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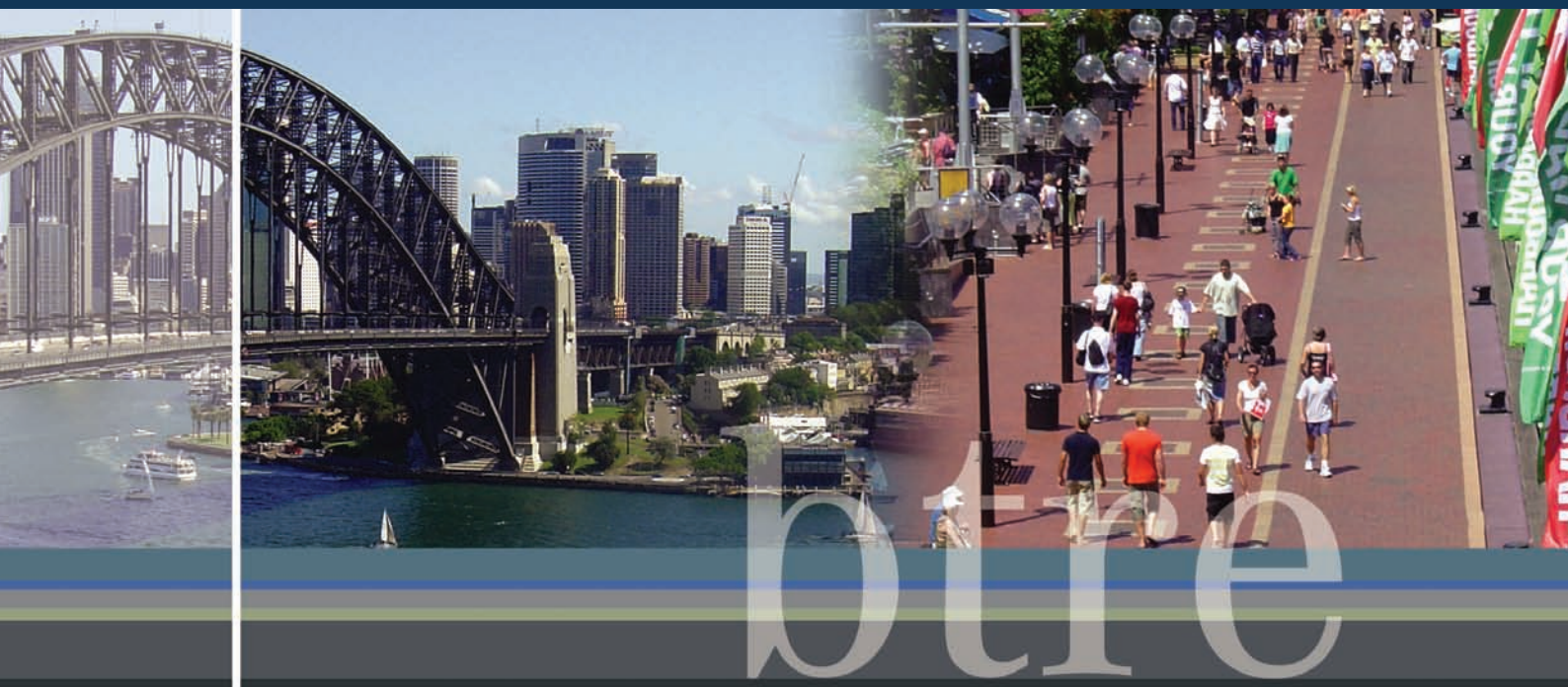

Drivers of Economic Growth in the Greater Sydney Metropolitan Region

Working Paper 67

BUREAU OF TRANSPORT AND REGIONAL ECONOMICS

DRIVERS OF ECONOMIC GROWTH IN THE GREATER SYDNEY METROPOLITAN REGION

WORKING PAPER

67

ISSN 1440-9707

ISBN 1-921260-03-3

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FOREWORD

This working paper presents the results from a collaborative project between the Planning Research Centre at the University of Sydney and the Bureau of Transport and Regional Economics (BTRE).

The project was led by Professor Edward Blakely, Professor and Chair of Urban and Regional Planning at the University of Sydney. Other members of the research team were Dr Santosh K. Bista (Planning Research Centre, University of Sydney) and Dr Godfrey Lubulwa (Bureau of Transport and Regional Economics).

Dr Judith Winternitz, former Deputy Executive Director of BTRE provided strategic and general direction to the project.

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August 2006

ACKNOWLEDGEMENTS

The authors would like to acknowledge the assistance of the Australian Bureau of Statistics in the preparation of the Census of Population and Housing data on place and industry of work for 1991 and 2001, and the help of staff at the Transport Population Data Centre in the New South Wales Department of Planning in relation to the geography and map of the Greater Sydney Metropolitan Region.

The authors are grateful to Leanne Johnson and Geoff Frost for constructive comments on various drafts of the paper, and to Lucy Williams for help with the electronic statistical annex to this report.

An earlier version of the report [Blakely, Lubulwa & Bista 2005] was presented at the 2005 Australia New Zealand Regional Science Association International (ANZRSAI) conference, Manukau City, New Zealand. The comments of those at the ANZRSAI Conference are gratefully acknowledged. However, the content of the paper remains the responsibility of the authors.

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EXECUTIVE SUMMARY

The Greater Sydney Metropolitan Region is the largest, and one of the fastest growing, metropolitan areas of Australia. The objective of the project was to develop an improved understanding of socio-economic drivers of growth in this region which covers Sydney Statistical Division, Illawarra, Central Coast and Newcastle.

Statistical Local Areas (SLAs) were the geographical units of study. This paper presents results from analyses of data about 54 SLAs in the region over the period 1991 to 2001. The study looks at the economic geography to find the economic drivers in each SLA across the region.

Methods

The study uses New South Wales as a reference region. Growth of a SLA is measured in two ways:

- Growth (relative to NSW) in aggregate real taxable income (ARTI), and
- Growth (relative to NSW) in estimated resident population.

The study hypothesises that growth in a SLA is dependent on at least 27 socio-economic factors. The study uses various statistical methods (for example, location quotient analysis, correlation analysis, multiple regression and cluster analysis) to understand the relationships between growth at the small area level and a number of socio-economic explanatory factors. In the regression models we explain growth between 1991 and 2001 as a function of explanatory variables measured in 1991.

Data

The study uses ABS Census of Population and Housing data on place and industry of work from the Australian Bureau of Statistics (ABS), as well as data from databases on taxable income and education, skills and qualifications constructed by the Bureau of Transport and Regional Economics since 2002. The place and industry of work data is based on people's responses to questions on the ABS Census about where the respondent lived, the address of the respondent's work place, and the kind of industry, business or services carried out by the respondent's employer.

The study period is 1991 to 2001. Thus, the results may be a representation of the past, rather than the present or the future of these SLAs.

Key findings

There were two key findings. The first result is about differential growth in the Greater Sydney Metropolitan Region. The study shows that the 54 SLAs in the study area can be classified into 4 major categories with very different growth experiences. We used two methods to classify regions. Under the first—the enhanced scatter plot method, the groupings of SLAs are defined as follows

Categories as defined by the enhanced scatter plot method	
Established/mature SLAs: • Aggregate real taxable income growing faster than NSW • Estimated resident population growing slower than NSW	**Globally exposed SLAs:** • Aggregate real taxable income growing faster than NSW • Estimated resident population growing faster than NSW
Declining SLAs: • Aggregate real taxable income growing slower than NSW • Estimated resident population growing slower than NSW	**Transitional SLAs:** • Aggregate real taxable income growing slower than NSW • Estimated resident population growing faster than NSW

The advantage of the enhanced scatter plot method is that it is non-econometric in nature and easy to use and interpret.

Under the second method—Ward's clustering method, we get four groupings. For economy, the groupings are given the same labels as those given to groupings derived by the enhanced scatter plot method. However, the groupings derived by Ward's cluster method are different in one major way. Compared to the enhanced scatter plot method, Ward's cluster method gives much greater emphasis on estimated resident population in defining the groupings. The groupings that result are based on an ordering of SLAs based on the estimated resident population location quotient. There is greater variation in SLA growth profiles in the population dimension than there is in the income dimension. The difference between the minimum (0.907) and maximum (2.184) of the estimated resident population location quotient is 1.277. In comparison, the difference between the minimum (0.975) and maximum (1.101) of the aggregate real taxable income location quotient is just 0.127. Thus according to Ward's cluster method SLAs in the Sydney Greater Metropolitan Region are more clearly differentiated with respect to estimated resident population growth than they are with respect to growth in aggregate real taxable income. Unlike in the enhanced scatter plot method, each of the groupings of SLAs under Ward's cluster method has some SLAs with incomes growing faster than NSW and other SLAs with incomes growing slower than NSW.

Ward's cluster method uses both the SLA estimated resident population location quotient and the SLA aggregate real taxable income location quotient in the computation of the measure of dissimilarity between SLA groupings. However the method leads to groupings of SLAs which are not very different from a simple ranking of SLA estimated resident population location quotient as shown below:

Categories as defined by Ward's cluster method	
Established/mature SLAs: • Estimated resident population location quotient ranging between 1.036 and 1.27 4 • Aggregate real taxable income location quotient ranging from 0.976 to 1.056	**Globally exposed SLAs:** • Estimated resident population location quotient ranging from 1.311 to 2.184 • Aggregate real taxable income location quotient ranging from 1.001 to 1.086
Declining SLAs: • Estimated resident population location quotient ranging between 0.907 and 0.963 • Aggregate real taxable income location quotient ranging from 0.982 to 1.032	**Transitional SLAs:** • Estimated resident population location quotient ranging between 0.979 and 1.016 • Aggregate real taxable income location quotient ranging from 0.975 to 1.024

While the cluster analysis is more complex its main advantage is that it is an established exploratory data analysis tool which aims to sort different objects into groups in such a way that the degree of association between two objects is maximal if they belong to the same group and minimal otherwise.

The major weakness common to both methods is that while they can be used to discover structures in data, they do not provide an explanation or theoretical justification for those structures. Both methods have no theoretical underpinnings in economics or regional science. They simply discover structures in data without explaining why they exist. The use of two methods leads to differences in SLA group membership. This is a form of sensitivity analysis or a test of robustness of SLA groupings with respect to choice of method. The four SLA groupings are:

Globally exposed

Enhanced scatter plot method: This is a group of the fastest growing SLAs in the region with their location quotients (LQ) for both estimated resident population and aggregate real taxable income relative to New South Wales greater than one. If a SLA has LQ greater than one relative to NSW for both estimated resident population and aggregate real taxable income, that SLA's share of both estimated resident population and

aggregate real taxable income grew during the study period. The number of SLAs in this group was 17 based on the enhanced scatter plot method.

Ward's cluster method: Under this method the number of SLAs in this group was 5. These were the five SLAs with the fastest growing estimated resident populations — Newcastle Inner, Kiama, Mosman, Sydney Remainder and Sydney Inner. This group of 5 SLAs is a subset of the grouping of the globally exposed SLAs identified by the enhanced scatter plot method. Ward's cluster method however excludes many SLAs which are growing faster than NSW but which are not outstanding. This group of 5 globally exposed SLAs stands out from the rest of the SLAs on most indicators, but especially with respect to real income per taxpayer; human capital; SLA openness; and the share of knowledge and technology intensive jobs.

Established/mature

Enhanced scatter plot method: This is a grouping of SLAs which have location quotients for *aggregate real taxable income relative to New South Wales greater than 1*, but their location quotients for *estimated resident population relative to New South Wales less than 1*. These SLAs increased their share of aggregate real taxable income in New South Wales, but had static or declining estimated resident population shares due to various socio-economic changes, life-cycle factors and changes in household composition in the SLAs. Factors that could be contributing to slow estimated resident population growth include children leaving home as young adults, break-up of family units due to separation/divorce, or death of partners. Under this method there are 13 SLAs in this group

Ward's cluster method: Under this method this grouping comprises of the next batch of 11 SLAs with fast growing estimated resident population—Cessnock, Concord, Auburn, Hawkesbury, Maitland, Burwood, Lane Cove, Woollahra, Camden, Hunters Hill and Liverpool. All the SLAs included in this group by this method have *estimated resident population location quotients greater than 1*. While they are growing faster than NSW they are in a class lower than the top 5 in the globally exposed SLAs. The text in italics under the two methods shows that the two methods are using different, diametrically opposed rules in allocating SLAs to this grouping. The 11 SLAs in this group include:

- Seven SLAs classified amongst the globally exposed SLAs by the other method. Ward's cluster method shifts them to this slower category because their populations grew markedly slower than those for the top 5.
- Four of the 11 SLAs in this group *have aggregate real taxable income location quotient less than 1* which the enhanced scatter plot method puts in the transitional SLA grouping.

Transitional

Enhanced scatter plot method: This is a grouping of 7 SLAs which have location quotients for aggregate real taxable income relative to New South Wales less than one, but their location quotients for estimated resident population relative to New South Wales greater than one.

Ward's cluster method: Under this method there are 24 SLAs in this group all of which have values of the estimated resident population location quotient around 1.0. The range of population location quotient in this group is from 0.978 to 1.063. This method includes in the group SLAs whose population location quotient is either marginal below or marginally above 1.0. Thus under this method this grouping comprises SLAs which are not significantly different in growth profile from the rest of New South Wales. About 44% (24 SLAs) are allocated to this group and are related in the following way with the categories developed using the other method:

- 5 were classified amongst the globally exposed SLAs by the enhanced scatter plot method;
- 11 were classified amongst the declining SLAs by the enhanced scatter plot method;
- 5 were classified amongst the established/mature SLAs by the enhanced scatter plot method;

The two methods agree on 3 of the 24 classified as transitional.

Declining

Enhanced scatter plot method: This is a group of the 17 slowest growing SLAs in the region with their location quotients for both estimated resident population and aggregate real taxable income relative to New South Wales less than one. If a SLA has LQ less than one relative to NSW for both estimated resident population and aggregate real taxable income, that SLA's share in both estimated resident population and aggregate real taxable income declined during the study period.

Ward's cluster method: Under this method this grouping is made up of the 14 SLAs with the slowest growing estimated resident population. These include:

- 6 SLAs which are classified as declining by both methods—Marrickville, Ryde, Fairfield, Wollongong, Lake Macquarie and Newcastle Remainder; and
- 8 which the enhanced scatter plot method puts in the Established/mature grouping of SLAs—Randwick, South Sydney, Waverley, Drummoyne, Sutherland Shire, Blacktown, Baulkham Hills and Shellharbour.

Under the Ward's cluster method every SLA in this group has estimated resident population location quotient significantly less than 1.0—the maximum population location quotient is 0.963. However, unlike in the enhanced scatter plot method some of the SLAs included in this grouping have aggregate real taxable income location quotients greater than 1—the maximum aggregate real taxable income location quotient is 1.032.

The labels given to these categories were convenient as a summary tool but we use them cautiously. They should not be interpreted as if all the SLAs in a category were identical in all aspects. Each one of the labels is more descriptive of those SLA in the centre of the category, and the descriptive power of the label is reduced for SLAs that are closer to the borders of a category.

From a statistical perspective the groupings and results based on Ward's cluster are stronger and should be given more weight. They are derived using a grouping method which is well established in the statistics literature. An additional advantage of the Ward's cluster method is that it clearly distinguishes the fastest growing SLAs. The grouping of globally exposed SLAs derived using Ward's cluster method stands out in most comparisons as distinct from the other SLAs.

The report also identifies which factors were statistically significant in explaining growth of SLAs.

SLA growth in aggregate real taxable income

One measure of differential growth in a SLA (between 1991 and 2001) is the location quotient of SLA aggregate real taxable income compared to New South Wales. The study suggests that important factors that explain differential growth as measured by the location quotient of SLA aggregate real taxable income include:

- the human capital stock of an area – the percentage of an SLA's employed persons (aged 15 and over) with a bachelor's degree or higher qualification in 1991;
- the real income per taxpayer in a SLA in 1991;
- the logarithm of the size of a SLA as measured by the estimated resident population in 1991;
- the degree of agglomeration of industries in a SLA in 1991;
- the degree of industry specialisation in 1991;
- the degree of openness of an area in 1991 – measured by the share of jobs that produce goods and services predominantly for a non-local market in all jobs in SLA in 1991; and
- the industry structure of an area in 1991.

The industry structure variables that the study finds important in the equation for the location quotient of SLA aggregate real taxable income were the percentage of employed people who work in the following sectors:

- Government administration and defence;
- Health and community services;
- Manufacturing;
- Property and business;
- Wholesale trade;
- Education, culture and recreation;
- Transport and storage;
- Mining;
- Construction; and
- Retail trade.

The coefficients of the employment shares of these sectors in the aggregate real taxable income regression equations have positive values implying that the higher the employment shares of these sectors in a SLA the higher the growth in SLA aggregate real taxable income.

SLA growth in estimated resident population

An alternative measure of differential growth in a SLA (between 1991 and 2001) is the location quotient of SLA estimated resident population compared to New South Wales. The study suggests that important factors that explain differential growth in the location quotient of SLA estimated resident population include:

- population density of a SLA in 1991;
- the degree of agglomeration of industries in a SLA in 1991; and
- the industry structure of an area in 1991.

The industry structure variables that the study finds important in the estimated resident population equation were the percentage of employed people who work in the following sectors:

- Construction;
- Education, culture and recreation;
- Transport and storage;
- Mining;
- Retail trade; and

- Agriculture, fisheries and forestry.

The coefficients of the employment shares of these sectors (except for Agriculture, forestry and fishing) in the estimated resident population regression equations have negative values implying that the higher the employment shares of these sectors in a SLA the lower the growth in SLA estimated resident population.

This report also provides insights and illustrations on the following phenomena:

- There were significant differentiations in economic conditions within the Greater Sydney Metropolitan Region. The region is characterised by substantial spatial clustering and concentration of various economic activities.

- There were different drivers of growth for different levels of geography. For example the key drivers were different in larger districts versus those operating in individual SLAs in the Greater Sydney Metropolitan Region. Chapters 4 and 5 provide results on this.

- There may be 'glass ceilings' to growth – that is a SLA or larger region may be able to grow up to a certain point, after which the growth path flattens out, and may even start declining because of internal unevenness. Our multivariate analyses in Chapter 4, for example, show that keeping other factors constant, SLAs with larger estimated resident population sizes in 1991 grew slower in the subsequent period from 1991 to 2001.

A new database

The research also offers researchers and policymakers new tools for analysing the growth in SLAs. The associated electronic database 'A statistical Annex - Greater Sydney Metropolitan Region data: 1991 to 2001' contains the data which underlies the analysis in this report. It is available from the BTRE website at <www.btre.gov.au>.

CHAPTER 1 INTRODUCTION

Why do some areas perform better than others in the same region in a vigorous and growing regional economy? Central metropolitan and suburban development has become a key issue in regional economic research in the last several decades. Australia's metropolitan regions have not developed evenly and localities within cities have shown sharp distinctions in their relative development patterns (BTRE 2003a).

Previous research on Australia (for example O'Connor et al 2001) shows that the older core manufacturing metropolitan regions have suffered massive job losses triggering lower economic growth compared with the nation and the non-manufacturing areas within the metropolitan region. For example, Newcastle and Wollongong, the steel fabricating areas of the pre-1970s within the Greater Sydney Metropolitan Region, were dramatically affected by deregulation and globalisation of this industry. Similar fates occurred to other manufacturing areas of Melbourne and Adelaide and to a lesser extent Brisbane and Perth. While attention given to these places has produced evidence of decline in the form of persistent high levels of unemployment, wage decline, and net out-migration of youth, as well as reductions in services, little work has looked at the forces that are allowing some of these places to rebound and others to remain stagnant. In this report we examine the factors that underlie or drive the economies of small areas, in the transition of the Greater Sydney Metropolitan Region to a global city-region. This study attempts to explain why some places in the Greater Sydney Metropolitan Region prosper while others continue to lag. While research addressing this type of question is relatively rare at the urban small area scale of our analysis, questions of this type are well-known in the economic development literature which focuses on nations or larger regions within a nation (for example, Myrdal 1957; Isard 1960).

1.1 SCOPE OF THE STUDY

This study uses regional economic analysis tools to look at the structure of Sydney's sub-regions or districts (Illawarra, Hunter, Western Sydney etc) and of the 54 SLAs that cover all of the Greater Sydney Metropolitan Region.

In the study, we look at both estimated resident population and aggregate real taxable income growth from various perspectives to determine the factors that lead to growth in SLAs, larger districts and the economy of the Greater Sydney Metropolitan Region as a whole. We use SLAs as the basic spatial unit of the analysis. We want to see if there

are differences in outcomes for small areas located in common economic catchments. We try to answer the following questions:

- Do some places perform better or worse than their neighbours within the same economic space?
- If so, what were the socio-economic factors that contribute to these divergences in performance?

The demographic composition of a SLA changes over time as households in the SLA go through their life cycles. For example, in the early phases a SLA may have fast estimated resident population growth because affordable housing attracts young low income families. Households going through the family formation phase increase the rate of estimated resident population growth in a place. When a SLA gets established the sizes of family units may get smaller as young adults start to move out of the place, and as life cycle processes like separation, divorce and/or death of spouses make an impact on SLA population. Thus places which at one time experienced fast growing estimated resident populations could change and become places with ageing, static, or declining estimated resident populations. The people left behind in an established/mature SLA are likely to have higher incomes, at least until they retire. These demographic processes and household life-cycle changes were not explicitly addressed in the study, though they do have an impact on the results of the study. They are one of the reasons why the membership of groupings of SLAs we develop later in the report are likely to change if one took data from a different time period.

1.2 DATA SOURCES AND THEIR LIMITATIONS

We use data from two main sources:

- Australian Bureau of Statistics; and
- Bureau of Transport and Regional Economics.

From ABS we obtained data on estimated resident population in the Greater Sydney Metropolitan Region from 1991 to 2001. ABS Census of Population and Housing provided data on place and industry of work in 1991 and 2001

Two BTRE databases were used to obtain information about the following variables: human capital variables at the SLA level (BTRE 2004) and taxable income at the SLA level (BTRE 2005).

Many of the data items are at least 5 years old and, in a rapidly changing dynamic economy, they may be illustrating past performance, rather than providing indicators of future directions or barriers. On the other hand, they were the best data available. We also use fairly conventional regional economic analysis to examine deep trends in

local economies. More sophisticated econometric tools might well be employed. But, we suspect they would only confirm our assessments since we tested these approaches and found no profound differences in results. Finally, we wanted to employ tools that were transparent and can be used by regional scientists and planners in Sydney and other regions.

1.3 CONTEXT OF THE STUDY

Uneven regional spatial outcomes have been a key research issue among Australian regional scientists and planners for many years (BTRE 2003a). One part of this research deals with the core-periphery thesis with respect to the differences between regional centres and the nation's capital city economies. The other, more recent, work deals with differences within capital city economies. O'Connor et al (2001) noted that there are significant areas within, and outside of, city regions that are part of the globally exposed economic system. Similarly, Stimson, Baum et al (2001) and Baum, Stimson et al (1999) in their 'communities of opportunity/vulnerability' research measured and assessed Australian spatial differentiation using the SLA as a standard spatial unit of analysis.

Another view of this phenomenon is expressed in the work of Vinson (2004), who examines unequal spatial outcomes in Sydney and shows a pattern similar to the work of Orfield (1997) in the US. That is, there are quarters of economic privilege in the Sydney metropolitan region in spite of the intentions of government policy in the distribution of education, health, transport and other resources. He illustrated this with maps of severe negative socio-economic outcomes. Randolph and Holloway (2005) concluded that as the Australian economy transforms from manufacturing to services, the suburbanization process is creating very large differences in the economic opportunity structure and the essential quality of life of many of Australia's urban areas.

1.4 THE STUDY AREA

Our study area is commonly referred to as the Greater Sydney Metropolitan Region. The region had 58 SLAs in 2001 compared with 1991 when the same region had only 54 SLAs. Fortunately between 1991 and 2001 the increase in SLA counts was largely due to sub-dividing some of the existing SLAs without significant changes in boundaries. For the purposes of this study, sub-divided SLAs were merged back to their 1991 boundaries as follows:

- we combined the SLAs known as Warringah and Pittwater in 2001 into one SLA Warringah/Pittwater in 1991;
- we combined Sutherland Shire - East and Sutherland Shire - West into Sutherland Shire in 1991; and

- we combined the three SLAs known in 2001 as Blacktown – North, Blacktown – South East and Blacktown - South-West into Blacktown in 1991.

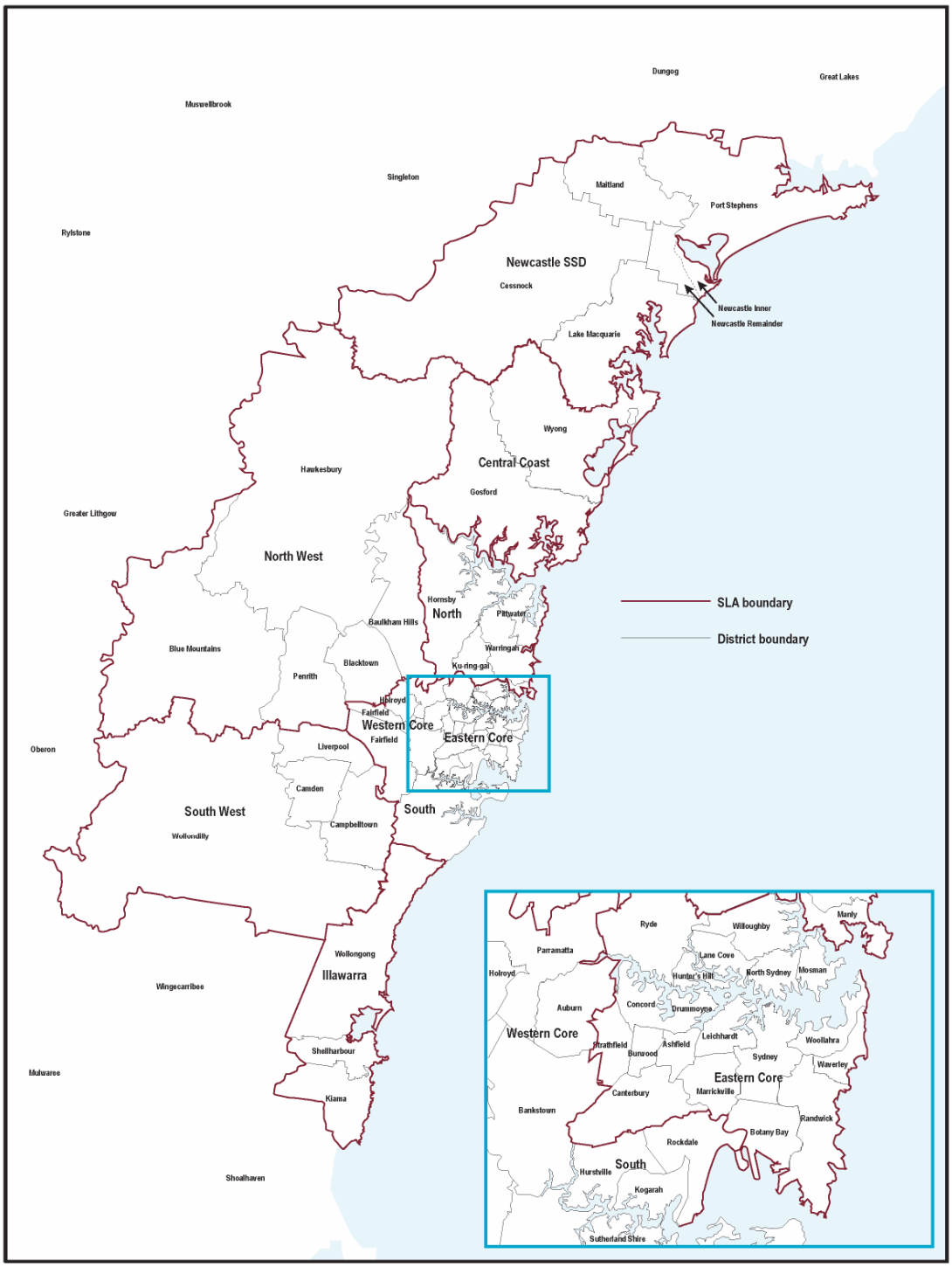
The 54 SLAs were grouped into 9 districts as shown in Table 1.1 based on the definitions of the New South Wales Department of Infrastructure, Planning and Natural Resources (see DIPNR 2004). Figure 1.1 shows a map of the 9 districts in the Greater Sydney Metropolitan Region.

TABLE 1.1 SLAS IN THE 9 DISTRICTS IN THE GREATER SYDNEY METROPOLITAN REGION

1. Eastern Core (a)	**3. North**	**7. Central Coast**
Ashfield	Hornsby	Gosford
Burwood	Ku-ring-gai	Wyong
Canterbury	Manly	
Concord	Pittwater/ Warringah	
Drummoyne		
Leichhardt		
Marrickville	**4. South**	**8. Illawarra**
Strathfield	Hurstville	Wollongong
Botany Bay	Kogarah	Shellharbour
Randwick	Rockdale	Kiama
South Sydney	Sutherland Shire	
Sydney –Inner		
Sydney–Remainder		
Waverley	**5. North-West**	**9. Newcastle (b)**
Woollahra	Baulkham Hills	Newcastle –Inner
Ryde	Blacktown	Newcastle–Remainder
Hunters Hill	Blue Mountains	Lake Macquarie
Lane Cove	Hawkesbury	Cessnock
Mosman	Penrith	Maitland
North Sydney		Port Stephens
Willoughby		
2. Western Core	**6. South-West**	
Auburn	Camden	
Bankstown	Campbelltown	
Fairfield	Liverpool	
Holroyd	Wollondilly	
Parramatta		

Notes:
a Names of districts are in bold font.
b Newcastle refers to the Newcastle Statistical Sub-Division within the Australian Bureau of Statistics Australian Standard Geographic Classification.

FIGURE 1.1 MAP OF THE GREATER SYDNEY METROPOLITAN REGION



Source: New South Wales Department of Planning, 2006.

CHAPTER 2 THE RESEARCH APPROACH

This chapter has two main objectives. The first is to make brief comments on the regional economic planning activities underway in Sydney. The study is meant to provide an additional resource which could inform some of these planning activities. The second and main objective is to outline the research approach and methods used in the study.

2.1 REGIONAL ECONOMIC PLANNING IN SYDNEY

Sydney is undergoing a new regional strategic planning process. Unlike former regional plans that focused almost exclusively on allocating land for housing estates, this one puts a greater emphasis on using tools to affect spatial economic outcomes. The new Sydney Strategic Plan is designed to influence the spatial allocation of job creation opportunities and to improve spatial economic well being across the entire metropolitan area (DIPNR 2005). Sydney is not alone in seeking to use planning tools to influence the spatial distribution of socio-economic outcomes. The new London Plan has similar goals. Similar ideas are in regional plans for Long Island in New York, Seattle, San Francisco and Paris. The theme of spatial distribution of economic activity and socio-economic outcomes is central to regional science.

Rostow (1960) discusses notions of regional economic interventions, and the role of industrialisation in changing national economic outcomes. In the latter part of the twentieth century the focus of regional science changed away from industrialisation and industrial structure, as global forces became pivotal to regional economic outcomes. The work of Piore and Lester (2004) articulated the increasing importance of regions with global attributes. Silicon Valley in California is an example of such a region. Saxanian (1996) and Porter (1998) contributed further to the debates over regional competitiveness. Regions with Rostow's industrial base were doomed as other regions marched up the high technology curve. Regional economic development became enamoured with technology parks and new higher education programs to transfer more knowledge into the regional economy to make it more able to survive and thrive in the global economic race (Porter 1995). Michael Porter argues persuasively that even low-income areas could and should transform their asset base and improve their competitive capacity.

Putnam et al (1970) put human social capital at the forefront of resources for a global economy and argued that small localities can change their own economic destiny by harnessing social and institutional mechanisms. Florida (2002) in his book, *Rise of the*

Creative Class added to these debates of place-based economy by suggesting that any place with creative people can become economically competitive and globally connected. These ideas came across the Pacific as Australia was liberalising its economy and moving to a knowledge—intensive economic base (Stilwell 2005). There were obvious spatial and structural imbalances from this shift across Australia, though they were not as pronounced as observed elsewhere (Goldsmith & Blakely 1992). In the Greater Sydney Metropolitan Region steel producing areas, like the Illawarra and Newcastle, suffered massive economic shocks. But these areas have started to recover and find new economic bases (Fagan & Webber 1999). Areas in many regions around the world are gaining economic advantage. Examples of this include Harlem in New York, most of San Francisco including Oakland and San Jose in the Bay area of California, as well as many inner city areas of Melbourne and Sydney. Blakely and Bradshaw (2002) argue that city based economic development strategies can make a profound difference for economic options and outputs in a new globally based economy, but the uneven effects of the new economic strategies are little known.

This study unpacks the directions of growth in small areas within the Greater Sydney Metropolitan Region. Our contribution improves understanding of the competitive mix of areas that make up the economy of the Greater Sydney Metropolitan Region. Any region's competitive advantage depends on its endowments, such as the quality of human resources, specialised technologies, the clusters of industries with global reach, and various institutional arrangements (O'Connor 1999). Our analysis acknowledges that these endowments vary across the Greater Sydney Metropolitan Region economic space because districts and SLAs are not homogenous.

2.2 THE UNIT FOR ANALYSIS

In this study we base our examination of the smallest unit for analysis on the SLA, an ABS geographic category for the collection of statistics, roughly approximating suburbs or closely related groups of suburbs. The Greater Sydney Metropolitan Region has 54 SLAs.

There is a relationship between SLAs and Local Government Areas (LGAs). LGAs, as the name suggests, are the areas administered by local governments or local councils. Being a product of the political process, the boundaries of LGAs are determined by the various state governments. The ABS recognises these boundaries within its Australian Standard Geographical Classification (ASGC). As the LGA boundaries are not defined by the ABS, they do not always take into account the statistical and geographic needs of the ABS. The ABS therefore utilises an intermediate area to address this issue called the Statistical Local Area (SLA). LGAs may comprise one or more SLAs. For example an LGA may be broken down into 2 SLAs, one encompassing the urban and the other the rural component of the parent LGA. SLAs can only be equal to or smaller than LGAs and are contained wholly within the LGA boundary (ABS 2003).

We group the 54 SLAs into nine districts. Some of these districts remain known for their old economic base while others were clearly influenced by new information industries and new technology. So, we look both at SLAs across the larger Greater Sydney Metropolitan Region and SLAs within their districts to see what the drivers of growth are. These districts are:

- Eastern Core;
- Western Core;
- North;
- South;
- North-West;
- South-West;
- Illawarra;
- Newcastle; and
- Central Coast.

2.3 MEASURES OF GROWTH IN A SLA

We use two measures of economic growth in a SLA:

- growth in total estimated resident population as determined by the Australian Bureau of Statistics; and
- growth in aggregate real taxable income (ARTI).

We assess the forces that produce growth in either or both of these variables.

Estimated resident population refers to the official estimates of the Australian population, which links people to a place of usual residence within Australia. Estimates of the resident population are given by ABS Census of Population and Housing counts by place of usual residence (excluding overseas visitors in Australia) PLUS an adjustment to account for census under-enumeration PLUS the number of Australian residents estimated to have been temporarily overseas at the time of the census (ABS 2005).

Aggregate real taxable income (ARTI) is the sum of individual taxable income recorded for all individuals that reside in a SLA. Aggregate real taxable income is aggregated over all individuals in a SLA, and is an undifferentiated aggregate of all the income accruing to taxpayers from any source. It therefore includes income derived from salary and

wages, net business income, distributions from partnerships or trusts, interest and dividends, eligible termination payments, some government pensions and allowances, superannuation payments and reportable fringe benefit amounts less any allowable deductions. Aggregate real taxable income does not include the income of individuals who earned below the tax-free threshold. Taxable income for companies, funds, trusts and partnerships is not included (BTRE 2005). All dollar figures of aggregate real taxable income have been adjusted for changes in prices (i.e. inflation) using the national Consumer Price Index with 2002-03 as the base year.

We select estimated resident population and aggregate real taxable income as measures of economic growth because they are both often closely associated with changes in a SLA's economic activity. BTRE (2005) has shown that of the two measures aggregate real taxable income is more closely related than estimated resident population to changes in economic activity as measured by Gross Domestic Product (see Table 2.1).

TABLE 2.1 CORRELATION COEFFICIENTS OF GROSS DOMESTIC PRODUCT AGAINST ESTIMATED RESIDENT POPULATION AND AGGREGATE REAL TAXABLE INCOME IN AUSTRALIA, 1960–61 TO 2000–01

	Aggregate real taxable income	Estimated resident population	Change in aggregate real taxable income	Change in estimated resident population
Gross Domestic Product (GDP)	0.991	0.995	NA	NA
Change in GDP	NA	NA	0.657	0.189

Note: *NA stands for not applicable.*
Source: *BTRE (2005).*

2.4 METHODS

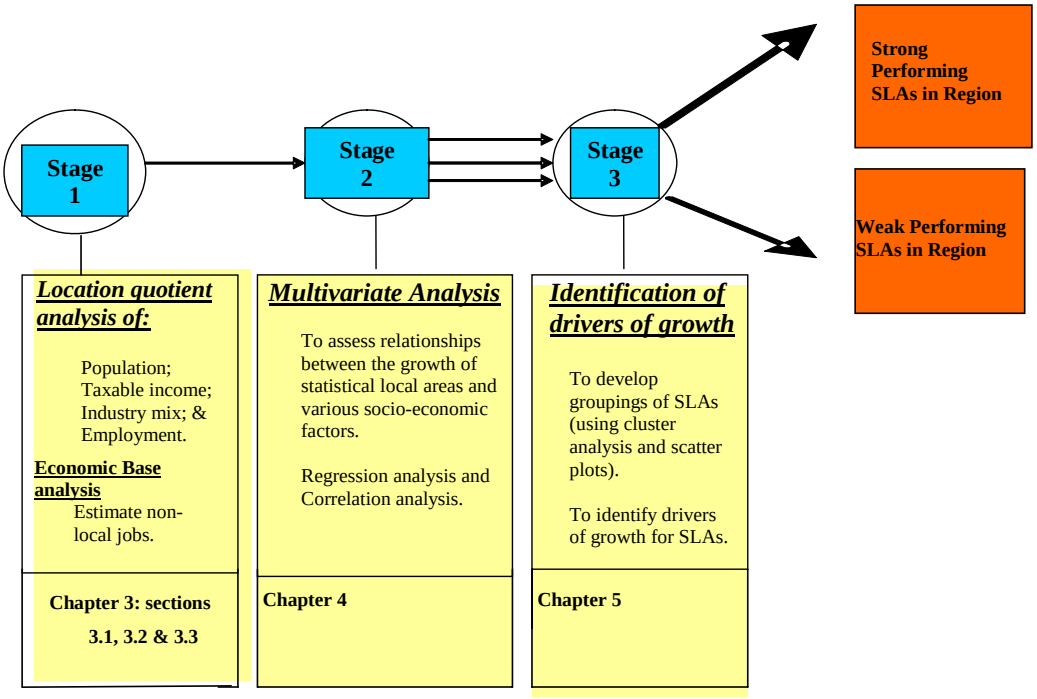
Our analytical approach is in three stages. First, we use location quotients (LQ) to measure SLA growth in estimated resident population and aggregate real taxable income and the importance of various industries in each SLA. In this stage we also examine key economic growth activities using economic base analysis methods.

In our second stage, we use correlation analysis and multivariate linear regressions to identify the important factors that explain differential growth in the Greater Sydney Metropolitan Region.

In the third phase we use various methods (including cluster analysis) to develop a typology of SLAs, and to identify drivers of growth for each type of SLA.

Our analytical approach is similar to the work done by Toft and Stough (1986) who look at economic spatial shifts and use shift share with location quotients to measure rates of growth among regions, and particularly to compare regional competitiveness in (selected) industries. A similar strategy to that in Stimson et al (2002) is used in Blakely (1994) to develop economic development pathways in the sub-regions of the Brisbane/Southeast Queensland economy. Our approach is outlined in Figure 2.2 which is a guide to the process used in our analysis.

FIGURE 2.2 A SCHEMATIC OVERVIEW OF THE APPROACHES USED IN THE STUDY



Source: Planning Research Centre, University of Sydney and Bureau of Transport and Regional Economics.

CHAPTER 3 LOCATION QUOTIENTS OF SLA DESCRIPTORS

3.1 LOCATION QUOTIENTS

This technique is applied to the following variables in this study:

- Estimated resident population;
- Aggregate real taxable income; and
- Employment in industries located in the 54 SLAs.

This technique was employed to identify the change in these selected variables for districts (geo-economic clusters of SLAs) and individual SLAs between 1991 and 2001. We use the state of NSW as the reference region as in earlier studies (for example, Stimson et al 2002). The location quotient approach implicitly recognises competition by considering a location's share of the NSW population. We use the location quotient in the same manner that Mikelbank (2006) did to assess the performance of a large number of suburbs in the United States:

> ' ..... for consistent geography, the task was to investigate population change over the time period. The calculation of a simple percentage change would be an obvious choice. However, the use of a location quotient has two distinct advantages. First, the construction of the location quotient makes use of a reference region, which in this case is the metropolitan area in which the individual suburb is located. It is this locally based comparison, inherent in the location quotient that makes it especially relevant... Secondly, the location quotient also contains the idea of competition by considering a location's share of the metropolitan population'. (Mikelbank 2006, p.8)

In the case of estimated resident population for a SLA, the location quotient (LQ) of estimated resident population for SLA i is calculated as:

$$LQ_i = \left(\sum_{t=1991}^{t=2001} \frac{Population_{i,t} / Population_{NSW,t}}{Population_{i,t-1} / Population_{NSW,t-1}} \right) / N$$

N denote number of years in the study period.

The top term (the numerator) in the equation for estimated resident population location quotients represents SLA i's share of the NSW estimated resident population in time period t.

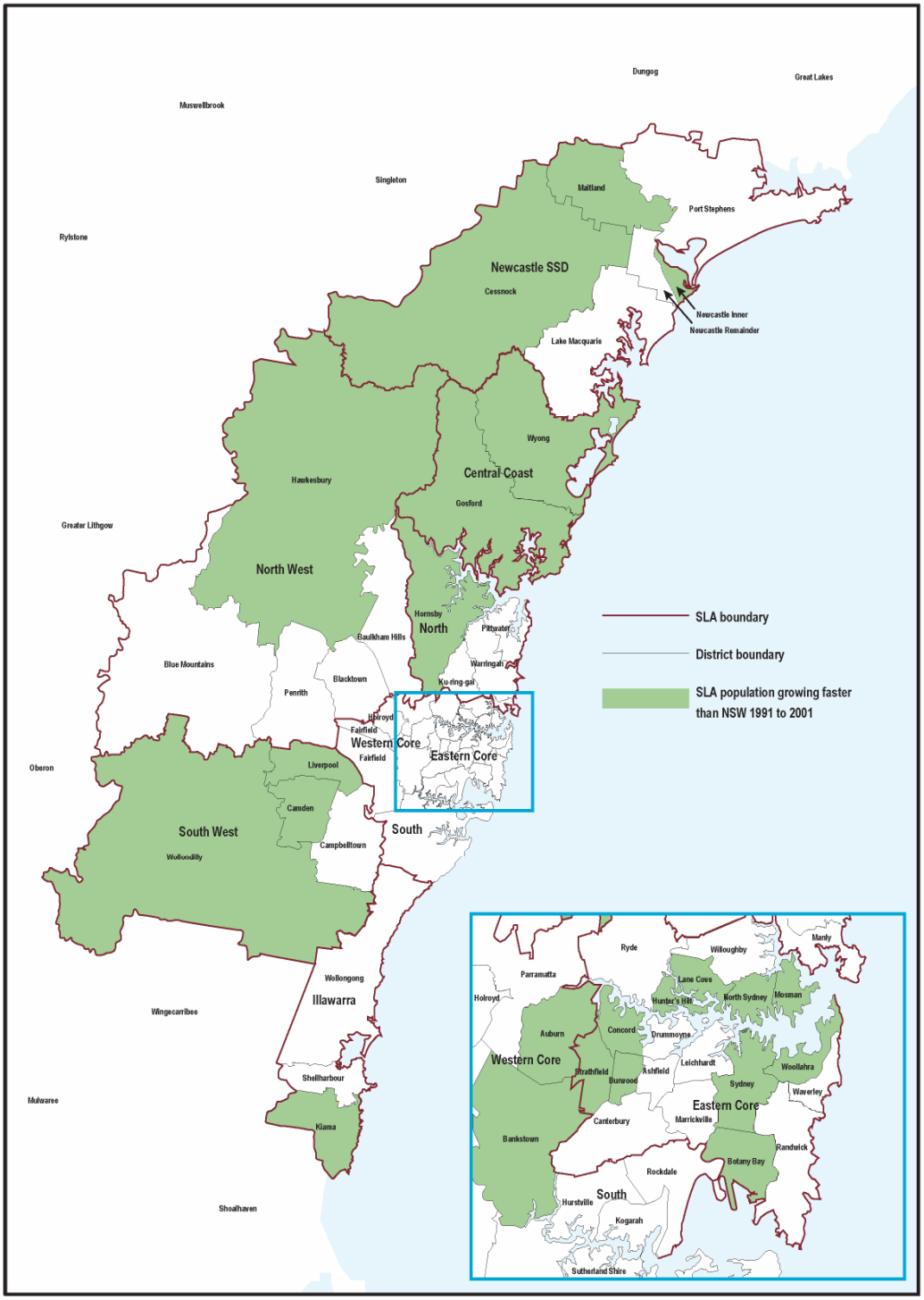
The bottom term (the denominator) in the equation for estimated resident population location quotient represents SLA i's share of the NSW estimated resident population in time period (t-1).

Thus, any SLA with an estimated resident population LQ > 1 increased its estimated resident population share over the period. Conversely, an estimated resident population LQ < 1 indicates a decline in that SLA's NSW estimated resident population share.

The estimated resident population location quotients with New South Wales as a reference region show whether a given region grew faster than NSW (i.e. it's LQ >1) or slower than NSW (i.e. it's LQ<1). The LQ analyses based on estimated resident population data from 1991 to 2001 reveal that out of 54 SLAs, 24 had LQ values greater than 1, as shown in Figure 3.1.

The detailed results from the estimated resident population location quotient analysis are available in a companion electronic database entitled 'A statistical Annex - Greater Sydney Metropolitan Region data: 1991 to 2001' located at the BTRE webpage <www.btre.gov.au>. Table 3.1 gives a summary showing the SLAs with LQ values greater than 1.

FIGURE 3.1 ESTIMATED RESIDENT POPULATION LOCATION QUOTIENTS OF THE SLAS IN THE GREATER SYDNEY METROPOLITAN REGION: AVERAGES FOR PERIOD FROM 1991 TO 2001



Source: *Derived by Planning Research Centre, University of Sydney and Bureau of Transport and Regional Economics based on analysis of Australian Bureau of Statistics estimated resident population data, 1991 to 2001*

TABLE 3.1 SLAS WHOSE SHARE IN NEW SOUTH WALES ESTIMATED RESIDENT POPULATION INCREASED BETWEEN 1991 AND 2001

Name of district	No of SLAs with ERP LQ>1	Percent of SLAs with ERP LQ>1	Names of the SLAs with ERP LQ>1	Total SLAs in the district
Eastern Core	11	52%	Botany Bay, Burwood, Concord, Hunters Hill, Lane Cove, Mosman, Strathfield, Sydney –Inner, Sydney– Remainder, North Sydney ,and Woollahra	21
Western Core	2	40%	Auburn, Bankstown	5
North	1	25%	Hornsby	4
South	0	0%	NA	4
North-West	1	20%	Hawkesbury	5
South-West	3	75%	Camden, Liverpool, Wollondilly	4
Central Coast	2	100%	Gosford, Wyong	2
Illawarra	1	33%	Kiama	3
Newcastle	3	50%	Cessnock, Maitland, Newcastle –Inner	6
Total	**24**	**44%**	**NA**	**54**

Note: NA stands for not applicable.
Source: Derived by Planning Research Centre, University of Sydney and Bureau of Transport and Regional Economics based on analysis of Australian Bureau of Statistics estimated resident population data, 1991 to 2001.

In the Greater Sydney Metropolitan Region, 44% of SLAs had estimated resident population LQ greater than 1. Table 3.1 shows that the SLAs in the following districts stand out as attracting population: Eastern Core, South-West, Central Coast and Newcastle.

On the other hand the following districts grew much slower than New South Wales: South, North and North-West.

Next we undertake a location quotient analysis of aggregate real taxable income (ARTI) from 1991 to 2001. We used the following equation where N denotes number of years in the study period:

$$LQ_i = \left(\sum_{t=1991}^{t=2001} \frac{Taxable\ income_{i,t} / \ Taxable\ income_{NSW,t}}{Taxable\ income_{i,t-1} / \ Taxable\ income_{NSW,t-1}} \right) / N$$

The detailed results for location quotient analysis of aggregate real taxable income for each SLA in the Greater Sydney Metropolitan Region are available in a companion electronic database entitled 'A statistical Annex - Greater Sydney Metropolitan Region data: 1991 to 2001' located at the BTRE webpage <www.btre.gov.au>. The interpretations of the results for aggregate real taxable income are similar to those for population. The aggregate real taxable income location quotients with New South Wales as a reference region show whether a given SLA's aggregate real taxable income grew faster than NSW (i.e. LQ >1) or slower than NSW (i.e. LQ <1). Table 3.2 shows that the SLAs in the following districts stand out as having faster growing (relative to NSW) aggregate real taxable income: Eastern Core, North, North-West, South-West, Central Coast and Illawarra.

On the other hand the aggregate real taxable incomes in most of the SLAs in the following districts grew slower than New South Wales: Western Core, South and Newcastle.

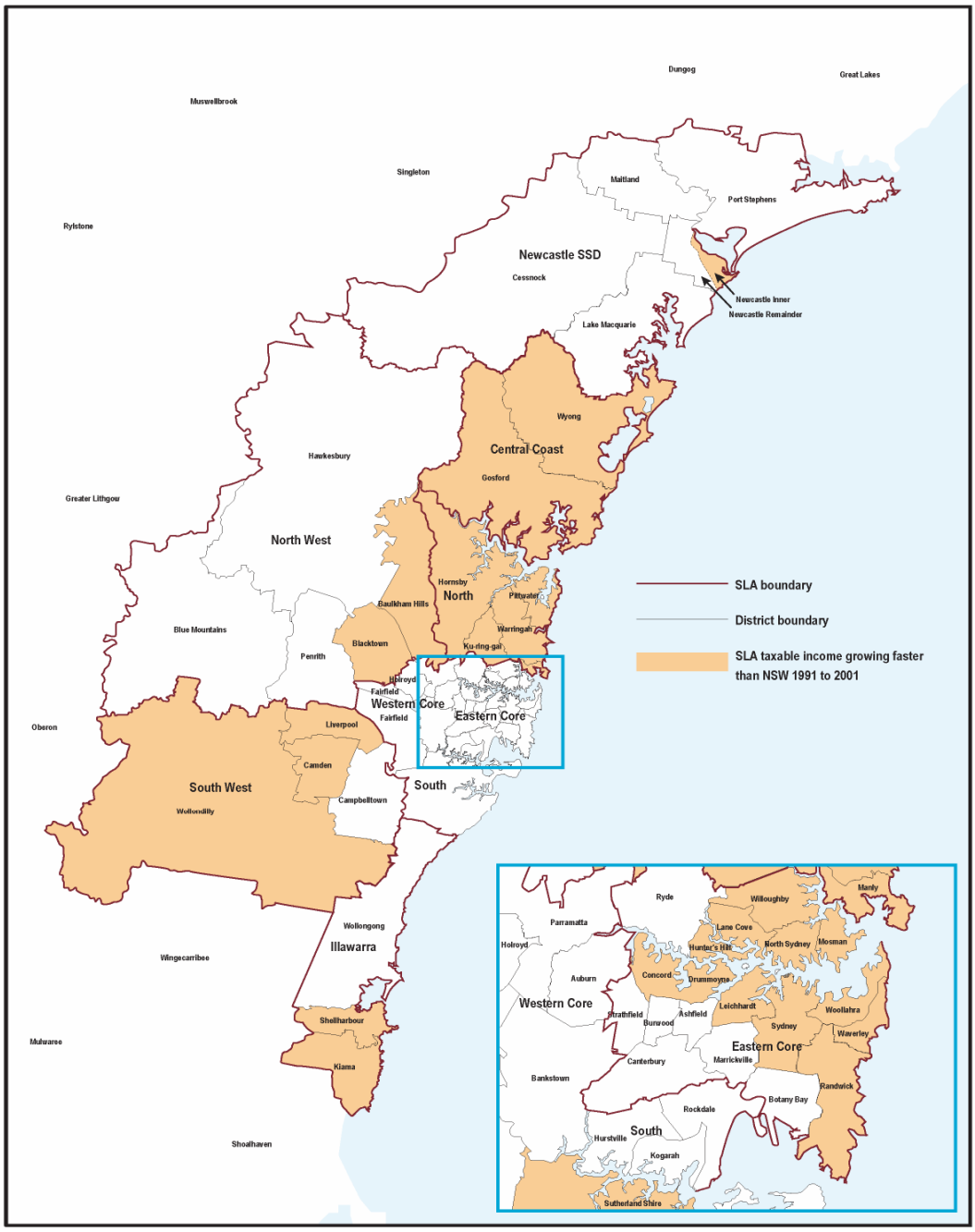
The map in Figure 3.2 distinguishes the SLAs with aggregate real taxable incomes location quotients greater than 1 from those with aggregate real taxable incomes location quotients less than 1.

TABLE 3.2 SLAS WHOSE SHARE OF NEW SOUTH WALES AGGREGATE REAL TAXABLE INCOMES INCREASED BETWEEN 1991 AND 2001

Name of district	Number of SLAs with ARTI LQ>1	Percent of SLAs with ARTI LQ>1	Names of SLAs with ARTI LQ>1	Total SLAs in the district
Eastern Core	14	67%	Leichhardt, South Sydney, Sydney –Inner, Sydney–Remainder, Randwick, Waverley, Woollahra, Concord, Drummoyne, Hunters Hill, Lane Cove, Mosman, North Sydney ,and Willoughby	21
Western Core	0	0%	NA	5
North	4	100%	Hornsby, Ku-ring-gai, Manly and Pittwater/ Warringah	4
South	1	25%	Sutherland Shire	4
North-West	3	60%	Baulkham Hills, Blacktown, and Hawkesbury	5
South-West	3	75%	Camden, Wollondilly, and Liverpool	4
Central Coast	2	100%	Gosford, and Wyong	2
Illawarra	2	67%	Kiama, and Shellharbour	3
Newcastle	1	17%	Newcastle –Inner	6
Total	**30**	**56%**		**54**

Notes: *NA stands for not applicable.*
Source: *Derived by Planning Research Centre, University of Sydney and Bureau of Transport and Regional Economics based on analysis of SLA aggregate real taxable income from BTRE (2005).*

FIGURE 3.2 AGGREGATE REAL TAXABLE INCOME LOCATION QUOTIENTS OF THE SLAS IN THE GREATER SYDNEY METROPOLITAN REGION: AVERAGES FOR THE PERIOD FROM 1990–91 TO 2000–01



Source: *Derived by Planning Research Centre, University of Sydney and Bureau of Transport and Regional Economics based on analysis of SLA aggregate real taxable income from BTRE (2005).*

3.2 PLACE AND INDUSTRY OF WORK DATA

We use place and industry of work data from the ABS Census of Housing and Population to determine employment specialisation by SLA. This data has been collected since 1971 (Robertson 2000). Place and industry of work data in 1991 was collected from Census respondents' answers to three questions on the census forms in 1991 and 2001:

- The respondent's residential address;
- For the main job held last week, what was the workplace address of the respondent's employer; and
- What kind of industry, business or service is carried out by the employer? (For example dairy farming, footwear manufacturing).

Destination zones

Destination zones (DZN) are prepared for the ABS by State government authorities (who are the major users of place and industry of work data). Each DZN is a geographical unit designed to represent areas with working populations of at least 100 persons. DZNs aggregate to SLA boundaries. ABS uses the answers to the above-mentioned three questions to code the number of people employed in different industries in different Destination Zones.

Industry classifications

In 1991, industries were classified using the Australian Standard Industry Classification (ASIC). By the 2001 ABS Census of Housing and Population, the relevant scheme for industry classification had changed to the Australian and New Zealand Standard Industrial Classification (ANZSIC) which accommodates more industry categories than the ASIC. The ABS applied a concordance between ANZSIC and ASIC to generate data on persons employed by industry of employment in each of the 54 SLAs. The industry listing used was closer to the 1991 listing. Thus at the 2 digit level our data set has 45 industries as opposed to the 53 industries recognised in ANZSIC. The two industry classifications and the associated concordances are described in ABS (1993).

Data quality

While there are some data quality issues associated with the place and industry of work data (Robertson 2000), this type of data is the best available for describing the industry structure of the Greater Sydney Metropolitan Region. Robertson (2000) reports that after analysing inconsistent responses in output validation, ABS found that only a small proportion of the overall population was affected by this issue.

3.3 EMPLOYMENT SPECIALISATION BY SLAS

We undertook a location quotient analysis of employment in the 16 ANZSIC industries listed in Appendix A, plus a specially defined industry covering all sectors which are knowledge and technology intensive. The knowledge and technology intensive composite industry comprises the following: Education; Health and community services; Finance and insurance; Communication services; Business services; Services to mining; and a number of other industries as spelt out in OECD (2001d).

The SLA location quotient of employment (ELQ) with respect to the j^{th} industry at time t is calculated as follows:

$ELQ_{sjt} = (E_{sjt}/E_{st})/(E_{NSWjt}/E_{NSWt})$, where,

E stands for employment;

s stands for a given SLA;

j stands for the j^{th} industry,

t stands for a given year; and

NSW stands for the state of New South Wales.

We used industry employment location quotients to identify which industries, in 2001, each SLA specialised in, as against the reference region (NSW). The technique measures the extent to which a SLA is specialised, relative to the reference region (Klosterman 1990).

If for a given industry, (e.g. manufacturing) the ELQ for a SLA is greater than 1, the share of people employed in manufacturing jobs in that SLA's total employment is larger than the share of NSW people employed in manufacturing jobs in NSW total employment. If manufacturing is more important than it is (on average) for the state of New South Wales, the SLA is considered to specialise in manufacturing.

The detailed results for employment location quotients (ELQ) by each of the 16 ANZSIC Division level industries for each SLA in the Greater Sydney Metropolitan Region are available in a companion electronic database entitled 'A statistical Annex - Greater Sydney Metropolitan Region data: 1991 to 2001' located at the BTRE webpage <www.btre.gov.au>. Table 3.3 summarises the results for the 9 districts in the Greater Sydney Metropolitan Region.

TABLE 3.3 SLAS WITH EMPLOYMENT LOCATION QUOTIENT GREATER THAN 1 FOR SELECTED INDUSTRIES IN THE GREATER SYDNEY METROPOLITAN REGION BETWEEN 1991 AND 2001

Industry	Agriculture, Forestry & Fisheries (A)	Mining (B)	Manufacturing (C)	Electricity, Gas & Water Supply (D)	Construction (E)	Wholesale Trade (F)	Retail Trade (G)	Accommodation, Cafes & Restaurants (H)
No of SLAs in GSMR where LQ>1	5	7	28	17	17	20	35	22
For each industry, percentage of SLAs with ELQ>1, that are in each district								
Eastern Core (20)	0%	0%	21%	29%	24%	35%	23%	55%
Western Core (6)	0%	0%	21%	12%	0%	30%	6%	0%
North (5)	0%	0%	7%	0%	12%	15%	14%	5%
South (3)	0%	0%	4%	12%	12%	0%	6%	5%
North-West (5)	20%	0%	11%	6%	12%	10%	14%	5%
South-West (4)	40%	14%	11%	12%	12%	5%	9%	0%
Central Coast (2)	0%	14%	7%	6%	6%	0%	6%	9%
Illawarra (3)	20%	29%	4%	6%	12%	0%	9%	9%
Newcastle (6)	20%	43%	14%	18%	12%	5%	14%	14%
Total (54)	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Continued over page

TABLE 3.3 SLAS WITH EMPLOYMENT LOCATION QUOTIENT GREATER THAN 1 FOR SELECTED INDUSTRIES IN THE GREATER SYDNEY METROPOLITAN REGION BETWEEN 1991 AND 2001 (continued)

Industry	Transport & Storage (I)	Communications Services (J)	Finance & Insurance services (K)	Property & Business Services (L)	Government Administration & Defence (M)	Health & Community Services (O)
No of SLAs in GSMR where LQ>1	14	15	10	22	17	29
For each industry, percentage of SLAs with ELQ>1, that are in each district						
Eastern Core (20)	43%	73%	60%	64%	29%	31%
Western Core (6)	29%	20%	10%	5%	6%	7%
North (5)	0%	0%	10%	23%	0%	10%
South (3)	7%	0%	10%	0%	12%	7%
North-West (5)	7%	0%	0%	5%	18%	7%
South-West (4)	14%	0%	0%	0%	6%	3%
Central Coast (2)	0%	0%	0%	0%	0%	7%
Illawarra (3)	0%	0%	0%	0%	18%	10%
Newcastle (6)	0%	7%	10%	5%	12%	17%
Total (54)	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Continued over page

TABLE 3.3 SLAS WITH EMPLOYMENT LOCATION QUOTIENT GREATER THAN 1 FOR SELECTED INDUSTRIES IN THE GREATER SYDNEY METROPOLITAN REGION, BETWEEN 1991 AND 2001 (continued)

Industry	Education, culture & recreational services	Personal & other services	Knowledge and technology intensive sector
No of SLAs in GSMR where LQ>1	**32**	**31**	**23**
	For each industry, percentage of SLAs with ELQ>1, that are in each district		
Eastern Core (20)	38%	35%	61%
Western Core (6)	3%	0%	9%
North (5)	9%	16%	13%
South (3)	3%	10%	4%
North-West (5)	16%	10%	4%
South-West (4)	6%	6%	0%
Central Coast (2)	6%	6%	0%
Illawarra (3)	9%	6%	0%
Newcastle (6)	9%	10%	9%
Total (54)	**100%**	**100%**	**100%**

Source: Derived by Planning Research Centre, University of Sydney and Bureau of Transport and Regional Economics based on analysis of Australian Bureau of Statistics place and industry of work data from ABS Census of Population and Housing, 2001.

Key results from the employment specialisation analysis summarised in Table 3.3 are as follows.

The retail industry is important for the Greater Sydney Metropolitan Region. In 35 (out of 54) SLAs in the Greater Sydney Metropolitan Region, the retail sector is more important than in the rest of NSW. The employment location quotient (ELQ) for the retailing sector is, for 19 regions out of 54, less than 1.00. For these 19 SLAs retailing is less important (in terms of the employment) than it is (on average) for the state of New South Wales.

For a given industry the percentage of SLAs with ELQ>1 that are in a district is an indication of the nature of industry specialisation in the district. Each district in the

Greater Sydney Metropolitan Region has at least one of the major industries with an ELQ greater than 1. We only mention the top 3 most important specialisations for each district. The percentage in brackets in the following text refers to the percentage of the SLAs in Greater Sydney Metropolitan Region with ELQ>1 for the given industry that are in the particular district. These numbers are shown in the second row of Table 3.4.

Eastern Core

- Communication services (73%);
- Property and business services (64%); and
- Technology and knowledge intensive industries (61%).

Western Core

- Wholesale (30%);
- Transport and storage (29%); and
- Communication services (20%).

North

- Property and business services (23%);
- Personal and other services (16%); and
- Wholesale (15%).

South

- Government administration and defence (12%);
- Construction (12%); and
- Electricity, gas and water supply (12%).

North-West

- Agriculture, forestry and fishing (20%);
- Government administration and defence (18%); and
- Education, culture and recreational services (16%).

South-West

- Agriculture, forestry and fishing (40%);
- Construction (12%); and
- Electricity, gas and water supply (12%).

Central Coast

- Mining (14%);
- Accommodation, cafes and restaurants (9%); and

- Health and community services (7%).

Illawarra

- Mining (29%);
- Agriculture, forestry and fishing (20%); and
- Government administration and defence (18%).

Newcastle

- Mining (43%);
- Agriculture, forestry and fishing (20%); and
- Electricity, gas and water supply (18%).

Some SLAs of the Greater Sydney Metropolitan Region have a number of different industry employment specialisations.

3.4 BASIC (NON-LOCAL) EMPLOYMENT

We undertake further analysis employing a technique proposed by Klosterman et al (1993) where employment in an industry in a given place is decomposed into two categories:

- Basic (or non-local) jobs; and
- Non-basic (or local) jobs.

This technique enables us to identify which of the selected sectors in a district or SLA serve the local market, and which sectors serve a wider (national or possibly international) market. Non-local jobs are important in studies of small area economies because strengthening and growing the local economy is often related to enhancing the basic sector employment. It is also often assumed that the basic sector is the engine of growth of a small area (Klosterman 1990, p. 115). For example it is hypothesised that there is a multiplier effect associated with having non-local jobs in an area. These jobs produce for a market larger than the local area. The export of goods and services from the area has direct and indirect effects. Direct effects include an increase in incomes accruing to those working in the non-local sector. Indirect or second round effects include increase in the demand for other goods as a result of higher incomes in the non-local sector. This in turn leads to increased demand for labour in other sectors in the area. The size of the multiplier effect depends on consuming/saving habits of people in the area. A higher propensity to consume leads to a smaller multiplier effect.

To estimate the number of non-local sub-sector jobs, we use the following relationships:

Basic (i.e. non-local) jobs in the j^{th} industry in a SLA = $(E_{sj}-E_s)*E_j$,

where

s stands for a given SLA;

E_{sj} = (Number of jobs in the j^{th} industry a SLA)/ (Total NSW jobs in the j^{th} industry);

E_s = (Number of jobs in a SLA)/ (Total number of jobs in NSW); and

E_j = (Total NSW jobs in the j^{th} industry).

The detailed estimates of the number of non-local (basic) jobs for each of the 16 ANZSIC Divisions and for each SLA in the Greater Sydney Metropolitan Region are available in a companion electronic database entitled 'A statistical Annex - Greater Sydney Metropolitan Region data: 1991 to 2001' located at the BTRE webpage <www.btre.gov.au>. These estimates are available for 1991 and 2001.

In these detailed estimates, a positive entry indicates the number of non-local jobs in the SLA. A negative entry indicates that for that industry, there are no basic (i.e., non-local) jobs in the SLA in that industry.

Table 3.4 and 3.5 provide a summary of these results for selected industries in the 9 districts.

TABLE 3.4 SLAS WITH BASIC SECTOR EMPLOYMENT IN THE GREATER SYDNEY METROPOLITAN REGION, 2001

District name (Number of SLAs in district)	Manufacturing	Retailing	Technology & knowledge Intensive	Finance, Insurance & Property Business	Construction
	Names of the SLAs with basic sector jobs in different industries				
Eastern Core(N = 21)	Botany Bay, Marrickville, South Sydney, Concord, Strathfield, Ryde & Canterbury (n = 7)	Leichhardt, Waverley, Woollahra, Ashfield, Burwood, Drummoyne, Mosman & Canterbury (n = 8)	Leichhardt, South Sydney, Sydney – Inner, Sydney– Remainder, Randwick, Waverley, Ashfield, Burwood, Concord, Hunters Hill, Lane Cove, Mosman, North Sydney, Ryde & Willoughby (n = 15)	Leichhardt, Sydney – Inner, Sydney– Remainder, Waverley, Woollahra, Burwood, Concord, Drummoyne, Hunters Hill, Lane Cove, Mosman, North Sydney, Ryde & Willoughby (n = 14)	Concord, Drummoyne, Hunters Hill, and Canterbury (n = 4)
Western Core (N = 5)	Auburn, Bankstown, Fairfield, Holroyd & Parramatta (n = 5)	Bankstown & Fairfield (n = 2)	Parramatta (n = 1)	Parramatta (n = 1)	
North (N = 4)		Hornsby, Manly, Ku-ring-gai & Pittwater/Warringah (n = 4)	Hornsby, Ku-ring-gai, & Manly (n = 3)	Hornsby, Ku-ring-gai, & Manly (n = 3)	Hornsby & Pittwater/Warringah (n = 2)
South (N = 4)	Hurstville & Sutherland Shire (n = 2)	Hurstville, Rockdale & Sutherland Shire (n = 3)	Kogarah (n = 1)	Hurstville & Kogarah (n = 2)	Rockdale & Sutherland Shire (n = 2)
North-West (N = 5)	Blacktown, Hawkesbury & Penrith (n = 3)	Baulkham Hills, Blacktown, Blue Mountains, Hawkesbury & Penrith (n = 5)	Baulkham Hills (n = 1)	Baulkham Hills (n = 1)	Baulkham Hills & Hawkesbury (n = 2)
South-West (N = 4)	Campbelltown, Wollondilly & Liverpool (n = 3)	Camden, Campbelltown, & Liverpool (n = 3)			Camden & Wollondilly (n = 2)
Central Coast (N = 2)	Wyong (n = 1)	Gosford & Wyong (n = 2)			Wyong (n = 1)
Illawarra (N = 3)	Wollongong (n = 1)	Kiama, Shellharbour & Wollongong (n = 3)			Kiama & Shellharbour (n = 2)
Newcastle (N = 6)	Cessnock, Lake Macquarie, Newcastle – Inner & Newcastle– Remainder (n = 4)	Cessnock, Lake Macquarie, Maitland, Newcastle– Remainder & Port Stephens (n = 5)	Newcastle –Inner & Newcastle– Remainder (n = 2)	Newcastle – Inner (n = 1)	Lake Macquarie & Maitland (n = 2)
Total 54	**26**	**35**	**23**	**22**	**17**

Continued over page

TABLE 3.4 SLAS WITH BASIC SECTOR EMPLOYMENT IN THE GREATER SYDNEY METROPOLITAN REGION, 2001 (continued)

District name (Number of SLAs in district)	Electricity, Gas and Water supply	Accommodation, Cafés & Restaurants	Transport & Storage	Health and Community services
	Names of the SLAs with basic sector jobs in different industries			
Eastern Core(N = 21)	Sydney–Inner, Sydney–Remainder, Drummoyne, Strathfield, Ryde & Willoughby (n = 6)	Botany Bay, Leichhardt, South Sydney, Sydney–Inner, Sydney–Remainder, Randwick, Waverley, Woollahra, Ashfield, Drummoyne, Hunters Hill & Mosman (n = 12)	Botany Bay, South Sydney, Sydney–Remainder, Randwick, Strathfield & Canterbury (n = 6)	Leichhardt, South Sydney, Randwick, Waverley, Woollahra, Ashfield, Burwood, Hunters Hill, Lane Cove & Ryde (n = 10)
Western Core (N = 5)	Bankstown (n = 1)		Auburn, Bankstown & Holroyd (n = 3)	Parramatta (n = 1)
North (N = 4)		Manly (n = 1)		Hornsby, Manly & Ku-ring-gai (n = 3)
South (N = 4)	Kogarah & Rockdale (n = 2)	Rockdale (n = 1)		Kogarah & Sutherland Shire (n = 2)
North-West (N = 5)	Blacktown (n = 1)	Blue Mountains (n = 1)		Blue Mountains & Penrith (n = 2)
South-West (N = 4)	Wollondilly & Liverpool (n = 2)		Camden & Wollondilly (n = 2)	Liverpool (n = 1)
Central Coast (N = 2)	Wyong (n = 1)	Gosford & Wyong (n = 2)		Gosford & Wyong (n = 2)
Illawarra (N = 3)	Wollongong (n = 1)	Kiama & Shellharbour (n = 2)		Kiama, Shellharbour & Wollongong (n = 3)
Newcastle (N = 6)	Lake Macquarie, Newcastle–Inner & Newcastle–Remainder (n = 3)	Cessnock, Newcastle–Inner & Port Stephens (n = 3)		Cessnock, Lake Macquarie, Maitland, Newcastle–Remainder & Port Stephens (n = 5)
Total 54	**17**	**22**	**11**	**29**

Source: Derived by Planning Research Centre, University of Sydney and Bureau of Transport and Regional Economics based on analysis of Australian Bureau of Statistics place and industry of work data from Census 2001.

TABLE 3.5 PERCENTAGES OF SLAS IN A DISTRICT WITH BASIC SECTOR EMPLOYMENT, 2001

	District names									
District	**Eastern**	**Western**	**North**	**South**	**North-West**	**South-West**	**Central Coast**	**Illawarra**	**Newcastle**	**Total**
Manufacturing	33%	100%	0%	50%	60%	75%	50%	33%	67%	48%
Retail	38%	40%	100%	75%	100%	75%	100%	100%	83%	65%
Technology & knowledge intensive industries	71%	20%	75%	25%	20%	0%	0%	0%	33%	43%
Finance, Insurance; Property and Business	67%	20%	75%	50%	20%	0%	0%	0%	17%	41%
Construction	19%	0%	50%	50%	40%	50%	50%	67%	33%	31%
Electricity, Gas and Water supply	29%	20%	0%	50%	20%	50%	50%	33%	50%	31%
Accommodation, Cafés & Restaurants	57%	0%	25%	25%	20%	50%	50%	33%	50%	41%
Transport & Storage	29%	60%	0%	0%	0%	50%	0%	0%	0%	20%
Health & Community services	48%	20%	75%	50%	40%	25%	100%	100%	83%	54%

Source: Derived by Planning Research Centre, University of Sydney and Bureau of Transport and Regional Economics based on analysis of Australian Bureau of Statistics place and industry of work data from Census 2001.

This section has discussed basic sector employment in selected industries at both the SLA level and at district level. At SLA level we have shown that out of the 9 selected industries the top four in terms of basic employment generation in 2001 were:

- Retail trade is the industry where the majority (35 out of 54) of SLAs had basic employment;
- Health and community services (29 SLAs);
- Manufacturing (26SLAs); and
- Technology and knowledge intensive industries (23 SLAs).

At the district level we show amongst other results that in 4 out of 9 districts every SLA in the district had basic employment in retail.

This analysis is a first step in developing an understanding of industry sector drivers of growth, a topic which is re-visited in chapter 5. A shortcoming of the analysis so far is

that we have focussed on one industry at a time in a one-dimensional model. A one dimensional analysis falls short of providing an explanation of why, for example, some small areas grow while others lag behind. Many of the SLAs which appear in Table 3.4 as having basic employment are also shown in a chapter 5 to belong to fast growing cluster of SLAs. Yet not every SLA included in Table 3.4 is a fast growing SLA. Basic employment is one of many possible explanatory variables for differential growth. Next chapter adopts a multivariate approach in attempting to identify factors that influence growth in SLAs.

Summary

This chapter has used Location Quotients of:

- SLA estimated resident population;
- Aggregate real taxable income; and
- Industry employment.

We have compared each SLA in the Greater Sydney Metropolitan Region with the rest of New South Wales. Using LQ analysis we have been able to distinguish the SLAs which grew faster (slower) than New South Wales with respect to estimated resident population and to aggregate real taxable income. Key outputs from this analysis are two measures of SLA growth. These measures are analysed further in the next chapter in an attempt to identify the factors that explain differences in growth across the SLAs in the study region.

We have also used LQ analysis to understand the industries in which SLAs specialise and to develop estimates of non-local jobs in each SLA. These measures are developed further in the next chapter as part of a multivariate analysis of SLA growth in the Greater Sydney Metropolitan Region.

CHAPTER 4 MULTIVARIATE ANALYSES OF SLA GROWTH

In this chapter we construct regression models expressing growth of a SLA as a function of various factors which affect SLA growth. In these models the measure of growth of a SLA is the dependent or explained variable. The other factors are referred to as the explanatory variables or the independent variables. Although these models deal with the dependence of SLA growth on a set of explanatory factors, *they do not necessarily imply causation*.

The regression models constructed here deal with what is known as the statistical, *not* functional or deterministic, dependence between the explained and explanatory variables. This distinction is important. In functional or deterministic dependence, common in physics for example, it is possible to predict precisely the value of the dependent variable once the values of explanatory variables are known. The models we construct in this chapter deal with statistical relationships between growth of a SLA and the factors that affect SLA growth. In these relationships it is not possible to precisely predict SLA growth for a number of reasons. There may be errors in the measurement of both our explained and explanatory variables. There may also be errors due to misspecification of the models – variables we may have left out due to data being unavailable, for example. Furthermore, even if all variables were perfectly measured, and the models fully specified, the explanatory variables are still likely to be subject to random variation because most of the explanatory variables relate to outcomes from human behaviours which are probabilistic and thus not deterministic in nature.

4.1 THE EXPLAINED VARIABLE: GROWTH OF A SLA

We use two alternative explained variables:

- the average location quotient of SLA aggregate real taxable income (relative to New South Wales) between 1991 and 2001; and
- the average location quotient of SLA estimated resident population (relative to New South Wales) between 1991 and 2001.

Data on these two variables are available in a companion electronic database entitled 'A statistical Annex - Greater Sydney Metropolitan Region data: 1991 to 2001' located at the BTRE webpage <www.btre.gov.au>. A common way to describe growth of an area is

by reference to growth rates (as opposed to location quotients) of an area. The rest of this section describes these more common measures of growth.

Table 4.1 summarises for the 54 SLAs in the study area:

- average annual growth rates of aggregate real taxable income of each SLA in the period from 1991 to 2001; and
- average annual growth rates of estimated resident population for each SLA in the period 1991 to 2001.

Table 4.1 also gives the rank (within the study area) of each SLA based on, respectively:

- the average annual growth in aggregate real taxable income (column two); and
- the average annual growth in estimated resident population (column four). The SLAs in Table 4.1 are sorted in descending order of their aggregate real taxable income growth rates.

The ordering of SLAs generally differs between the two measures of growth. Based on aggregate real taxable income the 10 fastest growing SLAs in the period from 1991 to 2001 were: Sydney–Remainder, Sydney–Inner, Camden, Hunters Hill, Mosman, South Sydney, Liverpool, Woollahra, Leichhardt, and Willoughby.

Two out of the 10 SLAs with the fastest growth in aggregate real taxable income are outer fringe SLAs—Camden and Liverpool.

Based on estimated resident population the 10 fastest growing regions in the period from 1991 to 2001 were: Newcastle–Inner, Kiama, Sydney–Remainder, Sydney–Inner, Mosman, Cessnock, Concord, Auburn, Hawkesbury and Maitland.

The fast growing SLAs based either on aggregate real taxable income or estimated resident population can be divided into:

- Fast growing sea change areas on the coast like Kiama;
- Urban fringe/commuting areas like Hawkesbury; and
- Recovery industrial areas like Liverpool and Newcastle.

The middle ring areas just outside the CBD core area reflect continuing urban transformation with added new migrant populations and gentrification. The next chapter develops a typology of SLAs in Greater Sydney Metropolitan Region and identifies the key attributes for the different SLA types.

TABLE 4.1 AVERAGE ANNUAL GROWTH RATES OF AGGREGATE REAL TAXABLE INCOME AND ESTIMATED RESIDENT POPULATION OF SLAS IN THE STUDY AREA BETWEEN 1991 AND 2001

Name of SLA	Aggregate real taxable income	Aggregate real taxable income Rank 1-54	Estimated resident population Rank 1-54	Estimated resident population Rank 1-54
Sydney–Remainder	21.70%	1	18.66%	3
Sydney–Inner	16.77%	2	16.93%	4
Camden	12.73%	3	6.21%	13
Hunters Hill	10.31%	4	5.37%	15
Mosman	8.85%	5	16.02%	5
South Sydney	8.00%	6	–8.14%	46
Liverpool	7.51%	7	4.18%	17
Woollahra	6.89%	8	6.10%	14
Leichhardt	6.67%	9	–1.03%	38
Willoughby	6.41%	10	0.71%	26
North Sydney	6.32%	11	1.67%	21
Lane Cove	6.14%	12	6.82%	12
Manly	5.81%	13	0.54%	30
Concord	5.65%	14	12.60%	7
Baulkham Hills	5.58%	15	–4.05%	41
Waverley	5.34%	16	–6.89%	42
Drummoyne	5.17%	17	–14.11%	53
Wollondilly	5.00%	18	1.86%	20
Ku-ring-gai	4.34%	19	0.09%	35
Hawkesbury	4.33%	20	11.62%	9
Wyong	4.27%	21	2.34%	19
Gosford	3.85%	22	1.62%	22
Blacktown	3.79%	23	–7.89%	45
Hornsby	3.57%	24	1.18%	24
Kiama	3.50%	25	24.78%	2
Pittwater / Warringah	3.48%	26	0.48%	32
Randwick	3.48%	27	–9.23%	48
Sutherland Shire	3.34%	28	–11.63%	52
Shellharbour	3.31%	29	–7.70%	44
Newcastle–Inner	3.25%	30	27.20%	1
Penrith	2.91%	31	–0.53%	36
Blue Mountains	2.87%	32	–1.28%	40
Port Stephens	2.33%	33	0.41%	34
Kogarah	2.31%	34	0.69%	27
Hurstville	2.28%	35	0.85%	25
Campbelltown	2.18%	36	0.49%	31
Botany Bay	2.15%	37	5.34%	16
Ryde	2.12%	38	–9.75%	51
Maitland	2.02%	39	9.92%	10

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TABLE 4.1 AVERAGE ANNUAL GROWTH RATES OF AGGREGATE REAL TAXABLE INCOME AND ESTIMATED RESIDENT POPULATION OF SLAS IN THE STUDY AREA BETWEEN 1991 AND 2001 (continued)

Name of SLA	Aggregate real taxable income	Aggregate real taxable income Rank 1-54	Estimated resident population	Estimated resident population Rank 1-54
Strathfield	2.00%	40	2.36%	18
Marrickville	1.89%	41	–8.78%	47
Parramatta	1.76%	42	0.68%	29
Ashfield	1.64%	43	–1.03%	39
Auburn	1.45%	44	11.96%	8
Burwood	1.31%	45	9.08%	11
Rockdale	1.23%	46	0.47%	33
Wollongong	1.23%	47	–9.53%	49
Lake Macquarie	1.22%	48	–28.17%	54
Newcastle–Remainder	0.99%	49	–7.07%	43
Fairfield	0.97%	50	–9.75%	50
Bankstown	0.88%	51	1.45%	23
Holroyd	0.79%	52	0.69%	28
Cessnock	0.33%	53	13.80%	6
Canterbury	0.25%	54	–0.65%	37

Source: Derived by Planning Research Centre, University of Sydney and Bureau of Transport and Regional Economics based on analysis of SLA aggregate real taxable income from BTRE (2005), and on analysis of estimated resident population data from 1991 to 2001 from the Australian Bureau of Statistics.

4.2 FACTORS AFFECTING GROWTH OF SLAS

This section discusses factors that previous empirical and/or theoretical studies have identified as affecting growth of an area. In the regression models we build in this chapter, these factors play the role of the explanatory or independent variables. Our aim is to identify factors or variables that are associated with growth of total estimated resident population and/or of aggregate real taxable income in a SLA. These explanatory variables fall in three main groups:

I. Socio-economic variables:

- Population size of a SLA in 1991;
- Income per taxpayer in 1991; and
- Population density in 1991.

II. Proxies for human capital:

- The percentage of a SLA's employed persons, aged 15 years and over, who have a degree or higher qualification in 1991; and
- The percentage of a SLA's employed persons who have a skilled vocational qualification in 1991.

III. Industry-related variables

- Agglomeration of industries in 1991;
- Industry specialisation in 1991;
- Degree of openness of SLAs in 1991; and
- Industry structure of SLAs in 1991.

The next sub-section discusses these explanatory factors in more detail.

4.2.1 Socio-economic variables

A SLA's population size in 1991

The regional research literature, for example, Bradley and Gans (1998), suggests that size of a region influences regional growth in two diametrically opposite ways. First, regions with a large estimated resident population may grow slower because of diseconomies of regional size. A region with a large estimated resident population tends to experience rising housing costs and commuting costs. These factors exacerbate socio-economic differences across the region and may lead to perceived changes in quality of life in a region and contribute to lower growth rates. On the other hand regions with large estimated resident populations can grow faster because of agglomeration effects (Feser, 2001) including improved productivity because of a larger labour pool, and because of inter-industry knowledge spill-overs between co-located industries which can lead to product variety and diversity and overall, better quality of life. It is difficult to determine *a priori* the expected sign of the coefficient of a SLA's initial period estimated resident population size. It may be positive, negative or zero depending on whether the growth enhancing factors are stronger or weaker or counter-balance the growth depressing factors.

Real income per taxpayer in 1991

The justification for including a SLA's initial period real income per tax-payer amongst explanatory variables of growth can be found in BTRE (2005). For example BTRE (2005, p xviii) argues that real income per tax-payer is 'another indicator to track regional and economic change which provides a regional insight into average income and is likely to be especially useful in the understanding of interregional equity issues'.

Elsewhere BTRE (2005, p 78) shows that there is a strong, positive and statistically significant relationship between initial period real income per tax-payer and subsequent growth in an area. We expect the variable to be positive and significant in the aggregate real taxable income regression equation.

Population density in 1991

Australian Bureau of Statistics (2002) suggests that there may be a relationship between population density and population growth of an area. We hypothesise that growth (particularly population growth) will be higher in SLAs which in 1991 had lower population densities.

4.2.2 SLA's human capital in 1991

Recent studies (OECD, 2001a, b, c) and Quiggin (1999) of the role of education, skills and qualifications in regional economic performance suggest that human capital has a favourable impact. In this study we explore the relationship between the growth of a SLA and the following proxies for human capital in a SLA:

- The percentage of a SLA's employed persons, aged 15 years and over, who had a degree or higher qualification in 1991; and
- The percentage of a SLA's employed persons, aged 15 years and over, who had a skilled vocational qualification in 1991.

Unfortunately, for each ABS Population and Housing Census only about 75% of respondents provide complete answers to the education questions. The remainder were either non-respondents or the question was not applicable to them (BTRE 2004). This shortcoming needs to be taken into account when interpreting the results. Based on results in Quiggin (1999), OECD (2001c) for example, we expect these variables to have a positive relationship between a SLA's human capital and SLA growth.

4.2.3 Industry-related variables in a SLA

Industry-based agglomeration in a SLA in 1991

Various theoretical studies (for example, Marshall 1920, Hoover 1937 and Chinitz 1961) have predicted that industry agglomeration has positive impacts on growth of a given area. Bostic et al (1997) proposed a way to construct a measure of industry-based agglomeration. This measure proxies the degree to which an industry's economic activity takes place in one or a small number of geographical areas. The effect of industry-based agglomeration depends on the number, and the sizes (in terms of employment) of industries agglomerated in a SLA. We use the approach by Bostic et al (1997) in defining agglomeration.

A key decision in this method is the choice of threshold value above which an industry is considered to be agglomerated in an area. The choice of threshold value is an

empirical one. In this study an industry in a SLA has to employ 2% or more of the NSW total number of industry jobs to qualify as an agglomerated industry in a SLA. For example, with a threshold of 2%, manufacturing is agglomerated in a given SLA, if the manufacturing jobs in the SLA form 2% or more of the manufacturing sector jobs in NSW. An SLA's 'overall' degree of industry-based agglomeration is then the total employment in agglomerated industries in a SLA divided by the total employment in New South Wales.

Appendix B lists the SLAs in the Greater Sydney Metropolitan Region sorted in descending order of degree of industry-based agglomeration effects. A SLA has low industry-based agglomeration effects when its industrial base is small; or it has a broad, diverse range of industries but with each one of the industries not large enough to pass the threshold test. On the other hand a SLA is likely to have high industry-based agglomeration effects when it has a few large industries, where each one is large enough to meet the threshold test for agglomeration.

The extent to which a region is specialised in 1991

Bradley and Gans (1998), Bostic et al (1997) and Blakely (2004) suggested that specialisation for a SLA is a possible explanatory variable in a regression equation for growth. When specialisation is zero for a SLA, that SLA is diversified (with employment spread evenly across all industries). On the other hand if specialisation has a value of 1 in a SLA, that SLA's employment is fully concentrated in a single industry. We use the formula from Bradley and Gans (1998). Bradley and Gans (1988, p. 269) concluded that for an area, specialisation does have negative risk implications but can also lead to higher productivity due to exploitation of comparative advantage. These earlier studies suggest that specialisation is worth including as a potential explanatory variable in a regression equation for growth of the SLAs in the Greater Sydney Metropolitan Region.

The degree of openness of a region

We defined a variable to proxy for SLA openness as follows:

SLA openness = (Number of basic jobs in SLA)/ (All jobs in SLA).

The distinction between local versus non-local jobs in a SLA is important because it is usually assumed the non-local (basic) jobs are a prime cause of small area growth (Klosterman 1990). Our hypothesis is that SLAs that have a larger number of non-local jobs are likely to grow faster than those that have few such jobs. Section 3.4 described the equation used to estimate the number of non-local jobs. We hypothesise a positive relationship between a region's openness and a SLA's growth.

Industry structure of SLAs in 1991

Much regional literature (for example Bradley and Gans 1998, Blakely & Bradshaw 2002 p. 67, BTRE 2003b) suggest that industry structure affects the rate of growth in a region. To test this hypothesis data on the share of employment in Australian and New

Zealand Standard Industrial Classification (ANZSIC) sectors are used. In the multivariate analysis we focus on the 16 industries at the 1-digit level of ANZSIC. For each SLA we compute the number of people employed in each of the 16 industries as a percent of the total number of people employed in a SLA. The count of people employed in each SLA by industry of employment is derived from the ABS Census place and industry of work data discussed in section 3. The share of employment in the different industries defines the 'industry structure' of a SLA.

4.2.4 District variables

A common way to explore differences between regions in a multivariate analysis is to introduce region-type variables. For example Bradley and Gans (1998), in a model which covers 104 cities in Australia, introduce State variables which are used to investigate whether cities in any one Australian State diverge from the average. District variables take on values of '1' if a SLA falls in that district and '0' if it does not. To explore possible differences in the growth of districts within the Greater Sydney Metropolitan Region we introduce three district variables:

- Sydney Statistical Division (SD) = 1 if an SLA is in the Sydney SD, zero otherwise;
- Newcastle = 1 if an SLA is in the Newcastle district, zero otherwise;
- Illawarra = 1 if an SLA is in the Illawarra district, zero otherwise; and
- Central Coast = 1 if an SLA is in the Central Coast district, zero otherwise.

4.3 STATISTICAL BASIS OF EXCLUDING SOME OF THE EXPLANATORY VARIABLES

The previous section has outlined the theoretical basis for possible explanatory variables in regression models on SLA growth. Not all of these possible explanatory variables are included in the regression models because of technical constraints we briefly explain here. A key statistical requirement for the models we construct in this chapter is that the set of explanatory variables should not be highly correlated. If the variables are highly correlated the regression coefficients have very large standard errors and they cannot be estimated with great precision or accuracy (Gujarati 1995).

To ascertain whether our set of possible explanatory variables is highly correlated we undertook exploratory pair-wise correlation analyses of variables. These results were used to identify pairs of highly correlated explanatory variables. One of the variables in each such pair is excluded from the analysis. On this basis, we excluded four industry structure variables—the % of SLA's employed persons (15 years of age and over) who in 1991 were employed in the following industries:

- Accommodation, cafes and restaurants,

- Finance and insurance,
- Communication services; and
- Personal and other services.

We express growth (relative to NSW) of a SLA between 1991 and 2001 as a linear function of the remaining explanatory variables:

Growth in a SLA (between 1991 and 2001)

$= \alpha_1$ * Logarithm of (estimated resident population in SLA in 1991)

$+ \alpha_2$ * Logarithm of (SLA's real income per taxpayer in 1991)

$+ \alpha_3$ * (SLA's population density in 1991)

$+ \beta_1$ * (% of a SLA's employed persons, aged 15 years and over, who had a degree or higher qualification in 1991)

$+ \beta_2$ * (% of a SLA's employed persons, aged 15 years and over, who had a skilled vocational qualification in 1991)

$+ \pi_1$* (Extent to which a SLA is specialised in 1991)

$+ \pi_2$* (SLA's degree of industry-based agglomeration in 1991)

$+ \pi_3$* (SLA's degree of openness in 1991)

$+ \lambda$* (Industry structure variables in the SLA in 1991)

$+ \delta_1$ * (District variable for Sydney SD)

$+ \delta 2$ * (District variable for Central Coast district)

$+ \delta_3$ * (District variable for Newcastle district)

$+ \delta_4$ * (District variable for Illawarra district)

+ Constant

+ Error term.

We estimated two regression models. One model has as the dependent variable the average estimated resident population location quotient values (with NSW as the reference region) for all SLAs in the Greater Sydney Metropolitan Region. The other equation has as the dependent variable the aggregate real taxable income location

quotient values (with NSW as the reference) for all SLAs in the Greater Sydney Metropolitan Region.

A region like the Greater Sydney Metropolitan Region is a dynamic system, and like many dynamic systems, its development over time exhibits sensitive dependence on initial conditions (Arthur 1988). That is, initial conditions do put a region on a path that cannot be left without some cost. In this study 1991 defines the initial conditions of Greater Sydney Metropolitan Region. Our choice to relate the measures of SLA growth to 1991 values of the explanatory variables embodies our assumption about path dependence. This form of path dependence exists in instances in which sensitivity to starting points exists, but with no implied inefficiency (Liebowitz & Margolis 1995).

4.4 RESULTS FROM MULTIVARIATE ANALYSES

Table 4.2 presents the results of the two regression analyses. In section 4.4.1 we first assess the quality of the regression models by answering some basic questions about each of the regression models:

- How much of the variance in the data does the model explain?
- What is the goodness of fit of the model?
- What is the strength or significance of the relationship between the explained and explanatory variables?

Section 4.4.2 then discusses individual estimates in more detail. This detailed discussion is limited to those variables which are statistically significant. In Table 4.2 the variables which are significant are bold and underlined. No weight or meaning can be attributed to the variables that are not statistically significant. The standard errors associated with these estimates tend to be large making the estimates themselves unreliable.

4.4.1 General observations

The goodness of fit of the regressions

The row labelled ‘Adjusted R-squared’ in Table 4.2 gives a measure of goodness of fit of the two models after adjusting for the number of explanatory variables in the model. The Adjusted R-squared indicates that the aggregate real taxable income equation explains 76.7% of the variance in the data. On the other hand the estimated resident population growth equation explains 62.7% of the variance in the data. Based on the values of the Adjusted R-squared, the equation for aggregate real taxable income growth is a better model than the estimated resident population growth regression. The explanatory power in these regressions is markedly higher than that reported from earlier studies based on Australia-wide data. An example is a study by Bradley and Gans (1998) which reported an Adjusted R-squared of about 50% for an equation comparable to ours. Their study used data on 104 towns across the whole of Australia.

One possible explanation for this difference is that the SLAs in Greater Sydney Metropolitan Region are driven by a common set of factors. It is likely that growth across a more diverse, heterogenous set of regions would be more difficult to explain.

Strength of the relationship between the explained and explanatory variables

Each equation includes 24 explanatory variables. In the aggregate real taxable income equation 14 (out of the 24) explanatory variables were statistically significant. In the estimated resident population growth equation, 11 of the explanatory variables were statistically significant.

TABLE 4.2 SLA AGGREGATE REAL TAXABLE INCOME LOCATION QUOTIENT AND SLA ESTIMATED RESIDENT POPULATION LOCATION QUOTIENTS AS FUNCTIONS OF FACTORS AFFECTING GROWTH BETWEEN 1991 AND 2001

	Aggregate real taxable income			Estimated resident population		
Variables (1991)	**Estimate (a)**	**SE (b)**	**T (c)**	**Estimate (a)**	**SE (b)**	**T (c)**
Adjusted R-squared		**0.767**			**0.627**	
Socio-economic variables						
Logarithm of SLA estimated resident population	**–0.018**	0.004	–4.66	NS	NS	NS
Population density	NS	NS	NS	**–0.027**	0.010	–2.66
Logarithm of real income per taxpayer	**0.080**	0.028	2.83	NS	NS	NS
Proxies for a SLA's human capital measured as % of SLA population (aged 15 years and over) with:						
A university degree or higher qualification	**–0.219**	0.105	–2.08	NS	NS	NS
Skilled vocational training	NS	NS	NS	NS	NS	NS
Industry-related variables						
Degree of industry agglomeration	**1.045**	0.370	2.82	**–6.278**	1.970	–3.19
Specialisation , 1991	**–0.846**	0.295	–2.86	NS	NS	NS
Openness of SLA	**0.063**	0.027	2.27	NS	NS	NS
SLA's industry structure measured as % of SLA population employed in:						
Government Administration & Defence	**0.397**	0.116	3.14	NS	NS	NS

Continued over page

TABLE 4.2 SLA AGGREGATE REAL TAXABLE INCOME LOCATION QUOTIENT AND SLA ESTIMATED RESIDENT POPULATION LOCATION QUOTIENTS AS FUNCTIONS OF FACTORS AFFECTING GROWTH BETWEEN 1991 AND 2001 (continued)

	Aggregate real taxable income			Estimated resident population		
Variables (1991)	**Estimate (a)**	**SE (b)**	**T (c)**	**Estimate (a)**	**SE (b)**	**T (c)**
SLA's industry structure - % of SLA population employed in:						
Education, Cultural & Recreational Services	**0.312**	0.092	3.38	**–1.245**	0.492	–2.58
Construction	**0.510**	0.156	3.26	**–3.434**	0.833	–4.25
Health & Community Services	**0.313**	0.104	3.01	NS	NS	NS
Transport & Storage	**0.372**	0.106	3.48	**–1.198**	0.569	–2.11
Manufacturing	**0.144**	0.068	2.10	NS	NS	NS
Property & Business	**0.377**	0.159	2.37	NS	NS	NS
Mining	**0.408**	0.145	2.87	**–2.602**	0.774	–3.36
Agriculture, Forestry and Fisheries	NS	NS	NS	**2.405**	1.002	2.40
Electricity, Gas & Water	NS	NS	NS	NS	NS	NS
Retail	**0.360**	0.134	2.68	**–1.522**	0.716	–2.13
Wholesale	**0.253**	0.099	2.56	NS	NS	NS
District Indicator variables						
SLA is in Sydney SD	NS	NS	NS	NS	NS	NS
SLA is in Central Coast	NS	NS	NS	NS	NS	NS
SLA is in Newcastle	NS	NS	NS	NS	NS	NS
SLA is in Illawarra	(d)					
Constant	NS	NS	NS	NS	NS	NS

Notes:
a The regression equations were estimated using a STATA linear regression procedure.
b SE stands for standard error of the estimate.
c This column gives T–values computed by dividing the estimate of a coefficient by the standard error of the estimate.
d When there are n indicator variables, estimates can only be derived for n–1 indicator variables. In our case the district variable for Illawarra drops out.
NS Not statistically significant at the 5% level of significance.
Source: Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney.

The entries in the columns headed 'T–values' in Table 4.2 indicate the strength of the relationship between a given explanatory variable and an explained variable. These values summarise the outcome of a well-known test for those variables which are statistically significant (Gujarati 1995, p. 129).

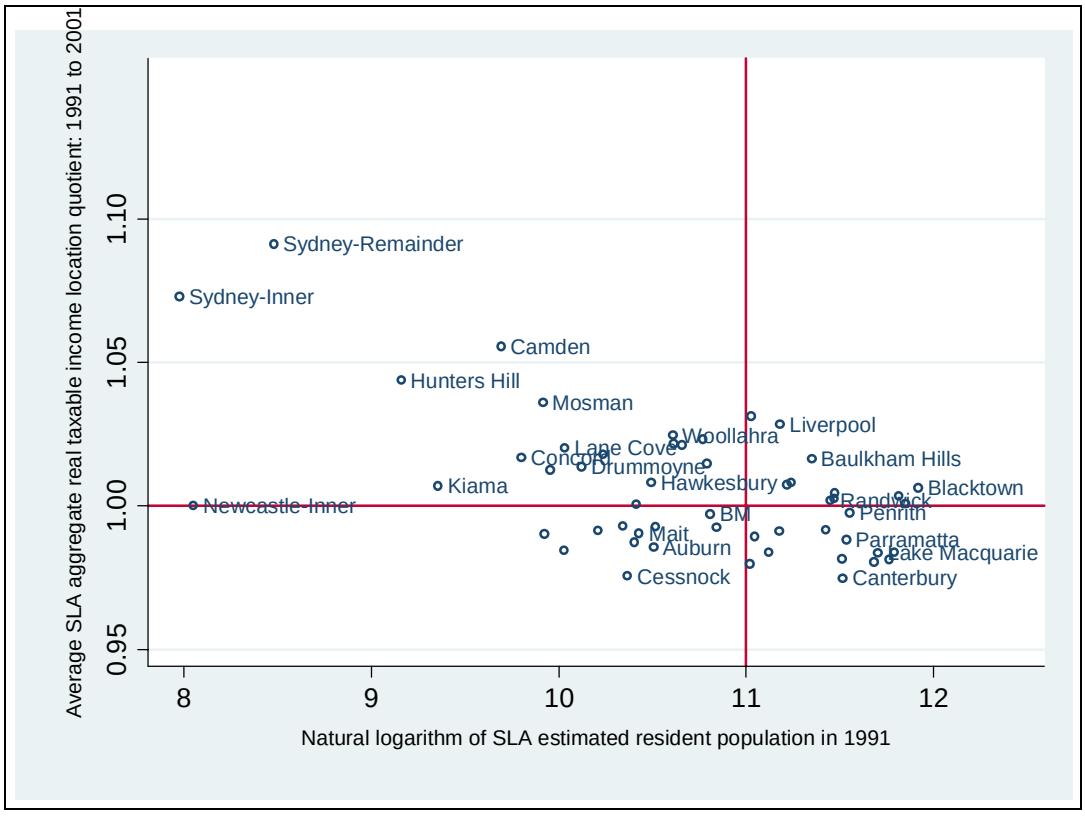
4.4.2 Statistically significant explanatory variables

In this section we discus in more detail those variables that are significant in either the aggregate real taxable income growth equation or in the estimated resident population growth equation, or both. The variables are discussed in the order they appear in Table 4.2.

A SLA's estimated resident population size in 1991

Table 4.2 shows that a SLA's estimated resident population size in 1991 is slightly negatively correlated with the growth in aggregate real taxable income between 1991 and 2001. This result is consistent with the result from Bradley and Gans (1998). Figure 4.1 shows a scatter plot of the natural logarithm of estimated resident population and average SLA aggregate real taxable income location quotients.

FIGURE 4.1 A SCATTER PLOT OF THE RELATIONSHIP BETWEEN THE SLA AGGREGATE REAL TAXABLE INCOME LOCATION QUOTIENT AND THE LOGARITHM OF THE SLA ESTIMATED RESIDENT POPULATION IN 1991



Notes: *The horizontal line where the aggregate real taxable income location quotient = 1 shows the SLAs whose aggregate real taxable income grew at the same pace as the rest of NSW between 1991 and 2001.The vertical line where the natural logarithm of SLA estimated resident population in 1991 = 11 shows the average estimated resident population of SLAs in the Greater Sydney Metropolitan Region in 1991 of 92 481 people.*
The names of SLAs are immediately to the right of their corresponding points on the graph. Some points are not labelled to avoid over-crowding the graph.
BM is short for Blue Mountains, Mait is short for Maitland.

Source: *Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney.*

To get a clearer idea of the impact on the aggregate real taxable income location quotient due to a change in initial (1991) SLA estimated resident population size, we differentiate the aggregate real taxable income regression equation with respect to initial SLA estimated resident population size in 1991 which yields the following:

$$\frac{\partial(Taxable\,income\,LQ)}{\partial(Initial\,SLA\,population\,size)} = -0.018/\,(Initial\ SLA\ population\ size)$$

From this computation, the impact on aggregate real taxable income location quotients of varying the initial estimated resident population size is negative and small irrespective of the size of SLA.

Population density

Australian Bureau of Statistics (2002) suggests that there may be a relationship between population density and the population growth of an area. We hypothesised that growth (particularly population growth) will be higher in SLAs which in 1991 had lower population densities. We would thus expect a significant negative coefficient for the population density variable in the population growth equation. Table 4.2 shows that the estimated coefficient for population density is –0.027 in the estimated resident population regression equation. When we differentiate the estimated resident population LQ regression equation with respect to SLA population density 1991 we get the following:

$$\frac{\partial(Population\,LQ)}{\partial(SLA\ population\ \ density)} = -0.027$$

Population density is measured in thousands of people per square kilometre. Thus an increase by one unit in SLA population density was associated with a 0.027 unit decrease in population LQ. Figure 4.2 shows the relationship between population density and the average estimated resident population location quotient.

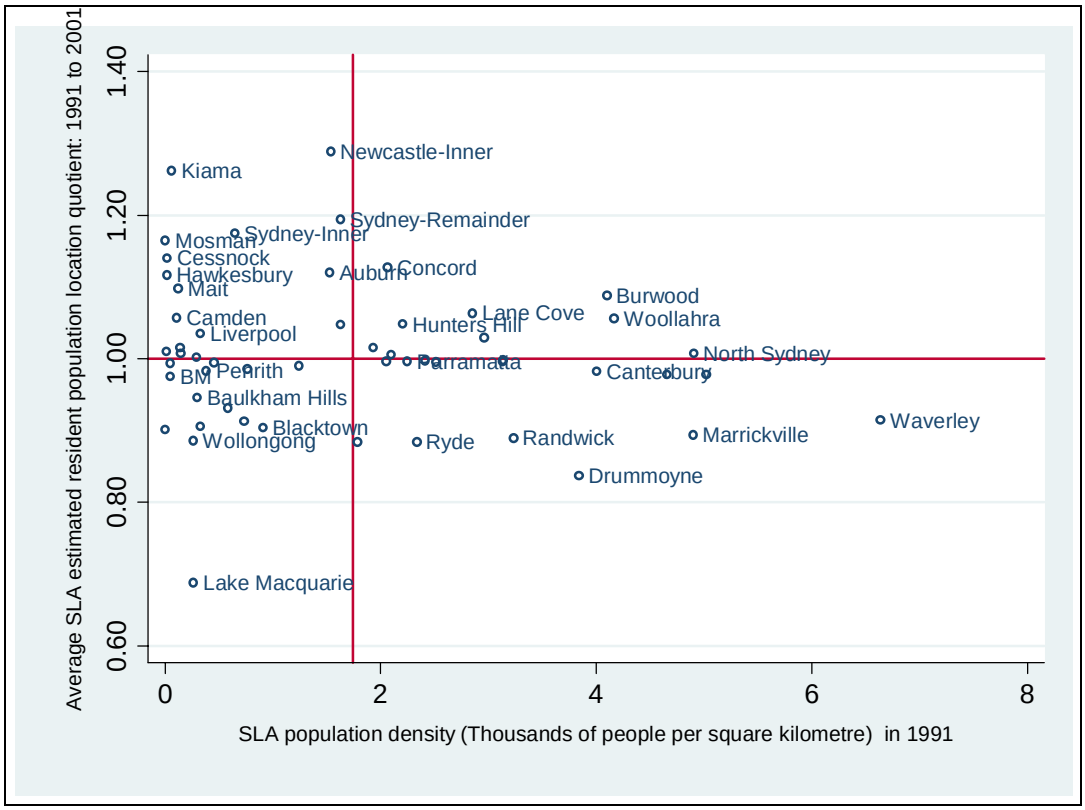
Logarithm of SLA's real income per taxpayer in 1991

In Table 4.2 a SLA's real income per taxpayer in 1991 is significant in explaining growth in aggregate real taxable income between 1991 and 2001, but not growth in SLA estimated resident population in the Greater Sydney Metropolitan Region. Differentiating the aggregate real taxable income regression equation with respect to SLA's income per taxpayer in 1991 gives:

$$\frac{\partial(Taxable\,income\,LQ)}{\partial(SLA's\,real\,income\,per\,taxpayer)} = 0.080/(SLA's\ \ real\,income\,per\,taxpayer)$$

Thus the implications of real income per taxpayer in 1991, for SLA growth are smaller the larger the initial SLA aggregate real taxable income.

FIGURE 4.2 A SCATTER PLOT OF THE RELATIONSHIP BETWEEN THE SLA ESTIMATED RESIDENT POPULATION LOCATION QUOTIENT AND THE SLA POPULATION DENSITY IN 1991



Note: *The horizontal line where the estimated resident population location quotient = 1 shows the SLAs whose estimated resident population grew at the same pace as the rest of NSW between 1991 and 2001.The vertical line where the SLA population density = 1.74 shows the average population density in the Greater Sydney Metropolitan Region in 1991.*
The names of SLAs are immediately to the right of their corresponding points on the graph. Some points are not labelled to avoid over-crowding the graph.
BM is short for Blue Mountains, Mait is short for Maitland.

Source: *Derived by Bureau of Transport and Regional Economics, and Planning Research Centre, University of Sydney.*

The share of a region's employed persons (aged 15 years and over) with a Bachelor's degree or higher qualification

In this study we used the share of a region's employed persons (aged 15 years and over) with a Bachelor's degree or higher qualification as a proxy for a SLA's human capital. Table 4.2 suggests that an increase by one unit in SLA human capital was associated with a decrease by 0.219 units in the aggregate real taxable income location quotient. This result is counter-intuitive and should be interpreted with caution. It may for example be due to poor quality in the data on educational attainment— on average 25 percent of respondents to the Census of Population and Housing do not provide answers to the education question (BTRE 2004). Another possible partial explanation for the result may be the rapid growth in educational attainment during the study period. Between 1991 and 2001 the growth rate of the number of people with a Bachelor's degree or higher qualification in New South Wales was 95%. Furthermore SLAs in major cities in NSW where the share of degree graduates in employed persons

was low in 1991, had higher growth in the number of people with a Bachelor's degree or higher qualification than in the rest of Australia (BTRE 2004).

Degree of industry-based agglomeration in a SLA

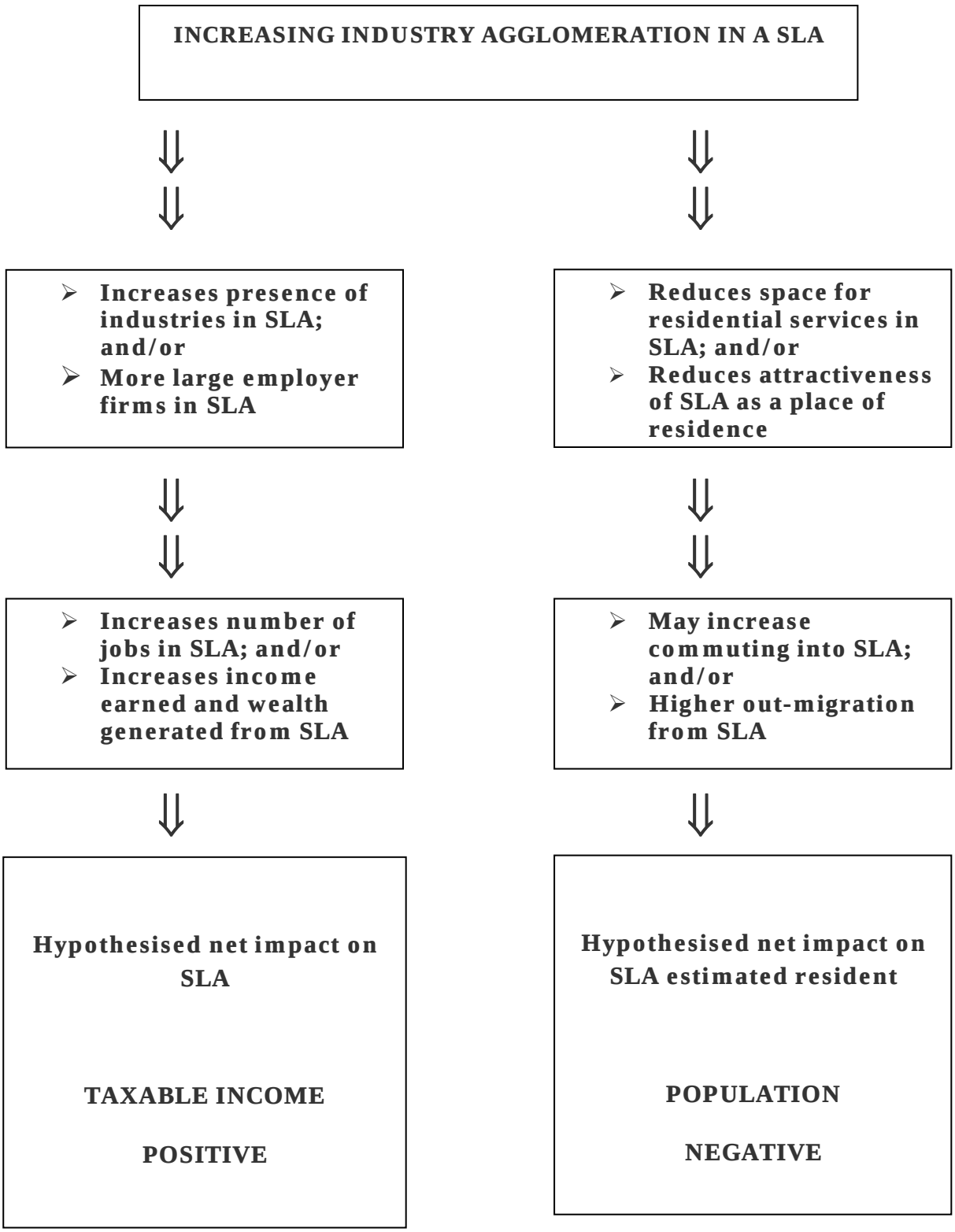
Judging from the t-values in Table 4.2 industry-based agglomeration is one of the most important explanatory variables for both SLA aggregate real taxable income growth and for SLA estimated resident population growth. Figure 4.3 summarises the pathways leading to this variable impacting differently on aggregate real taxable income growth compared to its impact on estimated resident population growth. Essentially in any SLA there is competition for space between needs of industry and the demands for residential space. Increasing industry agglomeration tends to crowd out residential services. In the equation for estimated resident population growth industry-based agglomeration has a *negative* value whereas in the aggregate real taxable income equation it has a *positive* value.

We interpret the estimates of the value of industry-based agglomeration as follows. If a SLA had 1 percentage point higher industry-based agglomeration in 1991, then the SLA's aggregate real taxable income would, on average, have grown 1.045 percent faster (than the rest of NSW) in the period 1991 to 2001. The same SLA would have had its estimated resident population growth reduced by 6.27 percent over the same period.

The extent to which a region is specialised

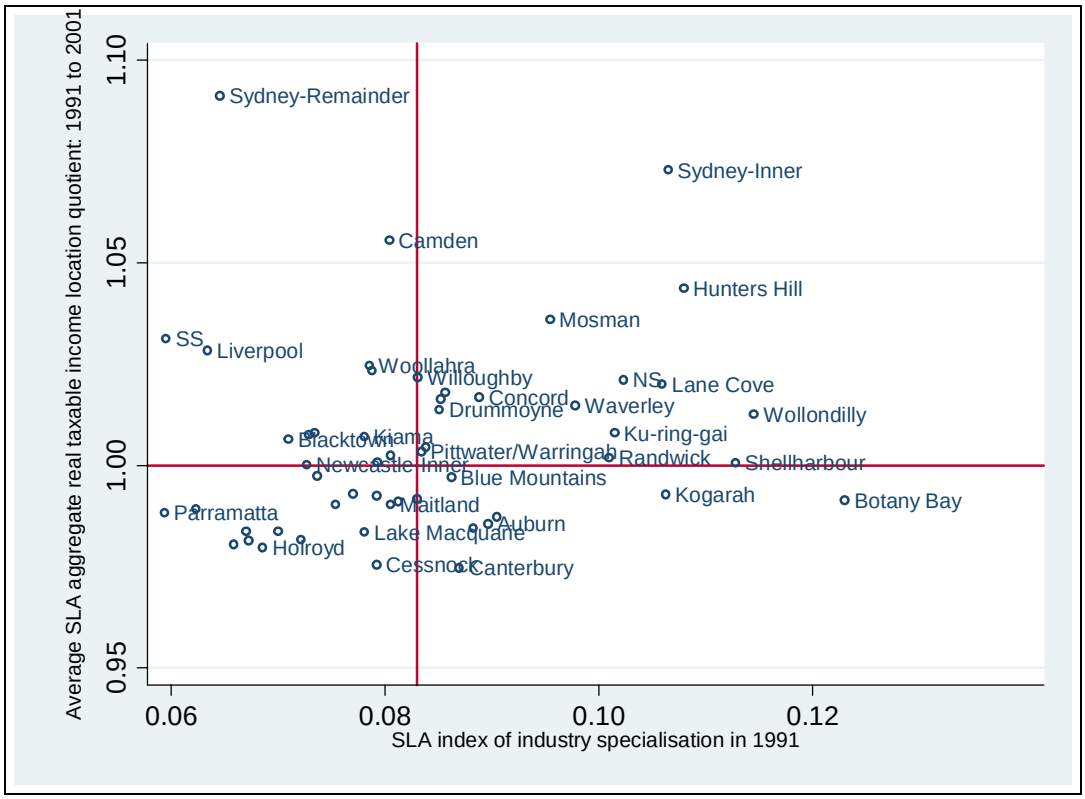
In the aggregate real taxable income regression equation, in Table 4.2 we find that the extent to which a region was specialised in 1991 is negatively correlated with a SLA's growth in aggregate real taxable income, in the period 1991 to 2001. Our result is consistent with results from Bradley and Gans (1988 p. 274). However the result differs from BTRE (2003b) which related industrial diversity to aggregate real taxable income growth in 425 Australian labour market regions and found the variable was not statistically significant. Kaufman (1993) also noted that there is little empirical evidence of a direct relationship between specialisation and the economic performance of regions, but that there is more empirical support for the argument that industrial diversity is positively related to the stability of regional performance. Figure 4.4 shows a scatter plot of the specialisation index against the average SLA aggregate real taxable income location quotient.

FIGURE 4.3 HOW INDUSTRY AGGLOMERATION AFFECTS THE SLA AGGREGATE REAL TAXABLE INCOME AND THE SLA ESTIMATED RESIDENT POPULATION



Source: *Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney.*

FIGURE 4.4 A SCATTER PLOT OF THE RELATIONSHIP BETWEEN THE SLA AGGREGATE REAL TAXABLE INCOME LOCATION QUOTIENT AND THE INDUSTRY SPECIALISATION INDEX IN 1991



Note: *The horizontal line where the aggregate real taxable income location quotient = 1 shows the SLAs whose incomes grew at the same pace as the rest of NSW between 1991 and 2001.The vertical line where the SLA industry specialisation index = 0.083 shows the average level of industry specialisation in the Greater Sydney Metropolitan Region in 1991*
The names of SLAs are immediately to the right of their corresponding points on the graph. Some points are not labelled to avoid over-crowding the graph.
SS is short for South Sydney. NS is short for North Sydney and Hawk is short for Hawkesbury.

Source: *Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney.*

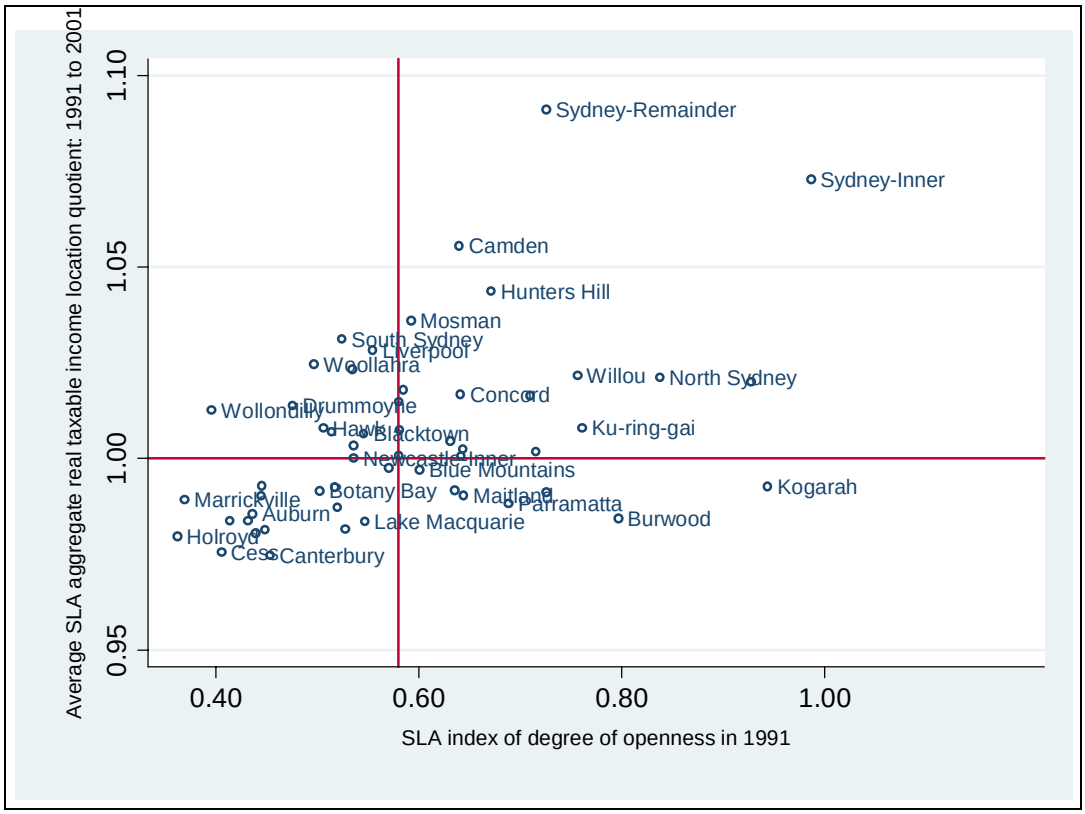
The degree of openness of a region

We defined a variable to proxy for SLA openness as follows:

SLA openness at time t = (Number of basic jobs in SLA)/ (All jobs in SLA).

Degree of openness is a significant variable in explaining growth of aggregate real taxable income of a SLA. SLAs which were more open in 1991 had their aggregate real taxable income grow faster by 0.063 percentage points in the period from 1991 to 2001. The variable was insignificant in the estimated resident population growth regression equation. Figure 4.5 is a scatter plot of the relationship between SLA aggregate real taxable income location quotients and SLA openness.

FIGURE 4.5 A SCATTER PLOT OF THE RELATIONSHIP BETWEEN THE SLA AGGREGATE REAL TAXABLE INCOME LOCATION QUOTIENT AND THE DEGREE OF SLA OPENNESS IN 1991



Note: *The horizontal line where the aggregate real taxable income location quotient = 1 shows the SLAs whose incomes grew at the same pace as the rest of NSW between 1991 and 2001.The vertical line where the SLA degree of openness = 0.58 shows the average level of SLA openness in the Greater Sydney Metropolitan Region in 1991.*
The names of SLAs are immediately to the right of their corresponding points on the graph. Some points are not labelled to avoid over-crowding the graph.
Penrith is represented by the scatter point immediately to the left of the point for Blue Mountains
Willou is short for Willoughby, N Sydney is short for North Sydney, Port St is short for Port Stephens and Hawk is short for Hawkesbury.

Source: *Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney.*

The industry structure of SLAs in 1991

As indicated previously we dropped 4 of these industries out of the analysis because they were highly correlated with one or more of the other independent variables. These four were Accommodation, cafes and restaurants; Communication services; Finance and insurance services; and Personal and other services. Ten of the 12 remaining industry structure variables are significant in the aggregate real taxable income growth equation. In Table 4.2 the following variables are all positively correlated with growth in a SLA's aggregate real taxable income:

- Government administration and defence;
- Educational, cultural and recreational services;
- Construction;

- Health and community services;
- Transport and storage;
- Manufacturing;
- Property and business services;
- Mining;
- Retail trade; and
- Wholesale trade.

In Table 4.2 the following six of the 12 remaining industry structure variables are significant in the estimated resident population growth regression:

- Educational, cultural and recreational services (negative);
- Construction (negative);
- Transport and Storage (negative);
- Mining (negative);
- Retail services (negative); and
- Agriculture, Forestry and Fisheries (positive).

Not much weight can be placed on the positive result for Agriculture, forestry and fisheries, because this industry is very small for most SLAs in the Greater Sydney Metropolitan Region. Figure 4.3 is relevant in interpreting the negative significant coefficients for industry structure variables in the estimated resident population growth regression equation. A one unit increase in the employment shares of any industry in a given SLA while improving the SLA's attractiveness as a place of work tends to reduce space for residential services and to reduce the attractiveness of the SLA as a place of residence which in turn leads to a reduction in the estimated resident population LQ for the SLA.

We use the estimate for the employment share of Government administration and defence to indicate how one can interpret the estimates for the coefficients of the industry structure variables. In Table 4.2, the variable representing the number of people employed in Government administration and defence as a percentage of a SLA's employed persons is not statistically significant in the estimated resident population growth equation. We find though that the variable has a positive and statistically significant coefficient in the aggregate real taxable income regression equation. Differentiating the aggregate real taxable income regression equation with respect to

the employment share of 'Government administration and defence' in SLA in 1991 equals 0.397. Thus a one unit increase in the employment share of 'Government administration and defence' in a SLA was associated with an increase of 0.397 points in the SLA's aggregate real taxable income location quotient.

District variables

None of the district variables were significant. Nonetheless we left them in both models because when we exclude them the estimates and level of significance of a number of other important variables are affected. This treatment of dummies in these types of models is common in the literature (for example see Bradley & Gans 1998).

Summary

This study has used data fine grained to a particular SLA in a complex economic web to identify drivers of growth in the Greater Sydney Metropolitan Region. We use simple techniques and apply them in a tiered fashion so the vagaries of a single analytical template do not give false response or easy answers for complex problems. These techniques can be fashioned to any region under study as long as reasonable data are available. In this chapter we constructed regression models expressing growth of a SLA as a function of various factors which affect SLA growth. Although these models deal with the dependence of SLA growth on a set of explanatory factors, they do not necessarily imply causation.

We concluded that the aggregate real taxable income regression model is a superior model for explaining SLA growth. The report also identifies which factors were statistically significant in explaining growth of SLAs

SLA growth in aggregate real taxable income

The study suggests that important factors that explain differential growth in aggregate real taxable income at SLA level include

- the human capital stock of an area – estimated as the percentage of employed persons (aged 15 and over) in an SLA with a bachelor's degree or higher qualification;
- the real income per taxpayer in a SLA;
- the size of a SLA as measured by estimated resident population;
- the degree of agglomeration of industries in a SLA;
- the degree of industry specialization;
- the degree of openness of an area; and

- the industry structure of an area.

The coefficients of the employment shares of these sectors in the aggregate real taxable income regression equations have positive values implying that the higher the employment shares of these sectors in a SLA the higher the growth in SLA aggregate real taxable income. The industry structure variables that the study finds important in the aggregate real taxable income equation were the percentage of employed people who work in the following sectors

- Government administration and defence;
- Construction;
- Health and community services;
- Manufacturing;
- Property and business;
- Wholesale trade;
- Education, culture and recreation;
- Transport and storage;
- Mining; and
- Retail trade.

The coefficients of the employment shares of these sectors in the aggregate real taxable income regression equations have positive values implying that the higher the employment shares of these sectors in a SLA the higher the growth in SLA aggregate real taxable income

SLA growth in estimated resident population

The study suggests that important factors that explain differential growth in estimated resident population at SLA level include

- population density of a SLA;
- the degree of agglomeration of industries in a SLA; and
- the industry structure of an area.

The industry structure variables that the study finds important in the aggregate real taxable income equation were the percentage of employed people who work in the following sectors:

- Construction;
- Education, culture and recreation;
- Transport and storage;
- Mining;
- Retail trade; and
- Agriculture, fisheries and forestry.

The coefficients of the employment shares of these sectors (except for Agriculture, forestry and fishing) in the estimated resident population regression equations have negative values implying that the higher the employment shares of these sectors in a SLA the lower the growth in SLA estimated resident population. The exception to this interpretation in the estimated resident population regression is Agriculture, forestry and fishing for which the coefficient is positive.

The chapter identified which factors were statistically significant in explaining growth of SLAs. The report also identifies which factors were statistically significant in explaining growth of SLAs.

CHAPTER 5 CONTRASTING STRONG WITH WEAKLY PERFORMING SLAS

A major question in this study is: What is the difference between strongly performing and weakly performing SLAs in the Greater Sydney Metropolitan Region?

There are different methods one can adopt to explore this question (see for example Barreto & Hughes 2004). The choice of method is often dependent on the problem at hand. In this study, we use two different methods to summarize information about SLAs in the Greater Sydney Metropolitan Region in such a way as to identify SLA groupings which have broadly similar growth profiles. The two methods are:

- An enhanced scatter plot method; and
- Ward's Cluster analysis method.

The advantage of the enhanced scatter plot method is that it is non-econometric in nature and easy to use and interpret. Mikelbank (2006) recently applied a similar approach in a US context. While the cluster analysis is more complex its main advantage is that it is an established exploratory data analysis tool which aims to sort different objects into groups in such a way that the degree of association between two objects is maximal if they belong to the same group and minimal otherwise.

The major weakness common to both methods is that while they can be used to discover structures in data, they do not provide an explanation or theoretical justification for those structures. Both methods have no theoretical underpinnings in economics or regional science. They simply discover structures in data without explaining why they exist. Despite this weakness the groupings of SLAs generated by the two approaches throw some light on the differences between levels of growth in the SLAs in the Greater Sydney Metropolitan Region. The use of two methods leads to differences in SLA group membership. This is a form of sensitivity analysis or a test of robustness of SLA groupings with respect to choice of method. The rest of the chapter is divided up as follows:

- Section 5.1 briefly describes the two approaches used to develop groupings of SLA in the Greater Sydney Metropolitan Region.
- Section 5.2 provides a comparison of SLA types based on key variables discussed in chapters 2 to 4 of the report.

- Section 5.3 identifies the key industry drivers in each of the 9 districts for the groupings derived using Ward's clustering method.

5.1 GROUPING SLAS WITH SIMILAR GROWTH PROFILES

The enhanced scatter plot method

Under this method we undertake a scatter plot graph of two variables:

- SLA aggregate real taxable income location quotient (on the vertical axis), and
- SLA estimated resident population location quotient (on the horizontal axis).

We super-impose two additional lines on the scatter plot graph which in turn divide the scatter plot into four quadrants. The first line is a horizontal line showing points where SLA aggregate real taxable income location quotient = 1. If a SLA falls along this line, that SLA's aggregate real taxable income grew at the same rate as NSW for the period from 1991 to 2001. The second line is a vertical line showing points where SLA estimated resident population location quotient = 1. If a SLA falls along this line, that SLA's estimated resident population grew at the same rate as NSW for the period from 1991 to 2001.

This method thus divides the scatter plot into four quadrants as follows.

Under the first method—the enhanced scatter plot method—there is stronger researcher control in the definition of the groupings of SLAs are defined as follows

Categories as defined by the enhanced scatter plot method	
Established/mature SLAs: • Aggregate real taxable income growing faster than NSW • Estimated resident population growing slower than NSW	**Globally exposed SLAs:** • Aggregate real taxable income growing faster than NSW • Estimated resident population growing faster than NSW
Declining SLAs: • Aggregate real taxable income growing slower than NSW • Estimated resident population growing slower than NSW	**Transitional SLAs:** • Aggregate real taxable income growing slower than NSW • Estimated resident population growing faster than NSW

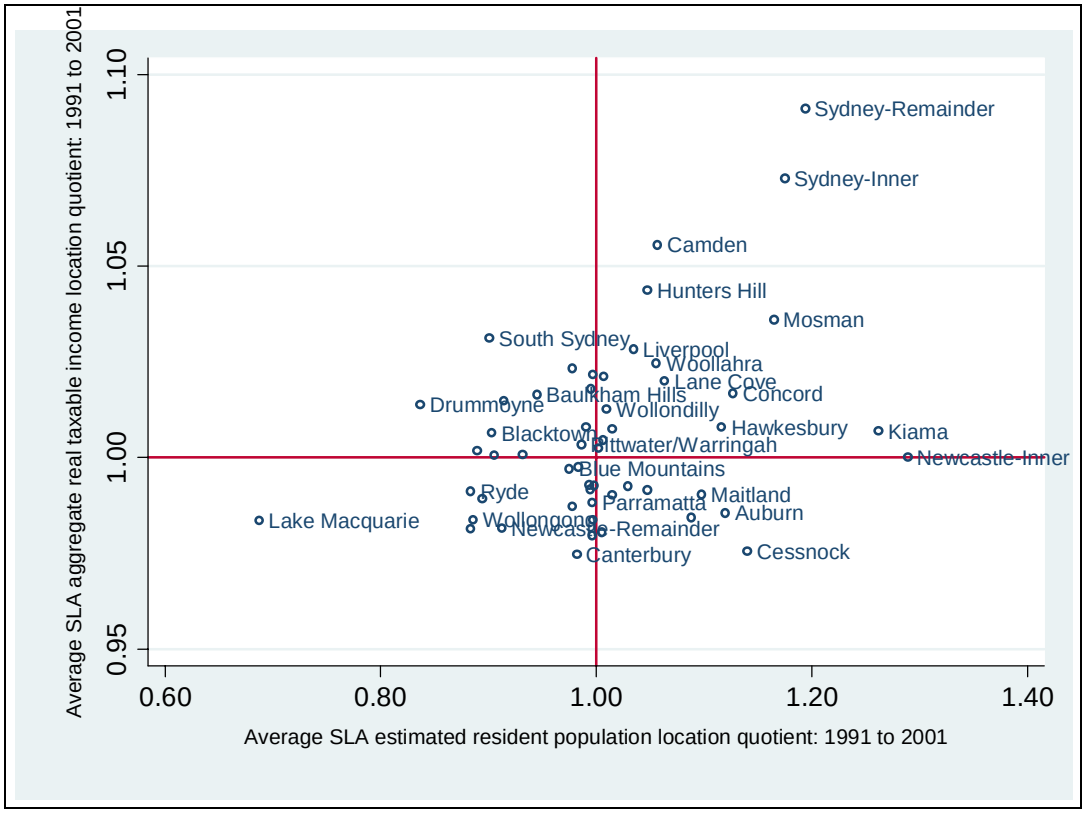
Figure 5.1 summarises the output of this method where:

- Globally exposed SLAs fall in the upper right quadrant of Figure 5.1;

- Established/mature SLAs fall in the upper left quadrant of Figure 5.1;
- Transitional SLAs are listed in the lower right quadrant of Figure 5.1; and
- The declining SLAs fall in the lower left corner of Figure 5.1.

Each one of these SLA grouping is described below after we discuss the second method.

FIGURE 5.1 USING THE ENHANCED SCATTER PLOT APPROACH TO GROUP SLAS IN THE GREATER SYDNEY METROPOLITAN REGION BETWEEN 1991 AND 2001



Note: *The horizontal line where the aggregate real taxable income location quotient = 1 shows the SLAs whose aggregate real taxable income grew at the same pace as the rest of NSW between 1991 and 2001. Similarly, the vertical line where the estimated resident population location quotient = 1 shows the SLAs whose estimated resident population grew at the same pace as the rest of NSW between 1991 and 2001.*
The names of SLAs are immediately to the right of their corresponding points on the graph. Some points are not labelled with SLA names to avoid over-crowding the graph.

Source: *Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney.*

The labels we gave to these groups were convenient as a summary tool but we use them cautiously. They should not be interpreted as if all the SLAs in a category were identical in all aspects. Each one of the labels is more descriptive of those SLAs in the centre of the category, and the descriptive power of the label is reduced for SLAs that are closer to the borders of a category.

In Figure 5.1 Lake Macquarie SLA is an outlier. An Outlier is a statistical term which refers to an observation in a distribution of data that deviates so much from the other observations as to arouse suspicions that it was generated by a different mechanism, and therefore discarding of the observation might be considered. In this analysis we do not discard the observation but we note that this SLA is significantly different from the other SLAs in this grouping.

Ward's cluster method

We also applied cluster analysis to identify sub-groups of SLAs which have a distinctive profile in terms of growth. The aim is to identify SLA groupings which have broadly similar growth profiles. A supplementary aim in applying cluster analysis was to undertake a sensitivity analysis/robustness testing on the groupings identified using the enhanced scatter plot method. STATA (2005) describes various cluster analysis methods. We applied Ward's hierarchical cluster method. A key output of a hierarchical cluster analysis method is a tree like structure describing how the different objects (SLAs in our case) are related to each other.

Each clustering method allows a variety of 'dissimilarity measures'. These measures are used within the cluster analysis algorithms to distinguish between objects under study. We use the Euclidean distance as our dissimilarity measure. The Euclidean distance is the straight line distance between two points (Black 2004). We applied Ward's cluster method on the two measures of SLA growth:

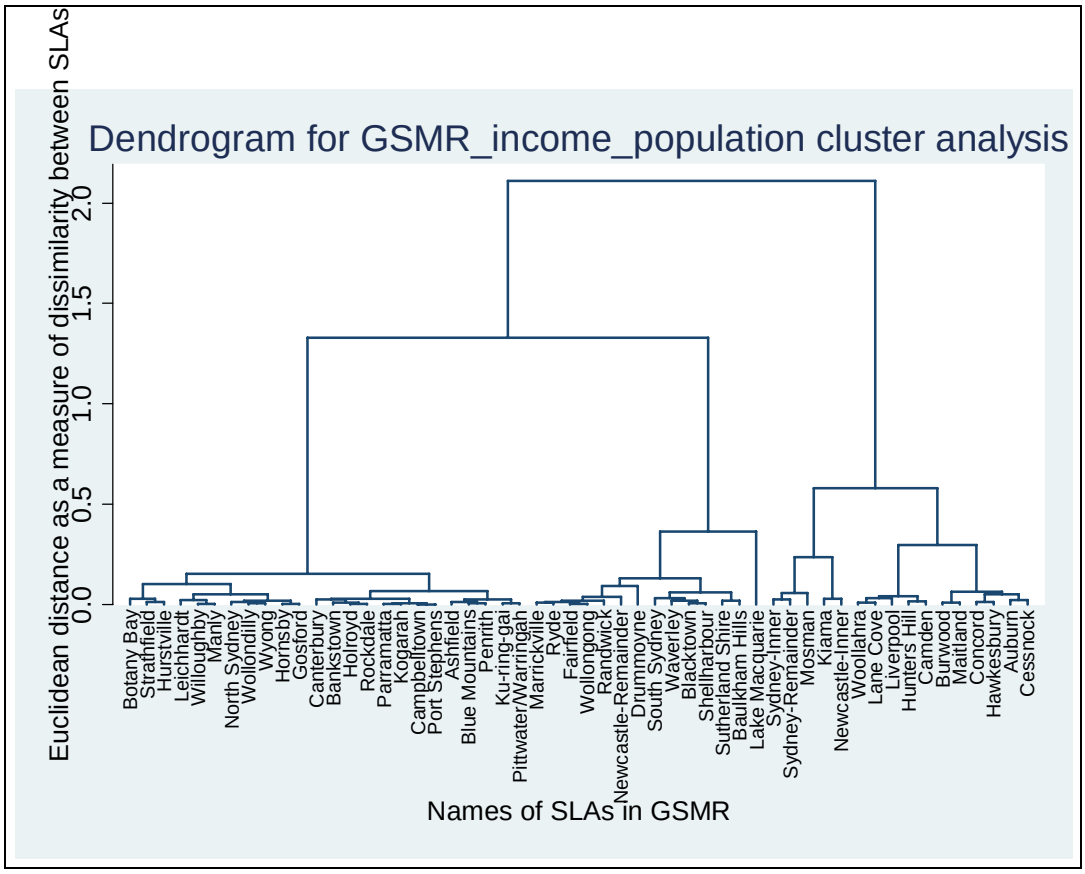
- SLA aggregate real taxable income location quotient; and
- SLA estimated resident population location quotient.

These variables have similar units and thus did not require further transformation before applying the cluster analysis method.

Using Ward's clustering method, we get four groupings. Compared to the enhanced scatter plot method, Ward's cluster method gives much greater emphasis on estimated resident population in defining the groupings because there is greater variation in SLA growth profiles in the population dimension than there is in the income dimension. The difference between the minimum (0.907) and maximum (2.184) of the estimated resident population location quotient is 1.277. In comparison, the difference between the minimum (0.975) and maximum (1.101) of the aggregate real taxable income location quotient is just 0.127. Thus according to Ward's cluster method SLAs in the Sydney Greater Metropolitan Region are more clearly differentiated with respect to estimated resident population growth than they are with respect to growth in aggregate real taxable income. Since within the group of 54 SLAs in the Greater Sydney Metropolitan Region there is more variation in the estimated resident population location quotient than in the aggregate real taxable income location quotient, the

estimated resident population location quotient plays a more dominant role in the cluster tree in Figure 5.2.

FIGURE 5.2 USING WARD'S HEIRARCHICAL CLUSTER METHOD TO GROUP SLAS IN THE GREATER SYDNEY METROPOLITAN REGION BETWEEN 1991 AND 2001



Note: GSMR stands for Greater Sydney Metropolitan Region.

Source: Derived by Bureau of Transport and Regional Economics using STATA statistical software command for Ward's linkage cluster method.

Unlike in the enhanced scatter plot method, each of the groupings of SLAs under Ward's cluster method has some SLAs with incomes growing faster than NSW and other SLAs with incomes growing slower than NSW.

Ward's cluster method uses both the SLA estimated resident population location quotient and the SLA aggregate real taxable income location quotient in the computation of the measure of dissimilarity between SLA groupings. However, the method leads to groupings of SLAs which are not very different from a simple ranking of SLA estimated resident population location quotient as shown below:

Categories as defined by Ward's cluster method	
Established/mature SLAs: • Estimated resident population location quotient ranging between 1.036 and 1.27 4 • Aggregate real taxable income location quotient ranging from 0.976 to 1.056	**Globally exposed SLAs:** • Estimated resident population location quotient ranging from 1.311 to 2.184 • Aggregate real taxable income location quotient ranging from 1.001 to 1.086
Declining SLAs: • Estimated resident population location quotient ranging between 0.907 and 0.963 • Aggregate real taxable income location quotient ranging from 0.982 to 1.032	**Transitional SLAs:** • Estimated resident population location quotient ranging between 0.979 and 1.016 • Aggregate real taxable income location quotient ranging from 0.975 to 1.024

While the cluster analysis is more complex its main advantage is that it is an established exploratory data analysis tool which aims to sort different objects into groups in such a way that the degree of association between two objects is maximal if they belong to the same group and minimal otherwise.

The key output from the cluster analysis is a cluster tree (dendrogram) of the 54 SLAs and is reproduced in Figure 5.2. On the vertical axis in Figure 5.2 is information about the levels of dissimilarity between the branches on the cluster tree. At the bottom of the dendrogram, each SLA is its own cluster. One can generate different numbers of clusters depending on the level of dissimilarity at which one undertakes the cluster count. At the highest level of dissimilarity (which in Figure 5.2 is about 1.5) there are two major clusters. We choose to take the count of clusters at the dissimilarity level of 0.5. At that level, there are four cluster groups. A tighter interpretation of Figure 5.1 gives 5 clusters. The fifth cluster has only one SLA, Lake Macquarie, which as indicated earlier is an outlier. Instead of 5 groupings we place Lake Macquarie in the declining grouping of SLAs—the grouping of SLAs to which it is closest out of the 4 SLA groupings.

We use the same names for SLA groupings derived by Ward's cluster as we gave to the groupings derived by the enhanced scatter plot method for two main reasons. First, this naming convention was adopted for economy and simplicity in presentation. This naming convention focuses on four main groupings. The SLA membership of the groupings differs depending on how the groupings are derived. Secondly, and more importantly, there is overlap between some of the groupings across the two methods. For example the SLAs in the globally exposed grouping by Ward's cluster method are a

subset of the globally exposed grouping by the enhanced scatter plot method. Similarly, there is some overlap between the transitional and the declining groupings of SLAs by Ward's cluster method and the transitional and the declining groupings of SLAs by the enhanced scatter plot method.

In the rest of this chapter we distinguish between the different groupings by adding the method of derivation as a qualifier to the names of groupings. The study shows that the 54 SLAs in the study area can be classified into 4 categories with very different growth experiences. The four SLA groupings are:

Globally exposed

Enhanced scatter plot method: The label 'globally exposed' describes a group of the fastest growing SLAs in the region with their location quotients (LQ) for both estimated resident population and aggregate real taxable income relative to New South Wales greater than one in the period from 1991 to 2001. If a SLA has LQ greater than one relative to NSW for both estimated resident population and aggregate real taxable income, that SLA's share in both estimated resident population and aggregate real taxable income grew during the study period. The number of SLAs in this group was 17 based on the enhanced scatter plot method.

While the name 'globally exposed' is used as a convenient label for this group of SLA, it must be interpreted with caution. Australia is an open economy, and as a trading nation almost every region in Australia is globally exposed. So the term 'globally exposed' can also be interpreted to mean 'very fast growing' in the double edge sense of both fast estimated resident population growth accompanied by fast growing aggregate real taxable income.

Ward's cluster method: Under this method the number of SLAs in this group was 5. These were the five SLAs with the fastest growing estimated resident populations — Newcastle Inner, Kiama, Mosman, Sydney Remainder and Sydney Inner. This group of 5 SLAs is a subset of the grouping of the globally exposed SLAs identified by the enhanced scatter plot method. Ward's cluster method, however, excludes many SLAs which are growing faster than NSW but which are not outstanding. This group of 5 globally exposed SLAs stands out from the rest of the SLAs on most indicators, but especially with respect to real income per taxpayer; human capital; SLA openness; and the share of knowledge and technology intensive jobs.

Established/mature

Enhanced scatter plot method: This is a grouping of SLAs which have location quotients for *aggregate real taxable income relative to New South Wales greater than 1*, but their location quotients for *estimated resident population relative to New South Wales less than 1*. These SLAs increased their share of aggregate real taxable income in New South Wales, but had static or declining estimated resident population shares due

to various socio-economic changes, life-cycle factors and changes in household composition in the SLAs. Factors that could be contributing to slow estimated resident population growth include children leaving home as young adults, break-up of family units due to separation/divorce, or death of partners. Under this method there are 13 SLAs in this group.

Ward's cluster method: Under this method this grouping comprises of the next batch of 11 SLAs with fast growing estimated resident population—Cessnock, Concord, Auburn, Hawkesbury, Maitland, Burwood, Lane Cove, Woollahra, Camden, Hunters Hill and Liverpool. All the SLAs included in this group by this method have *estimated resident population location quotients greater than 1*. While they are growing faster than NSW they are in a class lower than the top 5 in the globally exposed SLAs. The text in italics under the two methods shows that the two methods are using different, diametrically opposed rules in allocating SLAs to this grouping. The 11 SLAs in this group include:

- Seven SLAs classified amongst the globally exposed SLAs by the other method. Ward's cluster method shifts them to this slower category because their populations grew markedly slower than those for the top 5.
- Four of the 11 SLAs in this group *have aggregate real taxable income location quotient less than 1* which the enhanced scatter plot method puts in the transitional SLA grouping.

Transitional

Enhanced scatter plot method: This is a grouping of SLAs which have location quotients for aggregate real taxable income relative to New South Wales less than one, but their location quotients for estimated resident population relative to New South Wales greater than one.

Ward's cluster method: Under this method there are 24 SLAs in this group all of which have values of the estimated resident population location quotient around 1.0. The range of population location quotient in this group is from 0.978 to 1.063. This method includes in the group SLAs whose population location quotient is either marginal below or marginally above 1.0. Thus under this method this grouping comprises SLAs which are not significantly different in growth profile from the rest of New South Wales. About 44% (24 SLAs) are allocated to this group and are related in the following way with the categories developed using the other method:

- 5 were classified amongst the globally exposed SLAs by the enhanced scatter plot method;
- 11 were classified amongst the declining SLAs by the enhanced scatter plot method;

- 5 were classified amongst the established/mature SLAs by the enhanced scatter plot method;

The two methods agree on 3 of the 24 classified as transitional.

Declining

Enhanced scatter plot method: This is a group of the 17 slowest growing SLAs in the region with their location quotients for both estimated resident population and aggregate real taxable income relative to New South Wales less than one. If a SLA has LQ less than one relative to NSW for both estimated resident population and aggregate real taxable income, that SLA's share in both estimated resident population and aggregate real taxable income declined during the study period.

Ward's cluster method: Under this method this grouping is made up of the 14 SLAs with the slowest growing estimated resident population. These include:

- 6 SLAs which are classified as declining by both methods—Marrickville, Ryde, Fairfield, Wollongong, Lake Macquarie and Newcastle Remainder; and

- 8 which the enhanced scatter plot method puts in the Established/mature grouping of SLAs—Randwick, South Sydney, Waverley, Drummoyne, Sutherland Shire, Blacktown, Baulkham Hills and Shellharbour.

Under the Ward's cluster method every SLA in this group has estimated resident population location quotient significantly less than 1.0—the maximum population location quotient is 0.963. However, unlike in the enhanced scatter plot method some of the SLAs included in this grouping have aggregate real taxable income location quotients greater than 1—the maximum aggregate real taxable income location quotient is 1.032.

The labels given to these categories were convenient as a summary tool but we use them cautiously. They should not be interpreted as if all the SLAs in a category were identical in all aspects. Each one of the labels is more descriptive of those SLA in the centre of the category, and the descriptive power of the label is reduced for SLAs that are closer to the borders of a category.

From a statistical perspective the groupings and results based on Ward's cluster are stronger and should be given more weight. They are derived using a grouping method which is well established in the statistics literature. An additional advantage of the Ward's cluster method is that it clearly distinguishes the fastest growing SLAs. The grouping of globally exposed SLAs derived using Ward's cluster method stands out in most comparisons as distinct from the other SLAs.

Table 5.1 gives the full list of SLAs in each SLA group and by the district where SLAs are located. The SLAs which are allocated to the same grouping by the two methods are in bold and are underlined. There are 14 SLAs out of 54 SLAs in the Greater Sydney Metropolitan Region that are allocated to the same grouping by the two methods.

TABLE 5.1 GROUPINGS OF SLAS BY DISTRICT IN THE GREATER SYDNEY METROPOLITAN REGION BETWEEN 1991 AND 2001

District	Globally exposed SLAs		Established/mature SLAs	
	Scatter plot	Cluster analysis	Scatter plot	Cluster analysis
Eastern Core	Concord, Hunters Hill, Lane Cove, **Mosman**, **Sydney–Inner**, Sydney-North, **Sydney–Remainder**, Woollahra (n = 8)	**Sydney–Inner** **Sydney–Remainder**, **Mosman** (n = 3)	Drummoyne, Leichhardt, Randwick, South Sydney, Willoughby, Waverley (n = 6)	Lane Cove, Hunters Hill, Concord, Woollahra, Burwood (n = 5)
Western Core	(n = 0)	(n = 0)	(n = 0)	Auburn (n = 1)
North	Hornsby (n = 1)	(n = 0)	Ku-ring-gai, Manly, Pittwater/Warringah (n = 3)	(n = 0)
South	(n = 0)	(n = 0)	Sutherland Shire (n = 1)	(n = 0)
North-West	Hawkesbury (n = 1)	(n = 0)	Baulkham Hills, Blacktown (n = 2)	Hawkesbury(n = 1)
South-West	Camden, Liverpool, Wollondilly (n = 3)	(n = 0)	(n = 0)	Liverpool, Camden (n = 2)
Central Coast	Gosford, Wyong (n = 2)	(n = 0)	(n = 0)	(n = 0)
Illawara	**Kiama** (n = 1)	**Kiama** (n = 1)	(Shellharbour n = 1)	(n = 0)
Newcastle	**Newcastle–Inner** (n = 1)	**Newcastle–Inner** (n = 1)	(n = 0)	Maitland, Cessnock (n = 2)
Total SLAs	**17**	5	**13**	**11**

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TABLE 5.1 GROUPINGS OF SLAS BY DISTRICT IN THE GREATER SYDNEY METROPOLITAN REGION BETWEEN 1991 AND 2001 (continued)

District	Transitional SLAs		Declining SLAs	
	Scatter plot	Cluster analysis	Scatter plot	Cluster analysis
Eastern Core	**Botany Bay**, Burwood, **Strathfield** (n = 3)	Ashfield, **Botany Bay**, **Strathfield**, Leichhardt, Willoughby, North Sydney, Canterbury (n = 7)	Ashfield, Canterbury, Marrickville, **Ryde** (n = 4)	Marrickville, **Ryde**, Randwick, Drummoyne, South Sydney, Waverley (n = 6)
Western Core	Auburn, **Bankstown** (n = 2)	**Bankstown**, Holroyd, Parramatta (n = 3)	**Fairfield**, Holroyd, Parramatta (n = 3)	**Fairfield** (n = 1)
North	(n = 0)	Manly, Hornsby Ku-ring-gai, Pittwater/ Warringah (n = 4)	(n = 0)	(n = 0)
South	(n = 0)	Hurstville, Kogarah Rockdale (n = 3)	Hurstville, Kogarah, Rockdale (n = 3)	Sutherland Shire (n = 1)
North-West	(n = 0)	Blue Mountains, Penrith (n = 2)	Blue Mountains, Penrith (n = 2)	Blacktown, Baulkham Hills (n = 2)
South-West	(n = 0)	Campbelltown, Wollondilly (n = 2)	Campbelltown (n = 1)	(n = 0)
Central Coast	(n = 0)	Wyong, Gosford (n = 2)	(n = 0)	(n = 0)
Illawara	(n = 0)	(n = 0)	**Wollongong** (n = 1)	Shellharbour, **Wollongong** (n = 2)
Newcastle	Cessnock, Maitland (n = 2)	Port Stephens (n = 1)	**Lake Macquarie**, **Newcastle–Remainder**, Port Stephens (n = 3)	**Lake Macquarie**, **Newcastle–Remainder** (n = 2)
Total SLAs	**7**	**24**	**17**	**14**

Source: Derived by Planning Research Centre, University of Sydney and Bureau of Transport and Regional Economics.

5.2 A COMPARISON OF THE GROUPINGS OF SLAS

This section compares the four SLA types with reference to the following variables which we identified in earlier chapters as statistically significant in explaining growth of SLAs:

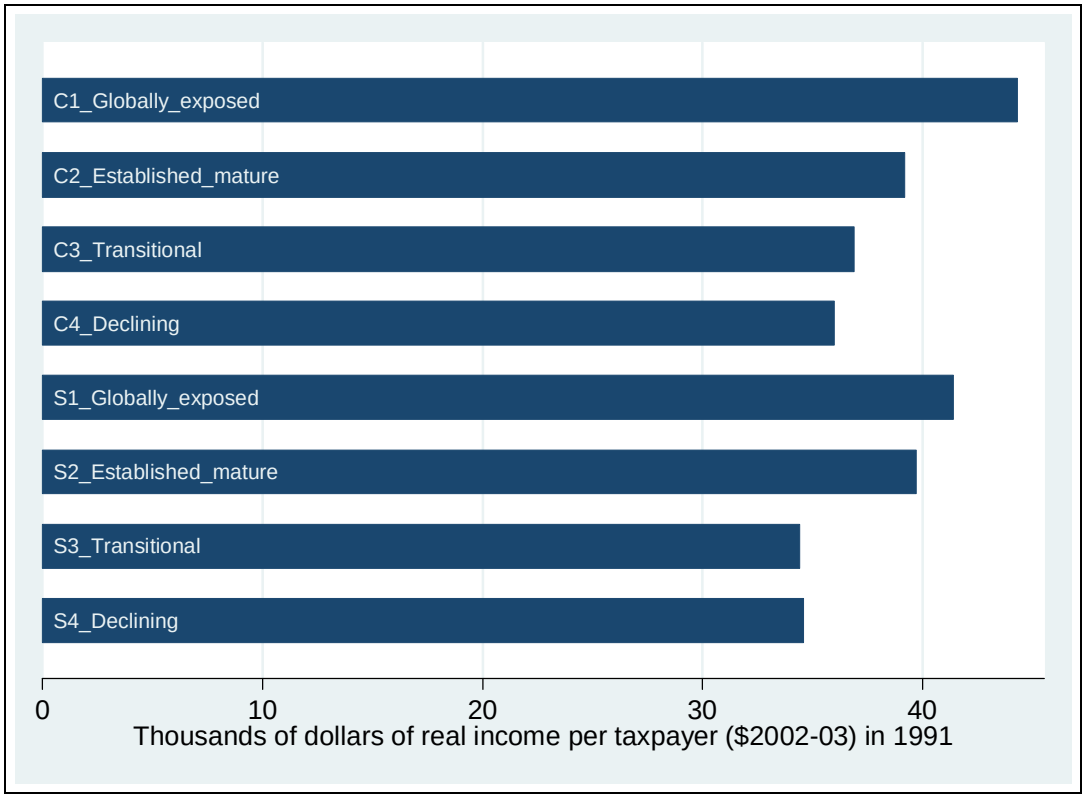
- Real income per taxpayer;
- Human capital;
- Measure of openness;
- The share of knowledge and technology intensive jobs; and
- Degree of industry-based agglomeration.

The aim of this section is to use a few variables to illustrate the differences between the SLA groupings in the Greater Sydney Metropolitan Region. We sort the 54 SLAs into the four SLA types for each method used to group SLAs. We then re-compute the variables for the SLA type as a whole. This ensures that the averages are population weighted. These comparisons are only meaningful when comparing groupings derived using the same method.

Real income per taxpayer

Figure 5.3 presents a summary of the real income per taxpayer variable in the different SLA groupings. Real income per taxpayer is highest in the globally exposed group of SLAs derived using Ward's cluster method. The other SLA groupings had lower values for RIPT with the declining group of SLAs having the lowest value.

FIGURE 5.3 REAL INCOME PER TAXPAYER IN THE DIFFERENT SLA GROUPINGS IN THE GREATER SYDNEY METROPOLITAN REGION.



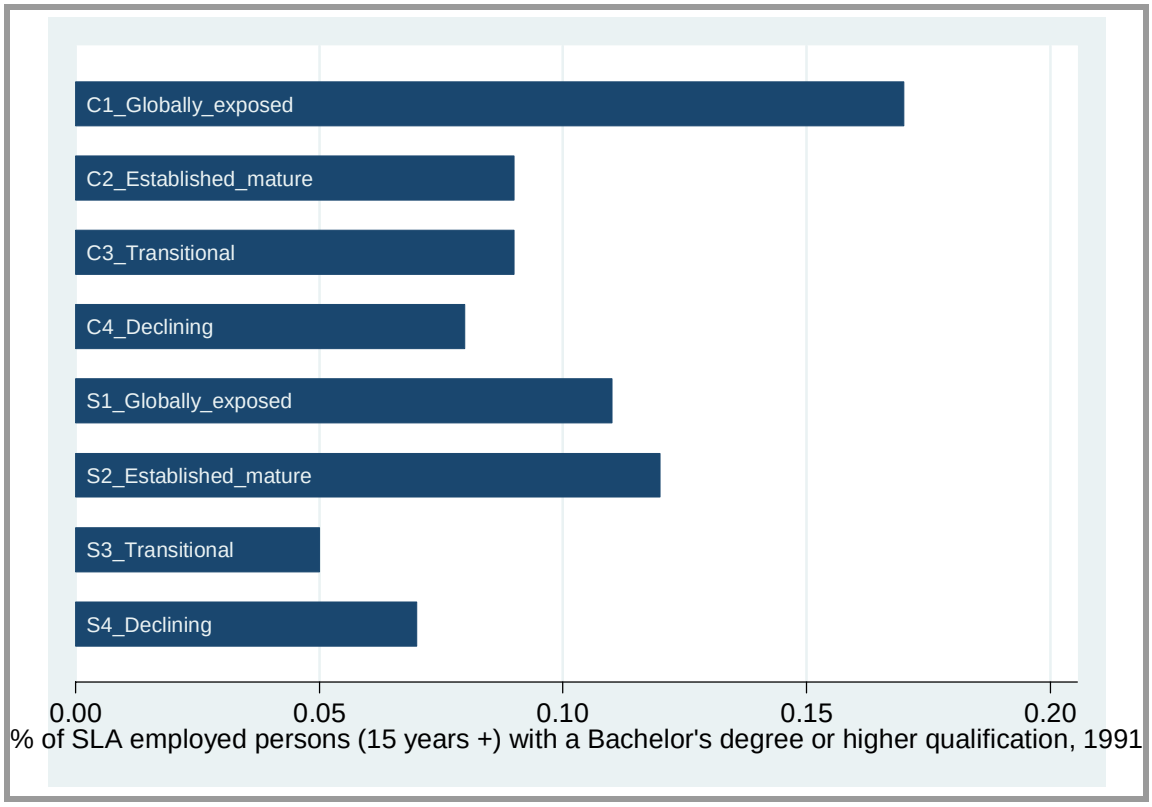
Note: *'C' indicates groups derived using Ward's cluster method. 'S' indicates the groups derived by the enhanced scatter plot method.*

Source: *Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney.*

Human capital

In Chapter 4 we concluded that human capital is an important driver of growth in the study area. Figure 5.4 shows for each SLA grouping, the average percent of SLA population (15 years and over) with a Bachelor's degree or higher qualification. This variable is a proxy for human capital. Thus we can conclude that the globally exposed SLA types have by far the highest levels of human capital in the Greater Sydney Metropolitan Region under Ward's cluster method. The transitional and declining SLAs generally have lower levels of human capital. For the groupings derived by Ward's cluster method, the declining SLAs have the lowest level of human capital as measured by the share of people (15 years and over) with a bachelor's degree or higher qualification. Amongst the groupings derived by the enhanced scatter plot method, the transitional SLAs have the lowest level of human capital. Under Ward's cluster method the globally exposed SLAs stand out in Figure 5.4 as much better endowed with human capital than SLAs in other groupings.

FIGURE 5.4 SHARE OF SLA EMPLOYED PERSONS (AGED 15 YEARS AND OVER) WITH A DEGREE OR HIGHER QUALIFICATION, BY SLA GROUPING IN THE GREATER SYDNEY METROPOLITAN REGION.



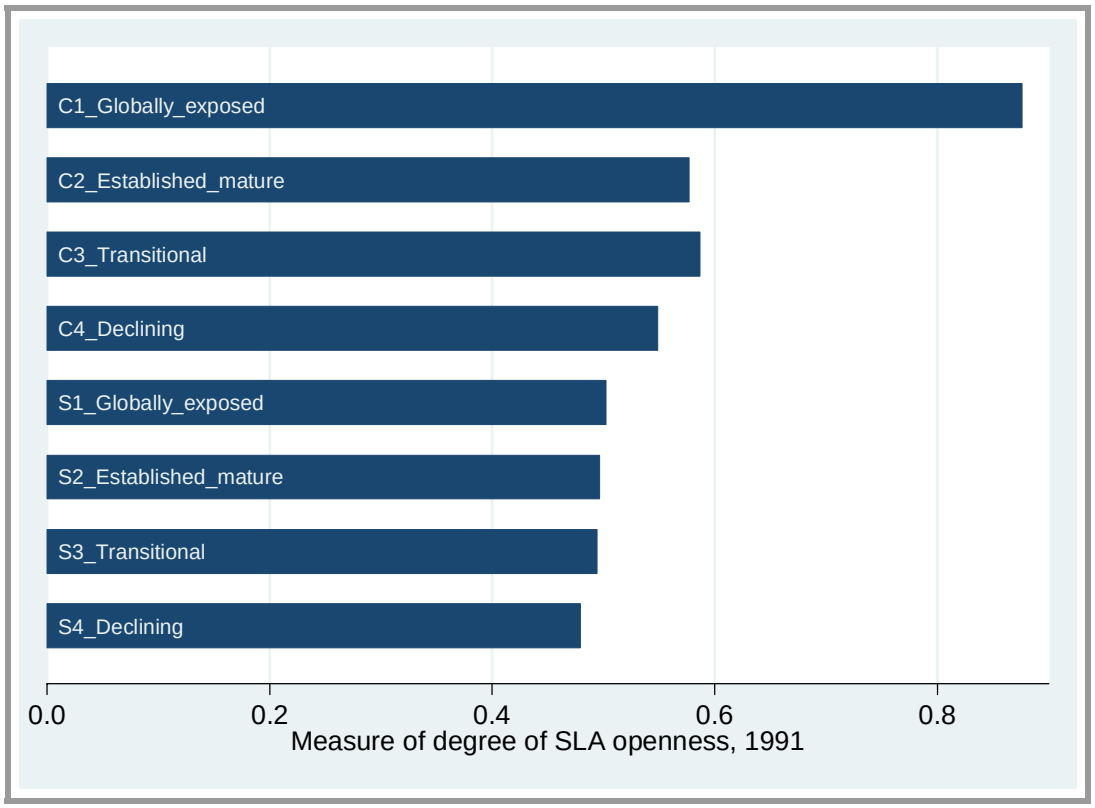
Note: *'C' indicates groups derived using Ward's cluster method. 'S' indicates the groups derived by the enhanced scatter plot method.*

Source: *Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney.*

SLA openness

We defined SLA openness as the share of non-local jobs in the SLA. Figure 5.5 shows SLA openness for the different SLA groupings. The SLA openness index ranges from 0 for a closed SLA to 100 for the most open SLA. The measure for openness is largest in the globally exposed SLA types and is lowest for the declining SLAs. Under the enhanced scatter plot method there is little difference across the SLA types with respect to openness. Ward's cluster method does better at distinguishing the globally exposed SLAs from the other types of SLAs on the basis of openness.

FIGURE 5.5 SLA OPENNESS BY SLA GROUPING IN THE GREATER SYDNEY METROPOLITAN REGION



Note: *'C' indicates groups derived using Ward's cluster method. 'S' indicates the groups derived by the enhanced scatter plot method.*
Source: *Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney.*

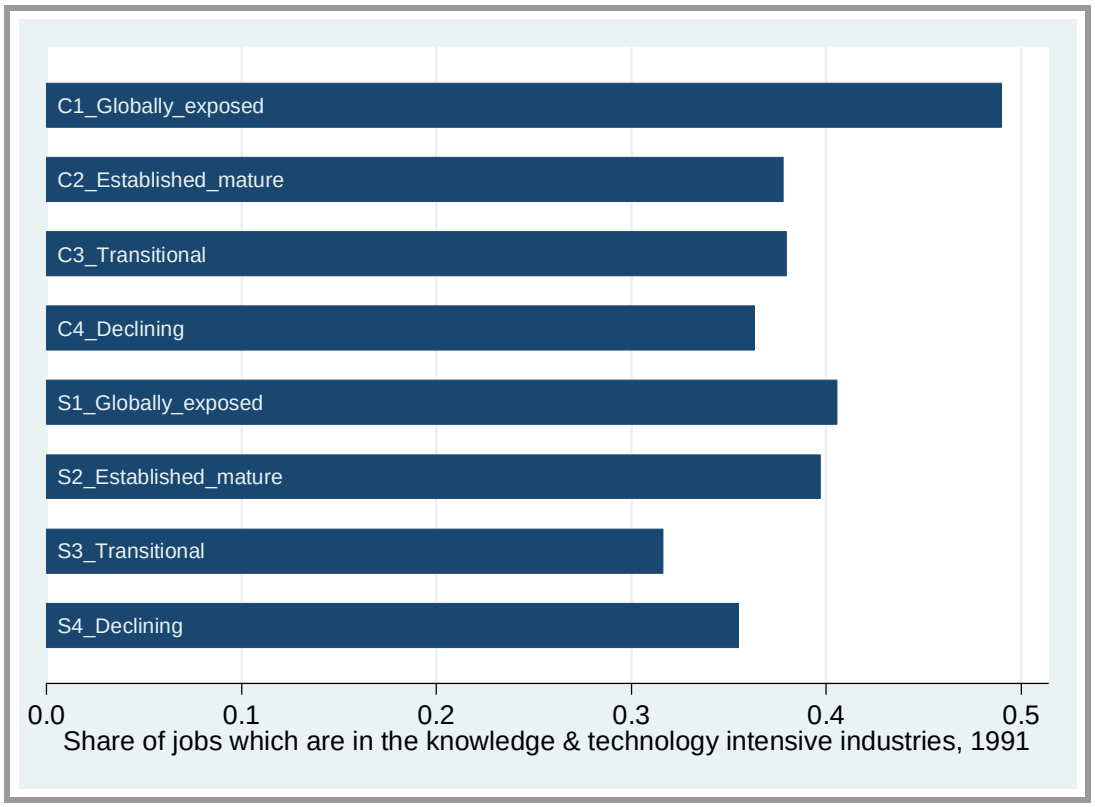
Share of jobs in the knowledge and technology intensive industries

We defined the knowledge and technology intensive industries to include the following:

- Education;
- Health and community services;
- Finance and insurance;
- Communication services;
- Business services;
- Services to mining; and
- a range of other industries (OECD, 2001d).

Apart from Communication services, the industry structure variables related to these industries were statistically significant in our regression models. Figure 5.6 shows how the shares of jobs in the knowledge and technology intensive sectors vary across the SLA types. This variable is highest in the globally exposed SLAs. Ward's cluster method does better at distinguishing the globally exposed SLAs from the other types of SLAs on the basis of shares of jobs in the knowledge and technology intensive industries.

FIGURE 5.6 SHARE OF KNOWLEDGE AND TECHNOLOGY INTENSIVE JOBS BY SLA GROUPING IN THE GREATER SYDNEY METROPOLITAN REGION



Note: *'C' indicates groups derived using Ward's cluster method. 'indicates the groups derived by the enhanced scatter plot method.*

Source: *Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney.*

Degree of industry-based agglomeration

Figure 5.7 presents a summary of the estimated number of jobs in agglomerated industries in the different SLA groupings divided by the total number of jobs in NSW. The degree of industry-based agglomeration by SLA grouping as summarised in Figure 5.7 varies in a complex way across the eight SLA groupings. Figure 5.7 shows that for the ranking of groupings derived using Ward's cluster method in descending order of the degree of industry-based agglomeration is:

- transitional grouping of SLAs;
- the declining grouping of SLAs;
- the globally exposed SLA; and
- the established/mature SLAs.

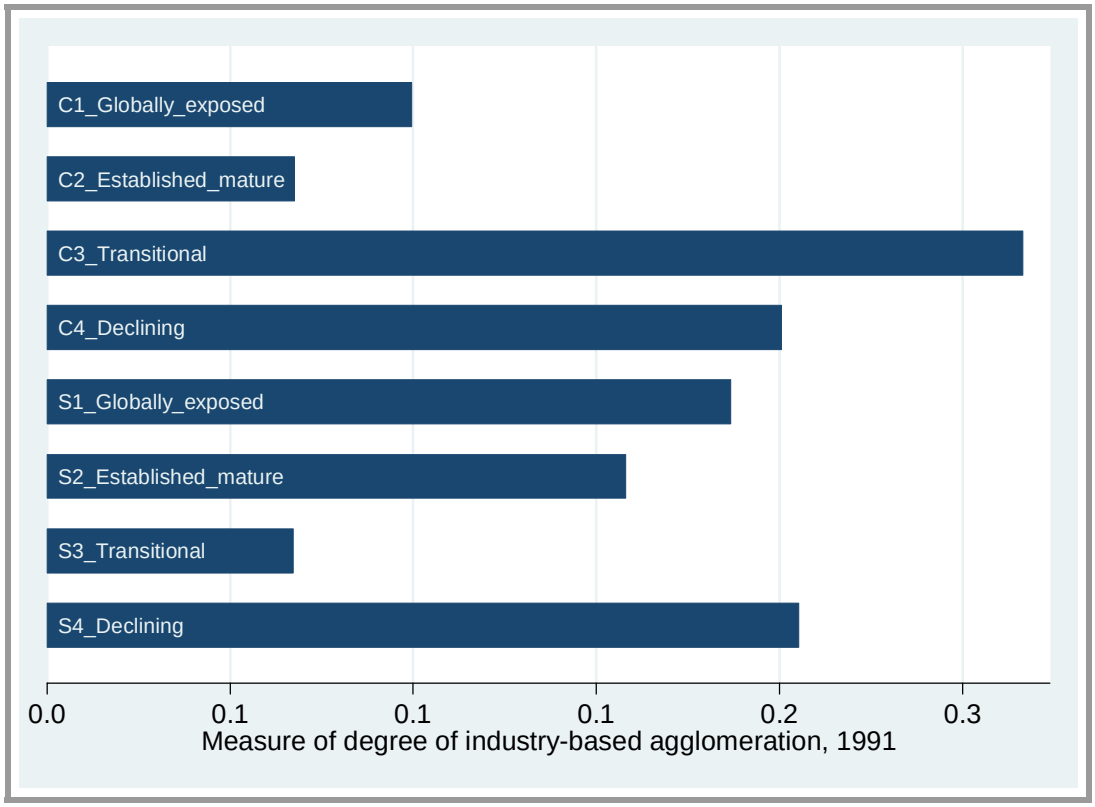
The ranking of groupings derived using the enhanced scatter plot method in descending order of the degree of industry-based agglomeration is:

- the declining grouping of SLAs;

- the globally exposed grouping of SLAs;
- the established/mature grouping of SLAs; and
- the transitional SLAs.

Ward's cluster method places greater emphasis on the estimated resident population. Under that method the transitional grouping and the declining grouping of SLAs register the slowest population growth rates. Furthermore Figure 4.3 suggested that there is a negative relationship between the degree of industry-based agglomeration and estimated resident population. Thus Figure 5.7 is another portrayal of this negative relationship between population growth and degree of industry-based agglomeration. This explains why the groupings of transitional and declining SLAs have such high numbers of jobs in agglomerated industries under Ward's cluster method. It also explains why the grouping of declining SLAs has the highest number of jobs in agglomerated industries under the enhanced scatter method.

FIGURE 5.7 DEGREE OF INDUSTRY-BASED AGGLOMERATION BY SLA GROUPING IN THE GREATER SYDNEY METROPOLITAN REGION



Note: *'C' indicates groups derived using Ward's cluster method. 'indicates the groups derived by the enhanced scatter plot method.*

Source: *Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney*

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Conclusions about the groupings from the two methods

Our results about SLA groupings are strongly conditioned on the method used to derive them. While there are some similarities in the results across the two methods, results generally differ with respect to method used.

From a statistical perspective the groupings and results based on Ward's cluster are stronger and should be given more weight. They are derived using a grouping method which is well established in the statistics literature. An additional advantage of the Ward's cluster method is that it clearly distinguishes the fastest growing SLAs. The grouping of globally exposed SLAs derived using Ward's cluster method stands out in most comparisons as distinct from the other SLAs.

5.3 KEY INDUSTRY DRIVERS IN SLA GROUPINGS BY DISTRICT

Given that a number of industry-related variables are significant in explaining the variation in the growth of SLAs in the Greater Sydney Metropolitan Region, it is worth identifying which industries are the key drivers in the different SLA types and in the different districts. Hill and Brennan (2000) and Reid (2004) suggest ways one can approach this task. In what follows we use location quotient analyses as a tool for identifying which industries are the key drivers in the Greater Sydney Metropolitan Region. Table 5.2 provides a summary of those industries which are important for each SLA type in each of the 9 districts. We only report results for the SLA types derived using Ward's clustering method. Very similar results emerge for the groupings derived using the enhanced scatter plot method.

TABLE 5.2 DISTRICT LEVEL ANALYSES: INDUSTRIES WITH LOCATION QUOTIENTS OF 1.3 OR HIGHER, IN THE GREATER SYDNEY METROPOLITAN REGION, 2001

District	Globally exposed SLAs	Established/ mature SLAs	Transitional SLAs	Declining SLAs
Eastern Core	Finance & insurance (4.8); Property & business (2.1); Government administration & defence (1.8); Technology & knowledge intensive industries (1.5); Communications (1.5).	Health & community services(1.7); Property & business (1.5); Technology & knowledge intensive sector (1.4); Finance & insurance (1.3); Communication (1.3); Personal & other services (1.3).	Communication (2.7); Transport & storage (2.5); Property & business (1.6).	Wholesale (1.6); Education, culture & recreation (1.4); Health & community services (1.4).
Western Core	Nil	Wholesale (2.9); Manufacturing (1.9); Communication (1.6); Transport & storage (1.4).	Manufacturing (1.9); Wholesale (1.5).	Manufacturing (2.3)
North	Nil	Nil	Wholesale (1.3); Retail (1.3);	Nil
South	Nil	Transport & storage (1.3)	Health & community services (1.6); Finance & insurance (1.3);	Retail (1.5); Personal & other services (1.4);
South	Nil	Transport & storage (1.3)	Health & community services (1.6); Finance & insurance (1.3);	Retail (1.5); Personal & other services (1.4);
North-West	Nil	Government administration & defence (2.9); Agriculture, forestry & fisheries (1.7)	Government administration & defence (1.4); Education, culture & recreation (1.3); Health & community services (1.3); Accommodation, cafes & restaurants (1.3); Retail (1.3).	Electricity, gas & water supply (1.6); Wholesale (1.6); Manufacturing (1.4); Retail (1.3).

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TABLE 5.2 DISTRICT LEVEL ANALYSIS: INDUSTRIES WITH LOCATION QUOTIENTS OF 1.3 OR HIGHER, IN THE GREATER SYDNEY METROPOLITAN REGION, 2001 (continued)

District	Globally exposed SLAs	Established/ mature SLAs	Transitional SLAs	Declining SLAs
South-West	Nil	Government administration & defence (1.7); Manufacturing (1.5).	Mining (3.7); Manufacturing (1.6); Retail (1.3); Education, culture & recreation (1.3).	Nil
Central Coast	Nil	Nil	Retail (1.5); Mining (1.4); Health & community services (1.3).	Nil
Illawara	Accommodation, cafes & restaurants (2.5); Construction (1.3); Retail (1.3); Personal & other services (1.3).	Nil	Nil	Mining (1.8); Manufacturing (1.4).
Newcastle	Government administration & defence (3.4); Electricity, gas & water supply (2.5); Finance & insurance (1.9); Property & business (1.5); Communications (1.4).	Mining (2.5); Accommodation, cafes & restaurants (1.5).	Government administration & defence (3.5); Accommodation, cafes & restaurants (1.5); Manufacturing (1.4); Retail (1.3).	Mining (2.6), Electricity, gas & water supply (1.8), Health & community services (1.4), Retail (1.3)

Note: The location quotients reported here were computed at the district level for each SLA cluster. The SLA groupings are derived by Ward's clustering method. Details of SLA membership of these clusters are in Table 5.1.

Source: Derived by Planning Research Centre, University of Sydney and Bureau of Transport and Regional Economics.

Table 5.2 is based on location quotient analysis of 17 ANZSIC industries in the study area based on 2001 data. The knowledge and technology intensive sector is analysed as the seventeenth industry. Only those industries with LQ greater than 1.3 are reported in Table 5.2. Generally if the location quotient is greater than 1 for an industry in a district, then that industry is more important in the given district than the industry is in the whole of NSW.

Detailed results on the specific SLAs are available in a companion electronic database entitled 'A statistical Annex - Greater Sydney Metropolitan Region data: 1991 to 2001' located at the BTRE webpage <www.btre.gov.au>. We focus on the top 3 or 4 industry specialisations in each district. One can make the following conclusions from Table 5.2

about district level specialisations by SLA cluster. The numbers in parenthesis are the LQ values for the industry listed. The higher the LQ value the more important the industry is in the district relative to NSW.

Eastern Core:

- Finance and insurance (4.8) in the globally exposed cluster;
- Communication (2.7) in the transitional cluster;
- Transport and storage (2.5) in the transitional cluster; and
- Property and business (2.1) in the globally exposed cluster.

Western Core

- Wholesale (2.9) in the established/mature cluster;
- Manufacturing (2.3) in the declining cluster;
- Manufacturing (1.9) in the established/mature and transitional clusters; and
- Communication (1.6) in the established/mature cluster of SLAs.

North

- Wholesale (1.3) in the transitional cluster; and
- Retail (1.3) in the transitional cluster.

South

- Health and community services (1.6) in the transitional cluster;
- Retail (1.5) in the declining cluster.

North-West

- Government administration and defence (2.9) in the established/mature cluster;
- Agriculture, forestry and fisheries (1.7) in the established/mature cluster;
- Electricity, gas and water supply (1.6) in the declining cluster; and
- Wholesale (1.6) in the declining cluster.

South-West

- Mining (3.7) in the transitional cluster; and
- Government administration and defence (1.7) in the established/mature cluster.

Central Coast

- Retail (1.5) in the transitional cluster; and

- Mining (1.4) in the transitional cluster.

Illawarra

- Accommodation, cafes and restaurants (2.5) in the globally exposed cluster; and
- Mining (1.8) in the declining cluster.

Newcastle

- Government administration and defence (3.5) in the transitional cluster;
- Government administration and defence (3.4) in the globally exposed cluster;
- Mining (2.6) in the declining cluster;
- Mining (2.5) in the globally exposed cluster; and
- Electricity, gas and water supply (2.5) in the globally exposed cluster.

There are significant differences in the industry-based drivers of growth in the Greater Sydney Metropolitan Region. Within each district there is some limited commonality in industry-based drivers. These commonalities could be a basis for cooperative initiatives at district level. The Western Core district, for example, has manufacturing as one of the most important industry specialisations in each of its three SLA clusters; and wholesale trade is an important specialisation in 2 of its three SLA clusters.

Summary

This chapter has attempted to identify groupings of SLAs in the Greater Sydney Metropolitan Region with similar growth profiles. We have used two methods to achieve this: The enhanced scatter plot method; and Ward's clustering method.

Each of these methods suggests that there are about four different SLA groupings in the Greater Sydney Metropolitan Region. The four groupings from the two methods have different SLA membership. The established/ mature grouping of SLAs has completely different sets of SLAs between the two methods. However there is some overlap of SLA membership between the two methods for the remaining 3 SLA groupings. We use the same names for the four groupings and distinguish them by using the method used to derive them as a prefix to each label.

The groupings are ordered as follows with the fastest growing SLA grouping listed first:

- Globally exposed;
- Established/mature;
- Transitional; and
- Declining.

The chapter also undertakes a comparison of the groupings with respect to the following variables: real income per taxpayer, human capital, SLA openness, the share

of knowledge and technology intensive jobs, and the degree of industry-based agglomeration.

The globally exposed grouping of SLAs dominates the other SLA groupings with respect to the first four variables. The dominance of the globally exposed grouping of SLAs is more pronounced amongst the clusters derived by Ward's cluster method. The comparison with respect to the degree of industry-based agglomeration is not as clear, and results in orderings of SLA groupings which differ strongly between the two grouping methods.

The chapter ends with an identification of the industry sector drivers of each of the SLA clusters by district in the Greater Sydney Metropolitan Region. The districts differ with respect to their most important industry specialization as follows.

- Eastern Core district – Finance and insurance;
- Western Core district – Wholesale;
- North district – Wholesale;
- South district – Health and community services;
- North-West district – Government administration and defence;
- South-West district – Mining;
- Central Coast district – Retail;
- Illawarra district – Accommodation, cafes and restaurants; and
- Newcastle district – Government administration and defence.

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CHAPTER 6 CONCLUSIONS

The objective of this study was to use regional economic analysis tools to look at the structure of the 9 districts and 54 SLAs in the Greater Sydney Metropolitan Region to determine the factors that lead to growth in SLAs, larger districts and the economy of the Greater Sydney Metropolitan Region as a whole.

Lang and Blakely (2005) concluded that small areas can be economically heterogenous even when they occupy the same economic geography. Each small area has endowments from the past (such as industries, natural resources etc), and each can grow or languish depending on how they capitalize on the past and view the future. This study makes two key findings.

The first result is about differential growth in the Greater Sydney Metropolitan Region. The study shows that the 54 SLAs in the study area divide up into 4 major categories with very different growth experiences. We used two methods to categorise regions:

- The enhanced scatter plot method; and
- Ward's clustering method.

While the two methods yield the same number (four) of SLA groupings, the membership of the groupings differ depending on the method used. Each one of the SLA groupings displays very different growth experiences. Under the first method—the enhanced scatter plot method there is stronger researcher control in the definition of the groupings of SLAs are defined as follows

Categories as defined by the enhanced scatter plot method	
Established/mature SLAs: • Aggregate real taxable income growing faster than NSW • Estimated resident population growing slower than NSW	**Globally exposed SLAs:** • Aggregate real taxable income growing faster than NSW • Estimated resident population growing faster than NSW
Declining SLAs: • Aggregate real taxable income growing slower than NSW • Estimated resident population growing slower than NSW	**Transitional SLAs:** • Aggregate real taxable income growing slower than NSW • Estimated resident population growing faster than NSW

The advantage of the enhanced scatter plot method is that it is non-econometric in nature and easy to use and interpret.

Under the second method—Ward's clustering method, we get four groupings. For economy, the groupings are given the same labels as the labels given to groupings derived by the enhanced scatter plot method. However, the groupings derived by Ward's cluster method are different in one major way. Compared with the enhanced scatter plot method, Ward's cluster method gives much greater emphasis to estimated resident population in defining the groupings. The groupings that result are based on an ordering of SLAs heavily reliant on the estimated resident population location quotient. There is greater variation in SLA growth profiles in the population dimension than there is in the income dimension. For example, the difference between the minimum (0.907) and maximum (2.184) of the estimated resident population location quotient is 1.277. On the other hand the difference between the minimum (0.975) and maximum (1.101) of the aggregate real taxable income location quotient is just 0.127. Thus, according to Ward's cluster method SLAs in the Sydney Greater Metropolitan Region are most different with respect to population growth and very similar with respect to growth in taxable income. Each of the groupings of SLAs under Wards method has a combination of SLAs with incomes growing faster than NSW and SLAs with incomes growing slower than NSW. However, these differences within each grouping in the income dimension are not statistically significant.

While Ward's cluster method is more complex in implementation its groupings of SLAs are not very different from a simple ranking of SLAs based just population growth of those SLAs as shown below.

Categories as defined by Ward's cluster method	
Established/mature SLAs: • Estimated resident population location quotient ranging between 1.036 and 1.27 4 • Aggregate real taxable income location quotient ranging from 0.976 to 1.056	**Globally exposed SLAs:** • Estimated resident population location quotient ranging from 1.311 to 2.184 • Aggregate real taxable income location quotient ranging from 1.001 to 1.086
Declining SLAs: • Estimated resident population location quotient ranging between 0.907 and 0.963 • Aggregate real taxable income location quotient ranging from 0.982 to 1.032	**Transitional SLAs:** • Estimated resident population location quotient ranging between 0.979 and 1.016 • Aggregate real taxable income location quotient ranging from 0.975 to 1.024

While the cluster analysis is more complex its main advantage is that it is an established exploratory data analysis tool which aims to sort different objects into groups in such a way that the degree of association between two objects is maximal if they belong to the same group and minimal otherwise.

The major weakness common to both methods is that while they can be used to discover structures in data, they do not provide an explanation or theoretical justification for those structures. Neither method has any theoretical underpinnings in economics nor regional science. They simply discover structures in data without explaining why they exist. The use of two methods leads to differences in SLA group membership. This is a form of sensitivity analysis or a test of robustness of SLA groupings with respect to choice of method. The four SLA groupings are described next.

Globally exposed

Enhanced scatter plot method: This is a group of the fastest growing 17 SLAs in the region with their location quotients (LQ) for both estimated resident population and aggregate real taxable income relative to New South Wales greater than one. If a SLA has LQ greater than one relative to NSW for both estimated resident population and aggregate real taxable income, that SLA's share of both estimated resident population and aggregate real taxable income grew during the study period.

Ward's cluster method: Under this method the number of SLAs in this group was five. These were the SLAs with the fastest growing estimated resident populations — Newcastle Inner, Kiama, Mosman, Sydney Remainder and Sydney Inner. This group of five SLAs is overlaps with the larger grouping of the globally exposed SLAs identified by the enhanced scatter plot method. Ward's cluster method however excludes many SLAs which are growing faster than NSW but which are not outstanding. This group of five globally exposed SLAs stands out from the rest of the SLAs on most indicators, but especially with respect to real income per taxpayer; human capital; SLA openness; and the share of knowledge and technology intensive jobs.

Established/mature

Enhanced scatter plot method: This is a grouping of SLAs which have location quotients for *aggregate real taxable income relative to New South Wales greater than 1*, but their location quotients for *estimated resident population relative to New South Wales less than 1*. These SLAs increased their share of aggregate real taxable income in New South Wales, but had static or declining estimated resident population shares due to various socio-economic changes, life-cycle factors and changes in household composition in the SLAs. Factors that could be contributing to slow estimated resident population growth include children leaving home as young adults, break-up of family units due to separation/divorce, or death of partners. Under this method there are 13 SLAs in this group

Ward's cluster method: Under this method this grouping comprises of the next batch of 11 SLAs with fast growing estimated resident population—Cessnock, Concord, Auburn, Hawkesbury, Maitland, Burwood, Lane Cove, Woollahra, Camden, Hunters Hill and Liverpool. All the SLAs included in this group by this method have *estimated resident population location quotients greater than 1*. While they are growing faster than NSW

they are in a class lower than the top five in the globally exposed SLAs. The text in italics under the two methods shows that the two methods are using different, diametrically opposed rules in allocating SLAs to this grouping. The eleven SLAs that are allocated to this grouping by re-distributing SLAs to this grouping as follows:

- Seven of the 11 SLAs in this grouping have aggregate real taxable income location quotients greater than 1 and were classed under the globally exposed SLAs by the enhanced scatter plot method. However the cluster method shifts them to this slower category because their populations grew markedly slower than those for the top five.

- Four of the 11 SLAs in this group *have aggregate real taxable income location quotient less than 1*.

Transitional

Enhanced scatter plot method: This is a grouping of 7 SLAs which have location quotients for aggregate real taxable income relative to New South Wales less than one, but their location quotients for estimated resident population relative to New South Wales greater than one.

Ward's cluster method: Under this method there are 24 SLAs in this group. As pointed out earlier this method relies heavily on the estimated resident population location quotient to determine SLAs which are dissimilar from each other. The aggregate real taxable income location quotient is not as useful in identifying differences in clusters because there is very little variation between SLAs with respect to income growth. The SLAs in this group by this method have values of the estimated resident population location quotient around 1.0. The range of population location quotient in this group is from 0.978 to 1.063, and thus this method includes in the group SLAs whose population location quotient is either marginal below or marginally above 1.0. Thus under this method this grouping comprises SLAs which are not significantly different in growth profile from the rest of New South Wales. About 44% (24 SLAs) are allocated to this group. The SLAs that are allocated to this grouping by re-distributing SLAs to this grouping as follows:

- 5 which are classified amongst the globally exposed SLAs by the enhanced scatter plot method;

- 11 which are classified amongst the declining SLAs by the enhanced scatter plot method;

- 5 which are classified amongst the established/mature SLAs by the enhanced scatter plot method;

The two methods agree on 3 of the 24 classified as transitional.

Declining

Enhanced scatter plot method: This is a group of the 17 slowest growing SLAs in the region with their location quotients for both estimated resident population and aggregate real taxable income relative to New South Wales less than one. If a SLA has LQ less than one relative to NSW for both estimated resident population and aggregate real taxable income, that SLA's share in both estimated resident population and aggregate real taxable income declined during the study period.

Ward's cluster method: Under this method this grouping is made up of the 14 SLAs with the slowest growing estimated resident population. These include:

- 6 SLAs which are classified as declining by both methods—Marrickville, Ryde, Fairfield, Wollongong, Lake Macquarie and Newcastle Remainder; and
- 8 which the enhanced scatter plot method puts in the Established/mature grouping of SLAs—Randwick, South Sydney, Waverley, Drummoyne, Sutherland Shire, Blacktown, Baulkham Hills and Shellharbour.

Every SLA in this group under the Ward's cluster method has estimated resident population location quotient significantly less than 1.0—the maximum population location quotient is 0.963. However, unlike in the enhanced scatter plot method some of the SLAs included in this grouping under this method have aggregate real taxable income location quotients greater than 1—the maximum aggregate real taxable income location quotient is 1.032.

The labels given to these categories were convenient as a summary tool but we use them cautiously. They should not be interpreted as if all the SLAs in a category were identical in all aspects. Each one of the labels is more descriptive of those SLA in the centre of the category, and the descriptive power of the label is reduced for SLAs that are closer to the borders of a category.

The report also identifies which factors were statistically significant in explaining growth of SLAs.

SLA growth measured by aggregate real taxable income location quotient

One measure of growth in a SLA (between 1991 and 2001) is the location quotient of SLA aggregate real taxable income compared to New South Wales. The study suggests that important factors that explain differential growth as measured by in the SLA aggregate real taxable income location quotient include:

- the human capital stock of an area – the percentage of an SLA's employed persons (aged 15 and over) with a bachelor's degree or higher qualification in 1991;

- the real income per taxpayer in a SLA in 1991;
- the logarithm of (the size of a SLA as measured by estimated resident population in 1991);
- the degree of agglomeration of industries in a SLA in 1991;
- the degree of industry specialisation in 1991;
- the degree of openness of an area in 1991 – measured the share of jobs that produce goods and services predominantly for a non-local market in all jobs in SLA in 1991; and
- the industry structure of an area in 1991.

The industry structure variables that the study finds important in the equation for the location quotient of SLA aggregate real taxable income were the percentage of employed people who work in the following sectors:

- Government administration and defence;
- Health and community services;
- Manufacturing;
- Property and business;
- Wholesale trade;
- Education, culture and recreation;
- Transport and storage;
- Mining;
- Construction; and
- Retail trade.

The coefficients of the employment shares of these sectors in the aggregate real taxable income regression equations have positive values implying that the higher the employment shares of these sectors in a SLA the higher the growth in SLA aggregate real taxable income.

SLA growth measured by estimated resident population location quotient

An alternative measure of growth in a SLA (between 1991 and 2001) is the location quotient of SLA estimated resident population compared to New South Wales. The study suggests that important factors that explain differential growth as reflected in the SLA estimated resident population location quotient include:

- population density of a SLA in 1991;
- the degree of agglomeration of industries in a SLA in 1991; and
- the industry structure of an area in 1991.

The industry structure variables that the study finds important in the estimated resident population equation were the percentage of employed people who work in the following sectors:

- Construction;
- Education, culture and recreation;
- Transport and storage;
- Mining;
- Retail trade; and
- Agriculture, fisheries and forestry.

The coefficients of the employment shares of these sectors (except for Agriculture, forestry and fishing) in the estimated resident population regression equations have negative values implying that the higher the employment shares of these sectors in a SLA the lower the growth in SLA estimated resident population. In the case of Agriculture, fisheries and forestry a positive coefficient implies that the higher the employment shares of this sector in a SLA the higher the growth in SLA estimated resident population. In that sense Agriculture, fisheries and forestry is different from the other sectors.

The focus of the study has been to develop an understanding of the drivers of growth in the Greater Sydney Metropolitan Region which is anchored in the statistical information available about the region. The study has used a growth-focused lens, the shape and quality of which is largely dependent on the availability and quality of relevant data. The challenges of policy may relate to issues which fall outside the scope of this study, but which may be impacted on by the processes of growth at small area level. To target these issues one may need to think outside the economic and statistical 'square' constructed in the study. These issues relate to spill-overs from the growth process and include:

- Impacts on individuals who do not have the new set of skills required to adjust to innovation and technological change;
- Possible negative impacts on social capital at the small area level resulting from changed demands on individuals as they participate in new industries and economic activities;
- Impacts of small area growth on life styles of people at different stages in the life cycle ;
- Impacts on price and quality of available housing, social infrastructure and services as the demand and supply of housing, infrastructure and services change in growing or lagging areas;
- Impacts on health of individuals and families and the quality of their lives; and

- Impacts on the environment as a result of growth at the small area level.

Determining which spill-overs from growth are relevant in a particular small area is an empirical task outside the scope of this study.

Nonetheless, this final section of the report briefly explores what the key results from this study might imply for policy. We make a few suggestions below about what the statistically significant results could mean for government and other stakeholders interested in the economic performance of SLAs in the Greater Sydney Metropolitan Region. These suggestions are based on average relationships across the study area. While these relationships may hold on average across the region, they need to be critically evaluated at the local level before they are applied in a particular SLA. Relationships that are statistically significant, on average, across the 54 SLAs in the study area may not necessarily be directly applicable at a smaller community area. With these caveats in mind, this study suggests the following.

The degree of industry-based agglomeration is important in the growth of a small area. Figure 4.3 summarised the pathways leading to this variable impacting differently on aggregate real taxable income growth compared to its impact on estimated resident population growth. Essentially in any SLA there is competition for space between needs of industry and the demands for residential space. Increasing industry agglomeration tends to crowd out residential services. In the equation for estimated resident population growth industry-based agglomeration has a *negative* value whereas in the aggregate real taxable income equation it has a *positive* value. There are favourable impacts on aggregate SLA aggregate real taxable income from increased agglomeration of industry in a small area. Appropriate uses of planning methods and land-use regulations to influence level of industry agglomeration could be beneficial to growth of a small area. Alternatively, or in addition, industry location decisions made by investors could be made in such a way as to increase the level of agglomeration in a small area. There is a need to balance the interests of industry with the demands of the wider community for residential space. Examples of best practice models of local and regional planning can be found in Gurran, Squires and Blakely (2006), and Roberts (2001) discusses some planning strategies.

The proxy for openness of a SLA is important for growth or lack of growth of SLAs. A proxy for openness of SLA is the non-local jobs as a share of total jobs in a SLA. If a SLA has non-local jobs, this often means that the SLA exports some of its goods to non-local markets. This variable is particularly important for the globally exposed group of SLAs. Policies that improve trade between regions and or between nations (policies about export and import tariffs, free trade agreements, policies affecting exchange rates for the Australian currency, etc) are likely to impact upon the performance of SLAs. Most of these policies, however, can only be developed at levels of geography larger than a SLA.

What more do we learn from this project?

The tools and analytic methods used here are available for use in other areas where economic change in a region masks locally driven economic transformations. In essence, in a large globally connected economic region there are areas that play different roles and sectors that act as either catalysts or drags on economic performance.

The techniques applied in this study are accessible to local decision makers and planners. These techniques allow policymakers and planners to see what is different about their local areas, cities, districts and communities.

This report, and the associated electronic database, is a useful document for economic development specialists as they examine the fortunes of small areas undergoing economic transition. We looked at a collection of data from several different perspectives to unlock locally driven or influenced economic change. No region or city is an economic island, particularly in a global economy. While this report offers a way to examine the context and dimensions of economic performance, it cannot, due to data limitations, identify all of the forces that do affect economic performance. This report provides some clues as to how one might better understand and guide economic options for one's communities. While this report focuses on the Greater Sydney Metropolitan Region its methods are valuable for other city-regions in Australia.

The study could also inform forthcoming BTRE research on the spatial dynamics of sponge cities in Australia, and the current study on the drivers of growth in Tasmania.

APPENDIX A LIST OF INDUSTRIES COVERED IN THE STUDY

TABLE A.1 MAPPING 2 DIGIT INDUSTRIES IN THE AUSTRALIAN STANDARD INDUSTRIAL CLASSIFICATION INTO THE AUSTRALIAN AND NEW ZEALAND STANDARD INDUSTRIAL CLASSIFICATION, 1991

One-digit industries in the Australian and New Zealand Standard Industrial Classification (ANZSIC)	Two-digit industries in the Australian Standard Industrial Classification (ASIC)
AGRICULTURE, FORESTRY, FISHING AND HUNTING (A)	*Agriculture, Forestry, Fishing and Hunting Undefined*
	Agriculture
	Services to Agriculture
	Forestry and Logging
	Fishing and Hunting
MINING (B)	*Mining Undefined*
	Metallic Minerals
	Coal
	Oil and Gas
	Construction Material
	Other Non-Metallic Minerals
	Services to Mining NEC
MANUFACTURING (C)	Manufacturing Undefined
	Food, Beverages, Tobacco
	Textiles
	Clothing and Footwear
	Wood, Wood Products, Furniture
	Paper, Paper Products, Printing, Publishing
	Chemical, Petroleum, Coal Products
	Non-Metallic Mineral Products
	Basic Metal Products
	Fabricated Metal Products
	Transport Equipment
	Other Machinery and Equipment
	Miscellaneous Manufacturing
ELECTRICITY, GAS AND WATER SUPPLY (D)	*Electricity, Gas, Water undefined*
	Electricity, Gas & water supply
	Water, Sewerage, Drainage
CONSTRUCTION (E)	*Construction Undefined*
	General Construction
	Special Trade Construction

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TABLE A1.1 MAPPING 2 DIGIT INDUSTRIES IN THE AUSTRALIAN STANDARD INDUSTRIAL CLASSIFICATION INTO THE AUSTRALIAN AND NEW ZEALAND STANDARD INDUSTRIAL CLASSIFICATION, 1991 (continued)

One-digit industries in the Australian and New Zealand Standard Industrial Classification (ANZSIC)	Two-digit industries in the Australian Standard Industrial Classification (ASIC)
WHOLESALE (F)	*Wholesale, Retail Trade, Undefined*
	Wholesale Trade
RETAIL TRADE (G)	Retail Trade
TRANSPORT AND STORAGE (I)	*Transport, Storage, Undefined*
	Road Transport
	Rail Transport
	Water Transport
	Air Transport
	Other Transport
	Services to Transport
	Storage
COMMUNICATION SERVICES (J)	Communication
FINANCE AND INSURANCE (K)	Insurance and Services to Insurance
	Finance Investment
PROPERTY AND BUSINESS SERVICES (L)	Property, Business Services
GOVERNMENT ADMINISTRATION & DEFENCE (M)	*Public Administration, Defence Undefined*
	Public Administration
	Defence
HEALTH AND COMMUNITY SERVICES (O)	*Community Services Undefined*
	Health
	Welfare, Religious Institutions
	Other Community Services
EDUCATION, CULTURE & RECREATION (N & P)	Education, Museum, Library Services
	Recreation, Services Undefined
ACCOMMODATION, CAFES AND RESTAURANTS (H)	Restaurant, Hotel, Club
	Entertainment, Recreational Services
PERSONAL AND OTHER SERVICES	Personal Services
	Private Households Employing Staff
	Non-classifiable economic unit
	Industry not stated
	Finance, Property, Business Services undefined

Notes: *In the table (and the analysis in the study) the following 1-digit industries are combined because it was not possible to separate the data as collected in 1991 to the two separate industries in the current ANZSIC: Education (N) and Cultural & Recreational Services (P).*
The 2-digit industries in italics are excluded from the analysis because they were not well-defined at the data collection point.

Source: *Prepared by the Australian Bureau of Statistics based on unpublished place and industry of work data files from the Census of Population and Housing.*

APPENDIX B DEGREE OF INDUSTRY-BASED AGGLOMERATION

Table B.1 shows the differences between SLAs on the basis of degree of agglomeration. The number of jobs refers to jobs in agglomerated industries in a SLA. The data on industry-based agglomeration that is used in the study for each SLA in the Greater Sydney Metropolitan Region are available in a companion electronic database entitled 'A statistical Annex - Greater Sydney Metropolitan Region data: 1991 to 2001' located at the BTRE webpage <www.btre.gov.au>.

TABLE B.1 DEGREE OF INDUSTRY-BASED AGGLOMERATION BY SLA IN THE GREATER SYDNEY METROPOLITAN REGION, 1991

Name of SLA	Degree of industry-based agglomeration	No. of jobs	Names of agglomerated industries
Sydney– Inner	0.049	118 827	Manufacturing, Electricity, gas & water, Construction, Wholesale, Retail, Property & business services, Accommodation, cafes & restaurants, Transport & storage, Finance & insurance
South Sydney	0.029	69 768	Manufacturing, Construction, Wholesale, Retail, Property & business service, Accommodation, cafes & restaurants, Transport & storage
Parramatta	0.016	38 961	Manufacturing, Electricity, gas & water, Construction, Wholesale, Retail, Property & business services
Bankstown	0.015	35 791	Manufacturing, Construction, Wholesale, Retail
North Sydney	0.015	35 480	Manufacturing, Construction, Wholesale, Retail, Property & business services, Finance & insurance

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TABLE B.1 DEGREE OF INDUSTRY-BASED AGGLOMERATION BY SLA IN THE GREATER SYDNEY METROPOLITAN REGION, 1991 (continued)

Name of SLA	Degree of industry-based agglomeration	No. of jobs	Names of agglomerated industries
Warringah & Pittwater	0.013	31 250	Manufacturing, Construction, Wholesale, Retail, Property & business services
Botany Bay	0.011	26 832	Manufacturing, Construction, Wholesale
Blacktown -	0.011	26 348	Manufacturing, Construction, Wholesale, Retail
Fairfield	0.010	23 638	Manufacturing, Construction, Wholesale, Retail
Wollongong	0.010	23 559	Mining, Manufacturing, Electricity, gas & water, Construction, Wholesale, Retail
Willoughby	0.009	22 986	Manufacturing, Construction, Wholesale, Retail, Property & business services
Ryde	0.008	20 994	Manufacturing, Construction, Wholesale, Retail
Sutherland Shire	0.008	20 877	Manufacturing, Construction, Wholesale, Retail
Newcastle–Remainder	0.008	20 597	Manufacturing, Construction, Wholesale, Retail
Auburn	0.008	20 334	Manufacturing, Construction, Wholesale, Retail
Lake Macquarie	0.007	18 379	Mining, Manufacturing, Construction, Wholesale, Retail
Holroyd	0.007	17 614	Manufacturing, Construction, Wholesale, Retail
Penrith	0.007	17 591	Manufacturing, Construction, Wholesale, Retail
Liverpool	0.007	16 844	Manufacturing, Construction, Wholesale, Retail
Sydney–Remainder	0.006	16 558	Manufacturing, Electricity, gas & water, Construction, Wholesale, Retail, Property & business services
Baulkham Hills	0.006	15 609	Manufacturing, Construction, Wholesale, Retail
Gosford	0.006	15 152	Manufacturing, Construction, Wholesale, Retail
Canterbury	0.006	14 498	Manufacturing, Construction, Wholesale, Retail
Hornsby	0.005	14 067	Manufacturing, Construction, Wholesale, Retail
Marrickville	0.005	14 029	Manufacturing, Construction, Wholesale, Retail
Campbelltown	0.004	11 767	Manufacturing, Construction, Wholesale, Retail
Hurstville	0.004	9 648	Manufacturing, Construction, Wholesale, Retail

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TABLE B.1 DEGREE OF INDUSTRY-BASED AGGLOMERATION BY SLA IN THE GREATER SYDNEY METROPOLITAN REGION, 1991 (continued)

Name of SLA	Degree of industry-based agglomeration	No. of jobs	Names of agglomerated industries
Wyong	0.0039	9 606	Manufacturing, Construction, Wholesale, Retail
Rockdale	0.0038	9 281	Manufacturing, Construction, Wholesale, Retail
Leichhardt	0.0036	8 780	Manufacturing, Construction, Wholesale, Retail
Randwick	0.0028	6 915	Manufacturing, Construction, Wholesale, Retail
Ku-ring-gai	0.0027	6 627	Construction, Wholesale, Retail
Strathfield	0.0022	5 491	Manufacturing, Wholesale
Concord	0.0022	5 490	Manufacturing, Construction, Wholesale
Lane Cove	0.0017	4 257	Manufacturing, Construction, Wholesale
Hawkesbury	0.0015	3829	Manufacturing, Construction, Wholesale
Waverley	0.0014	3398	Wholesale, Retail
Wollondilly	0.0007	1784	Mining
Cessnock	0.0007	1745	Manufacturing, Wholesale
Maitland	0.0006	1659	Manufacturing, Wholesale
Drummoyne	0.0006	1579	Manufacturing, Wholesale
Port Stephens	0.0005	1205	Construction
Newcastle– Inner	0.0003	752	Wholesale
Woollahra	0.0002	638	Wholesale
Manly	0.0002	470	Wholesale
Blue Mountains	0.0001	464	Wholesale
Ashfield	0.0001	444	Wholesale
Burwood	0.000	0	No agglomerated industry
Hunters Hill	0.000	0	No agglomerated industry
Mosman	0.000	0	No agglomerated industry
Kogarah	0.000	0	No agglomerated industry
Camden	0.000	0	No agglomerated industry
Kiama	0.000	0	No agglomerated industry
Shellharbour	0.000	0	No agglomerated industry

Note: *Degree of industry-based agglomeration represents number of people in a SLA employed in agglomerated industries as a share of total employment in New South Wales.*

Source: *Derived by Bureau of Transport and Regional Economics and Planning Research Centre, University of Sydney.*

ABBREVIATIONS

ABS	Australian Bureau of Statistics
ASIC	Australian Standard Industrial Classification
ANZSIC	Australian and New Zealand Standard Industrial Classification
ARTI	Aggregate real taxable income
BTRE	Bureau of Transport and Regional Economics
DZN	Destination zones (used in assembling place and industry of work data)
ERP	Estimated resident population
GSMR	Greater Sydney Metropolitan Region
LQ	Location quotient
NA	Not applicable
No	Number
NS	Not statistically significant at 5 percent level of significance
NSW	New South Wales
OECD	Organisation for Economic Cooperation and Development
R^2	R- squared – a measure of goodness of fit of a regression model to the data
SLA	Statistical Local Area
Vol	Volume

GLOSSARY

Term	Explanation of term
Agglomeration economies	In this report this term refers to the impacts resulting from the clustering of industrial activities in an area. These agglomeration effects could be beneficial to firms if, for example, they favor better supply of specialized facilities, labor pools and vocational training. But they could also have negative effect on the growth of an area by crowding out residential services and space.
Aggregate Real Taxable Income	Taxable income reported by individual taxpayers to the Australian Taxation Office in a given financial year and aggregated to a total for a given SLA, and expressed in real terms. The reported individual taxable income is an undifferentiated aggregate of all the income accruing to taxpayers from any source. It therefore includes income derived from salary and wages, net business income, distributions from partnerships or trusts, interest and dividends, eligible termination payments, some government pensions and allowances, superannuation payments and reportable fringe benefit amounts less any allowable deductions.
Economic base analysis	An economic theory and model which analyses urban and regional growth assuming a division of the economy into basic and non-basic sectors. Basic sectors are those producing primarily for export and non-basic sectors are those serving the needs of the basic sectors and of the population. Jobs in the basic sectors are referred to as non-local jobs while jobs in the non-basic sector (serving mainly local needs) are referred to as local jobs.
Human capital	This term refers to the value to the economy of increased educational investment in individuals. The Organisation for Economic Cooperation and Development (OECD) adopts a broader definition of human capital that incorporates the knowledge, skills, competencies and attributes embodied in individuals

	that facilitate the creation of personal, social and economic wellbeing. This definition can include a range of competencies and attributes including communication, numeracy, tacit knowledge, intra-personal attributes such as health, self discipline and motivation, and interpersonal skills.
Industry specialisation and diversity	This concept deals with the sectoral composition of a given place. A highly specialised place will have a few industries dominating its sectoral composition. The inverse of the concept of specialisation is industrial diversity. Thus when a place has a high index of industrial specialisation (close to 1), the corresponding value for industrial diversity is small (close to zero).
Industry structure	Industry structure of a place refers to the distribution of jobs, employment or output across industries located in that place. Industry structure can be estimated by computing either: Each industry's share of total jobs in a place, or Each industry's share of output. These shares in a given place add up to 100 percent.
Local jobs (non-basic) jobs	In economic base analysis jobs in the non-basic sector (serving mainly local needs) are referred to as local or non-basic jobs.
Location quotient	Generally this term refers to a measure of the relative significance of a phenomenon in a region compared with its significance in a larger benchmark region In this report the phenomenon of interest is often employment, the place is a SLA, and the benchmark or reference larger region is New South Wales. A high location quotient for a specific activity implies specialization and the export of the goods or services produced by the activity. It is often hypothesised that a location quotient of 1 represents self-sufficiency. If a place has a location quotient higher than 1 it is interpreted to have specialised in the activity and if the activity is one where a good or a service are produced the place is likely to be a net-exporter of the good or service in question. On the other hand if a place has a location quotient less than 1, and if the activity is one where a good or a service is produced, the place is likely

	to be a net-importer of the good or service in question.
Non local (basic) jobs	In economic base analysis, jobs in the basic sectors are referred to as non-local or basic jobs.
Openness	In economic base analysis, basic sectors are those likely to be producing for export. It is possible to estimate the number of non-local (or basic) jobs in a place. The number of the non-local jobs in an area (relative to all jobs available in the place) can be used as a proxy for the degree of openness of a place.
Population density	Population within an area (usually one square kilometre or square mile).
Population size	Population size refers to the estimated resident population (ERP) of a place. Estimated resident population is the ABS' official estimate of the population and is based on the concept of residence. It refers to all people, regardless of nationality or citizenship, who usually live in Australia, with the exception of foreign diplomatic personnel and their families. It includes usual residents of Australia who are overseas for less than 12 months and excludes overseas visitors who are in Australia for less than 12 months.

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