarchical and rules-based, but there others, including boundary analysis. Cluster analysis progresses from the initial set of areas to the final set of regions in one step, drawing on the relative similarity of the statistical properties of the areas, as measured by an affinity matrix. Coombes also points out that clustering approaches usually specify the required number of regions at the outset, but that such an approach cannot ensure that all regions will meet the minimum statistical objectives. This constraint, plus the requirement of contiguity, reduces the options that are available, so the results are likely to be sub-optimal.

On the other hand, hierarchical methods group areas based on a criterion which is gradually lowered, until all the areas satisfy the criterion (Coombes, 2000:1504). Contiguity requirements can be imposed which, to some extent, make the grouping sub-optimal, but reduced the computational demands of the procedure, by reducing

the number of permutations (Massey and Scheurwater, 1980). The hierarchical model gradually raises the statistical measures of the consolidated areas and can impose the number of required regions, or minimum statistical requirements. One major deficiency is that the initial area groupings severely constrain the options that are available later in the analysis (Coombes, 2000:1505), because they are preserved throughout the procedure.

Coombes (2000:1504) defines the third type of procedure as rules-based, which typically commences by the definition of core areas from which the final regions are built up. The remaining non-core areas are residual and remain unallocated, unless linked directly or indirectly to one of the core areas. The final number of regions is not known at the outset. On the other hand, the other two procedures commence with each basic area as a potential region, so if it is not linked to others during the procedure, it remains as a single area region, rather than being unallocated under the rules-based approach. Coombes (2000:1504) notes that a further distinction between the approaches is that a geographical model is likely to underpin the rules-based approach, while more general principles underpin the other methods, such as graph theory or factor analysis. He points to the assumption that each US metropolitan statistical area is based on at least one city, which provides the focus for commuting flows, while hierarchical and clustering methods are based on more general principles relating to the degree of interaction between and across boundaries. He notes, however, that a geographical model may not provide an ideal basis for the definition of boundaries, which may be used for a range of social science purposes.

Based on Coombes' algorithm, but utilising a revised spline function, Casado-Diaz (2000) constructs LLMs from 1991 Census data based on the whole working population and various sub-groups for the 539 municipios of Valencia. By gender and occupation sub-groups, the resulting number of LLMs differ as predicted, with there being more 'female' LLMs than male, and employees in more prestigious occupations travelling further, thereby giving rise to fewer LLMs. He argues that these LLMs represent a better spatial breakup for the imposition of labour market policy than those areas which are administratively determined.

Papps and Newell (2002) employ the algorithm to identify LLMs in New Zealand based on area unit travel to work data from the 1991 Census, but adjust the parameter values to reflect New Zealand's smaller population and its lower spatial density. The LLMs exhibit wide variation in area with the urban LLMs much larger which reflects their superior systems of transportation. While there are significant difference between LLMs and the NZ local authority areas, there was some nesting of LLMs within these district council zones (Papps and Newell, 2002:19). In a later paper Newell and Perry (2003) compare the functional labour markets associated with both the 1991 and 2001 Census. They find problems of compatibility between the two datasets due to a change in the area unit boundaries over the decade. The number of LLMs falls but mean self containment measures decline, while average employment increases. The authors note the greater noise associated with the 2001 dataset. They recommend the continued use of the 1991 LLM boundaries.

In her Danish study Andersen (2002) employed 275 municipalities. She utilised a mixture of two algorithms based on Coombes et al (1986) and Miljøministeriet (1994). The sensitivity of the number of LLMs to the parameter values is subject to analysis. Andersen (2002:843) also includes shopping location data to overcome the reliance on commuting data as the basis for defining functional economic areas.

Inevitably the Functional Economic Areas are greater in size than municipalities, since municipalities are the basic spatial units.

Finally, utilising the commuting data from the 2001 Census, the Bureau of Transport and Regional Economics (BTRE, 2003) defined 425 SLA based regions for Australia drawing on measures of closure. A labour market region was defined for each capital city based on the capital city SLA, plus contiguous SLAs with more than 30% of the employed residents working outside the SLA. Regional centres were also constructed with contiguous SLAs being subject to the same criterion. In areas with a number of similarly sized towns in close proximity and multi-directional commuting patterns, a broader labour market region was defined (e.g. Riverland SA). In NSW 101 regions were defined.

4.   The Algorithm

Coombes et al (1986) employ a non-hierarchical, rules-based procedure, so that, while the upper limit on the number of LLMs is determined by specific criteria which identify foci in the first stage of the algorithm, these foci can be subsequently dismembered if they do not satisfy particular criteria. Space constraints preclude a comprehensive treatment of the algorithm, so a summary is provided below and in Figure 1 (see also Coombes et al 1986:948-52 and Papps and Newell, 2002:9-14).

Stage 1

Labour market foci are initially identified as those SLAs (j) which satisfy either of the following job ratio and self containment criteria:

(1) $\qquad JR(j) = \sum_i T_{ij} / \sum_i T_{ji} > \alpha_1$

(2) $\qquad SC(j) = T_{jj} / \sum_i T_{ji} > \alpha_2$

where T_{ij} denotes the number of employees who live in SLA i and work in SLA j. Thus the job ratio JR(j) denotes the ratio of employees working in area j to the number of employed residents of area j, whereas the self containment ratio, SC(j) denotes the number of residents employed locally relative to the total number of employees who are resident of area j. A value of the former ratio in excess of unity identifies areas which are centres of in-commuting, whereas a high self–containment ratio implies little out-commuting (Coombes et al, 1986:949).

In their England and Wales work, Coombes et al (1986:949) employ the values of 1.3 and 0.55 respectively for α_1 and α_2. In this study the final distribution and number of LLMs was little affected by modest departures from these values, although these values influenced the initial number of foci. After experimentation, the figures employed were 1.4 and 0.75 respectively, but there was no impact on the final number and structure of LLMs if α_1 was raised to 1.60. Approximately 100 foci are initially identified by this procedure, both for the aggregate data and data differentiated by gender or groups of occupations. This is proportionately much higher than the recommendation of about 20% of zones by Coombes et al (1986). A generous number of foci in Stage 1 do not prejudice the final regional configuration, because some foci are candidates for amalgamation to satisfy criteria in the later stages of the algorithm, particularly if they are contiguous and strongly inter-linked. Some foci can be

dismembered. These parameter values will also lead to the identification of non-metropolitan foci.

Stage 2

Each of the foci (j) is ordered by commuting inflows, namely $\sum_i T_{ij} - T_{jj}$.

Then the standard measures of closure by residence and employment are computed for the highest ranked focus and if the minimum value of the two standard measures of closure exceeds α_3 (0.5), then the focus is excluded from further consideration. If not, the next focus (i) is identified for which the following measures of interaction both exceed their corresponding parameter values, namely 0.1 and 0.01:

(3) $\qquad T_{ij} / \sum_k T_{ik} > \alpha_4$

(4) $\qquad T_{ji} / \sum_k T_{jk} > \alpha_5$

If no focus satisfies this criterion, then the next ranked focus (j) is selected and its measures of closure are considered. The focus to be amalgamated with focus j is the one which maximises the weighted interaction index:

(5) $\qquad I_{ij} = T_{ij}^{\;2} / [\sum_k T_{ik} * \sum_k T_{kj}] + T_{ji}^{\;2} / [\sum_k T_{jk} * \sum_k T_{ki}]$

from those foci (i) satisfying constraints (3) and (4), as long as the maximand (I_{ij}) exceeds α_6, which is set at 0.002. Focus i is now removed from consideration and further amalgamation with the amalgamated focus j is now considered by computing the closure measures for the amalgamated focus, j and the next focus i, as described above, and the sequence of computations is repeated.

Stage 3

In this stage all foci are considered alike, whether or not they satisfy the α_3 constraint on the measures of closure, and the possibilities for amalgamation are expanded to include non-foci.

The foci are ranked according to an objective function, which is used for assessing the final LLMs (Coombes et al, 1986:951).

(6)
$$\min(1, [\sum_k T_{jk} * c_1 / \alpha_7], [((\sum T_{jk} * c_2) + c_3) / \alpha_7]) * \min(1, \{T_{jj} / \max(\sum_k T_{kj}, \sum_k T_{jk}) * \alpha_8])$$

The parameters α_7, α_8 represent population (employment) size and self-containment, respectively. Coombes sets the value of 2,000 for the former. In personal correspondence he explained that he did not consider that smaller areas were deserving of being kept separate and such areas would be a source of instability for the UK estimates of unemployment rates which are generated by the TTWA spatial classification and are the basis for EU funding. Given the relative remoteness of some areas in NSW and hence the infeasibility of such areas being part of a larger LLM, due to the absence of any interaction, it was decided to impose a very loose

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employment constraint. This approach also reflected the even smaller employment levels associated with the sub-groups of employment based on gender or groups of occupations. A more demanding employment constraint would lead to the algorithm not converging, with some residual foci not being amalgamated. This could lead to the selective deletion of certain SLAs according to the particular sub-group under consideration, which would be highly unsatisfactory.

A range of values of α_8 between 0.70 and 0.90 are considered. The values of c_1 to c_3 are set at 5.2954, 0.08885 and 1822.3 respectively. All foci with a value in excess of α_9, namely 0.625, are excluded from any further consideration, until all the foci have been considered. Then potential fusions with focus j are considered, both of foci with a spline value of less than α_9 and unallocated areas, as long as they satisfy equations (3) and (4). Again the zone (i) corresponding to the maximum value of the interaction function is chosen. The spline value of this amalgamated focus (proto LLM) is now recalculated and further amalgamations with this focus are considered if it does not satisfy the α_9 constraint. If no amalgamations with focus j are possible, the next focus is considered (Coombes et al, 1986:951).

Stage 4

After ordering by their economically active populations, $\sum_{k} T_{ik}$, the residual zones (i) are identified with the proto LLMs for which there are non-zero commuting flows in either direction or left on a reserve list. The proto LLM for which the interaction function (5) is maximised is chosen. The remaining unallocated residual zones are then considered for amalgamation. The process is continued until all residual zones have been allocated or there have been two successive rounds without any amalgamations.

Stage 5

The proto LLMs do not necessarily satisfy the current self containment constraint associated with the spline function, particularly when it is increased to 0.9267 (α_{10}). The proto LLMs are ordered according to the spline function (6). If the lowest value is less than α_{10}, then it is dismembered and is treated as a number of residual zones and Stage 4 is repeated, followed by Stage 5. The amalgamations through Stage 4 may increase the self-containment of the remaining proto LLMs. If the lowest value of (6) for the proto LLMs exceeds α_{10}, then the process is complete. No refinements of the algorithm were undertaken, in contrast to the UK work. The algorithm structure can be summarised as follows (Papps and Newell, 2002:10):

Figure 1: Summary of Coombes et al (1986) algorithm, as applied to NSW Total

1. Define base spatial units - 196 SLAs.

2. Identify spatial units to act as labour market foci based on the associated job ratio and supply-side self-containment - 100 foci.

3. Amalgamate foci that exhibit a high degree of interaction, if some foci have inadequate degree of self containment -93 foci.

4. Expand amalgamated foci to form proto LLMs by allocating them other foci and non-foci with which they have a high degree of interaction - 93 proto LLMs incorporating 111 SLAs.

5. Allocate remaining (residual) non-focus SLAs to proto LLMs - 93 proto LLMs incorporating 196 SLAs.

6. Iteratively dismember proto LLMs that do not satisfy minimum value of objective function and reallocate all corresponding SLAs - 73 LLMs

5. The Data

The Statistical Local Area is the base spatial unit used for the collection of statistics other than those collected from the Population Censuses. In non-census years, the SLA is the smallest unit defined in the Australian Standard Geographical Classification. SLAs are based on the boundaries of incorporated bodies of local government (ie Local Government Areas) where these exist. One or more SLAs can make up an LGA. In aggregate, the coverage of SLAs is exhaustive and exclusive. To protect confidentiality the JTW data are subject to rounding, that is generalising the values to either 0 or a multiple of 3. It is not possible to ascertain the impact on the results of this process.

After assembling the 2001 JTW database, the following work locations (columns) were deleted: Sydney (Undefined); no fixed address; migratory and off-shore; and Undefined NSW; not stated and not applicable. In addition, the following residential locations (ie rows) were omitted: Migratory and off-shore; Undefined Sydney; no usual address; and Undefined NSW. A number of runs of the algorithm led to 160108809 Unincorporated Far West and 145108652 Yarrowlumla (A) - Pt B. not being assigned. Both these areas have very low populations so the corresponding data were deleted. The inclusion of these SLAs would mean that not all SLAs would be absorbed into the LLMs defined by sub-groups. These deletions meant that the JTW matrix consisted of 196 SLAs for all computations.

Rather than constructing separate LLMs for all 9 major occupations, separately, the occupations were consolidated into 5 Occupational Groups (OGs) in line with work undertaken by the author on occupational gender segregation (see, for example, Watts, 2003). The Managerial and Administrative Managerial OG was represented by Managers and Administrators; the Professional OG by Professionals and Associate Professionals; the Clerical, Sales and Service OG was represented by Advanced Clerical & Service Workers, Intermediate Clerical, Sales & Service Workers and Elementary Clerical, Sales & Service Workers; the Skilled Blue Collar OG was identified with the major occupational group, Tradespersons and Related Workers; and the Unskilled OG consisted of Intermediate Production & Transport Workers and Labourers & Related Workers. The groupings reflect the likelihood that the labour markets for occupations drawing on similar skills are connected by information flows. For consistency, the aggregated data across all occupations were used to represent

total employment, even though the official total JTW data includes JTW data defined across other descriptors which have been omitted.

All observations which represented commuting distances in excess of 200km each way, as measured by the NSW Department of Transport LGA road network matrix, were deleted. The matrix documents the shortest distance between the centroids of SLAs by main road. Newell and Perry (2003) found that, while long distance commuting on a weekly basis in New Zealand may be an aspect of changing work patterns, it had a large impact on some catchment boundaries. LLMs are supposed to represent work areas where the 'working population habitually seeks employment and where local employers recruit most of their labour' (Newell and Perry, 2003). An earlier study of commuting by the author (Watts, 2003) demonstrated that 200km was a plausible limit on daily commuting each way. It is likely that, while some employees may travel long distances to work at the beginning of the week and return to their normal residence at the end, some of these data may be incorrect. For the aggregate data, 1.1% of the journeys were deleted, leaving total employment of 2,417,900 from the JTW data. The algorithm was run using a program written in TSP 4.5 which is available on request.

6.   The Results

Using a value of α_8 (self-containment) of 0.90, the total JTW data generated 73 Local Labour Markets of which 40 LLMs consisted of singleton SLAs, mainly in the west of NSW; 16 LLMs consisted of 2 SLAs; 4 consisted of 3 SLAs; 6 consisted of 4 SLAs; 4 consisted of 5 SLAs, centred on Bathurst, Lismore, Tamworth and Wagga-Wagga; and 1 LLM of 6 SLAs centred on Orange. The LLM centred on Newcastle consisted of 10 SLAs, which, with the inclusion of Great Lakes, Gloucester, Merriwa and Murrurundi, would make up the Hunter Statistical Region. The Sydney LLM consisted of 52 SLAs which included parts of the Illawarra, namely Shellharbour and Wollongong. The mean number of employed residents per LLM was 33,122. Putting aside Lord Howe Island (193), the next smallest LLM was Brewarrina with 673 employed residents and 648 jobs. A map of the LLMs is shown in Figure 2. Some summary statistics are provided in Table 1.

The number of LLMs based on male commuting data was lower than for women. The LLMs associated with the occupational groups also accorded with predictions, with Professional and Trade occupations yielding the fewest LLMs, with Labourers and Clerical workers having the highest. A priori it might be expected that Managerial and Administrative workers would commute further and hence the number of LLMs would be relatively low, but, of course, many of these employees operate in small, local businesses. Ignoring which focus underpins each LLM, and using the aggregate data LLM as the benchmark, there were modest differences across the groups of LLMs. Between 21 SLAs (Professional occupations) and 46 SLAs (Managerial and Administrative occupations) would need to be relocated for the occupationally based LLMs to coincide with those generated by the total data. The corresponding figures for men and women were 10 and 18, respectively. While all groupings were associated with separate Sydney and Hunter Region LLMs, a noticeable difference for Labourers is that the Hunter region LLM, includes SLAs, close to or within Sydney, namely Manly, Pittwater Warringah, Gosford, Wyong, Hornsby, North Sydney, Ku-ring-gai, Mosman, Willoughby. The number of SLAs compromising the Sydney LLM for Labourers is correspondingly lower and, like Clerical Sales and Service, does not include Shellharbour, Wingecarribee and Wollongong.

Figure 2: Local Labour Markets for New South Wales based on Total JTW Data, 2001
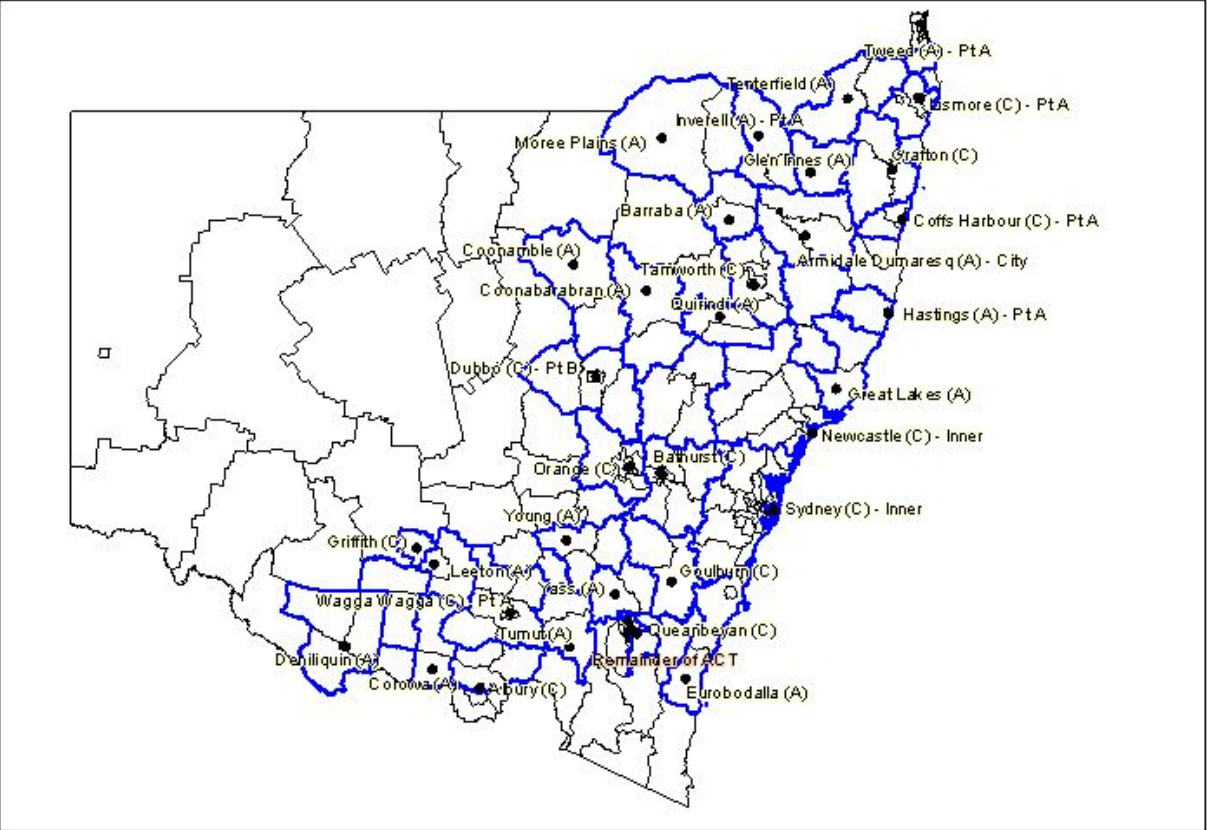
Notes: The LLMs consisting of single SLAs are shown with the light boundaries. The boundaries of the multi-SLA LLMs are shown in bold, with the corresponding foci shown with bold dots. The ACT SLAs are not included in the analysis.

Coombes (2000:1507) argues that a range of spatial data should be employed to identify spatial groupings, rather than being confined to one dataset. For example, data on the location of banks and shops and even recreational pursuits could be utilised to get a broader picture of residential location which is not just determined by journey to work. Another deficiency of the use of a single dataset is that any large sub-group with a particular pattern of commuting behaviour is likely to dominate the regionalisation. Also the regionalisation procedure is dependent on the parameters chosen. Coombes (2000:1507) overcomes these problems by creating synthetic data in the form of a binary, upper triangular matrix for each spatial grouping associated with the different datasets where unity in the i,j cell signifies that area j lies in the LLM with area i (i<j). Thus the focus corresponding to each grouping is ignored. These binary matrices can be layered on top of each other and the corresponding cell entries added together. For each column, j the row (i) with the largest entry denotes the location of area j. The summary statistics for the synthetic data (AVE) are also shown in Table 1. 14 SLAs would need to be relocated for the grouping to conform to that associated with the aggregate data. The large groupings of Sydney and Newcastle and most of the groupings of 4 and 5 SLAs remain unchanged.

Table 1 Summary Statistics for Local Labour Markets

| | Foci | Consolidated Foci | LLMs | % Flow | Self-Containment | | | |
| | | | | | Residential | | Employment | |
					Mean	SD	Mean	SD
Total	100	93	73		0.933	0.042	0.939	0.035
Men	105	98	72	53.2	0.928	0.042	0.935	0.035
Women	103	98	78	46.8	0.938	0.043	0.947	0.032
MA	121	110	79	10.0	0.926	0.041	0.925	0.041
PR	96	89	66	32.7	0.940	0.045	0.947	0.036
TR	102	102	72	10.7	0.940	0.044	0.943	0.039
CLS	101	96	82	31.6	0.946	0.045	0.956	0.034
LR	103	97	78	15.0	0.927	0.043	0.933	0.038
AVE			76		0.923	0.079	0.933	0.052
BTRE			101		0.890	0.080	0.903	0.076
SRegion			22		0.658	0.265	0.716	0.270

Source: ABS 2001 Census Journey to Work data for NSW and author's calculations.
Notes: The residential self containment is defined by (2) and employment self-containment is defined as residents who work in the area divided by total employment in the area.

The BTRE regions all satisfy the constraint of less than 200km being commuted. A comparison of the SLA groupings reveals considerable similarity, with the BTRE regions generally being sub-areas of the 73 LLMs, based on the aggregate data, with the remaining BTRE SLAs typically operating as separate regions. In only two cases, did a LLM constitute a sub-area of a BTRE region (Gunning and Yass versus Gunning, Queanbeyan, Young and Yass; and Berrigan versus Berrigan and Jerilderie). As shown in Table 1, the average closure rates are higher for the LLMs, but the closure rates are higher for some BTRE regions.

There is no simple relationship between the spatial breakdown based on the ABS Statistical Regions and on the LLMs. The Statistical Regions provide a major breakup of the Sydney region, with 12 SRs, as well as Gosford-Wyong. The remaining 9 SRs represent highly consolidated non-Sydney regions, namely, Hunter, Illawarra, South Eastern, Richmond-Tweed, Mid-North Coast, Northern, Far West-North Western, Central West and Murray-Murrumbidgee. The closure rates for the SRs vary

considerably, with a 14 of the 44 measures lying below 0.5. Thus, to the extent that meaningful LLMs can be identified from commuting patterns, neither the Statistical Regions, nor the Statistical Region Sectors represent meaningful LLMs.

Finally a major criticism of the construction of local LLMs is that, while they exhibit high rates of closure, their constituent areas do not exhibit high rates of interaction. As noted above, the criterion for the addition of residual SLAs to proto LLMs is merely that there are non-zero flows between the respective areas. The degree of interaction within the LLMs was measured by computing the weighted sum of half the interaction index (5) for each pairwise combination of SLAs within each LLM, with the weights given by the row (residents) and column (employment) sums for each pair of SLAs, divided by the corresponding totals for each LLM. Thus if an LLM consists of 3 SLAs, three computations make up the overall interaction measure with the denominator of the weight being the sum across the 3 SLAs of twice the corresponding number of employees plus residents. These calculations can also be undertaken between LLMs. The lowest value of the interaction measure is 0.00031 for the LLM comprising Barraba and Bingara, with 3 other LLMs based on foci at Coonabarabran (0.00070), Corowa (0.00060) and Sydney (0.00066) with index magnitudes less than half the value of α_6, which is set at 0.002, and represents the magnitude required for the amalgamation of foci in Stage 2 of the algorithm. Relaxing closure (α_8) to 0.80 means Barraba and Bingara Coonabarabran all become singleton LLMs and further relaxation to 0.75 and then 0.70 leaves the Sydney LLM (0.00067) unchanged with 51 SLAs. The Sydney LLM is the only one which does not satisfy the constraint on the interaction index.

7.   Concluding Comments and Future Research Directions

This paper is designed to explore the conceptual and measurement issues associated with using a rules-based algorithm to identify LLMs in NSW. The strength of the approach is that it is non-hierarchical, so that while the first stage of the algorithm identifies the maximum number of LLMs, amalgamation and dismemberment of the LLMs is possible in order to meet the numerical criteria. From the perspective of closure, the regionalisation process has been satisfactory, but the imposition of high rates of interaction between the constituent SLAs will inevitably lead to non-convergence of the algorithm. These observations highlight the problems of defining LLMs as being mutually exclusive and exhaustive, but also emphasise the conceptual, as well as empirical, issues associated with defining a Local Labour Market. The nature of the economic relationship between the focus and remaining areas is clearly different than between the remaining areas themselves, as noted by Barkley et al (1995) who differentiate between the centres and the hinterlands in their analysis of intra-regional spatial association. Given the heterogeneous relationships between areas constituting LLMs, the greater focus on closure, rather than interaction, may be appropriate, as argued by Eurostat (1992), unless the LLM is the basis for the calculation of labour market and other statistics.

The test of a pattern of regionalisation is the extent to which it adds to our understanding of spatial economic processes, so at this stage the question in the paper's title remains unanswered. We have demonstrated that the spatial classification employed by the ABS does not accord with commuting patterns. On the other hand, the BTRE spatial demarcation appears to be a reasonable rule of thumb.

Three research directions can be pursued in addition to extending the work to the other Australian States and Territories and further disaggregating the spatial data by utilising Origin and Destination Zones. First, spatial data analysis of the SLAs within the LLMs can be employed, as described by Barkley et al (1995). Second, following the work of Bailey and Turok (2000), labour market accounts can be developed for the Australian urban areas, although there will be difficulties associated with the limited availability of JTW data from the earlier censuses. Third, the set of LLMs will provide a spatial framework within which economic relationships can be analysed, in particular the determinants of the rates of local working. Working locally is alleged to convey significant benefits, particularly to the low skilled who tend to have a higher rate of unemployment and to commute shorter distances than higher skilled workers (Immergluck 1998:171). Thus a shortage of appropriate local jobs will tend to raise the rate of unemployment of the low skilled, given that they may have limited capacity to migrate to job rich areas, given housing costs and poor information networks. The results of this research will inform the development of policy to address persistent dispersion in local utilisation rates. In particular, the design of policy will counter the tendency of commuters elsewhere to secure local jobs that have been targeted towards local residents. Brodsky (2000) found that countries which assessed both the needs of the unemployed and the LLM before developing individual action plans had effective programs.

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