A Spatial Econometric Analysis of Selected Local Labour Market Outcomes in New Zealand

A thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

In

Labour Studies

at

The University of Waikato

by

William (Bill) Cochrane

THE UNIVERSITY OF WAIKATO

Te Whare Wānanga o Waikato

2011

ABSTRACT

This thesis analyses several aspects of local labour market performance in New Zealand. Each of these aspects represents a different feature of the local labour market that together aim to provide a comprehensive understanding of how local labour markets respond to local or external shocks, taking spatial dependencies into account.

The first aspect considered is the change in regional employment outcomes in New Zealand from the 1980's to 2006. This is examined using shift-share techniques supplemented by exploratory spatial data analysis. The analysis finds that in general, region specific factors were more important than industry structure in explaining total employment change in a region and that productivity and/or demand shocks spill over between regions.

The relationship between homeownership and unemployment is the second aspect considered. Particularly, Oswald has argued that disparities in unemployment rates maybe attributable to differences in homeownership rates, higher homeownership rates being associated with higher unemployment rates. Using spatial panel models this claim is supported in the New Zealand context. The spatial estimation strategy adopted yields parameter estimates significantly lower than the standard fixed effects model. This indicates that in the non-spatial models some of the variation in regional unemployment rates has been incorrectly attributed to the explanatory variables rather than to the presence of some spatial spillover effects of unemployment across regions.

Thirdly, the thesis investigates the extent to which the spatial-temporal variation in local labour market outcomes and social security benefit uptake can be linked to the composition of the local labour force. This is investigated using spatial seemingly unrelated regression. The results indicate that three factors in particular matter in the determination of labour market participation and social security benefit uptake: the age structure of the population, the past performance of the regional labour market and the proportion of solo parents.

Lastly a simultaneous equations growth model of real income, population, land rent and public infrastructure investment is developed that allows the impact of local authority infrastructure spending in New Zealand to be assessed for the 1996-2006 period. The results of the estimation of this system of equations, using a spatial three stage least squares (3SLS) procedure, show that an increase in local infrastructure spending increases population growth, real income and land values, but is itself endogenous and spatially correlated.

ACKNOWLEDGEMENTS

This project would never have been commenced, let alone finished, without the support, assistance and guidance of a large number of people.

I owe a great debt to my chief supervisor Jacques Poot who has been unflaggingly supportive and willing to guide me through the arcane world of econometrics. Out of somewhat deficient materials he has managed to fashion something resembling a labour economist.

Through Jacques I was able to interact with Arthur Grimes, Phillip McCann and Dave Mare – all of whom have been as patient with me as they have been generous with both their time and knowledge. From Jacques, Arthur, Phil and Dave I have learnt as much about the craft of being an academic as I have about economic technique.

Sadly my second supervisor, long time friend and comrade Paul Harris did not live to see me finish this work, dying shortly before its completion. While Paul might not have had much to say about econometrics he had an unwavering believe in my ability to complete this task and a determination to ensure that I shared that view.

I would also wish to express my gratitude to Euan Kilgour and Aaron Hawthorn for the technical and moral support they have ably provided over a number of years on this and numerous other projects.

Over the time that this thesis has taken life has thrown up a fair few challenges which I doubt I would have surmounted had it not been for my mates, particularly Matt Roskruge and Bevan Yeatman, who helped me out when I needed it and have always been around to have a beer and remind me that a lot worse fates befall people than being an academic.

My partner Kellie McNeill deserves a massive thank you for keeping me sane, on track and for showing me what the words productivity and output mean while finishing her own thesis.

Lastly I wish to thank the University of Waikato for financially supporting my work through a University of Waikato doctoral scholarship and the Foundation for Research, Science and Technology for funding assistance (FRST grant MOTU-0601 Infrastructure). I am, however, solely responsible for the views expressed here.

TABLE OF CONTENTS

List of Tables

List of Figures

CHAPTER 1

INTRODUCTION

1.1 SETTING THE SCENE

A central concern of the spatial sciences, both in theory and empirics, is the existence of socio-economic disparities that exist between different areas within a national economy. Among developed countries, these disparities are often greater than those between nation states. Moreover, strengthening agglomeration forces are contributing to growing disparities between metropolitan and peripheral regions (e.g., Glaeser, 2010; McCann, 2008). This has led to a resurgence of interest in regional disparities (Capello & Nijkamp, 2009, p. 1). Some regions within a nation, often the most urbanised ones, are able to attract labour and capital and fully utilise their resource endowments. In this way such regions act as drivers of the national economy, while others stagnate or lag behind the more ‘dynamic’ regions. Consequently, inter-regional disparities often prove persistent over time. A government’s desire to limit differences in opportunities and wellbeing of individuals irrespective of their location therefore necessitates an in-depth understanding of the causes and mechanisms through which these inequalities arise and the ways in which these are reproduced. Such an understanding may assist in designing policies that address both efficiency and equity concerns in order to ameliorate the consequences of inequality and unbalanced growth within the regional economic system.

When thinking of the region as an economic system it would be easy to assume that a region is merely an open national economy writ small. Indeed, regions share many of the characteristics of national economies. However, spatial interactions (through trade, migration, capital mobility and information exchange) between regions within a nation tend to be in general more intense and effected with greater ease than those between nations and are consequently often more developed. For example, labour in liberal democracies is able to move freely within the national space but is constrained in its ability to cross national frontiers. While capital is more mobile across borders than labour, it faces internationally barriers too that are absent within a country. Furthermore, the barriers to the free movement of goods and services, such as tariffs, quotas and import restrictions, are likely to be far less or entirely absent within a national space than between nations.

In addition to addressing processes of regional economic development regional science can speak to broader issues. The recent economic history of the world has been marked by an erosion of the barriers between national spaces and a consequent increase in the degree of economic interaction between nations, with nations becoming more akin to regions within a supra-national entity, hence the study of the adjustment processes of regions within national entities may offer hints as to how national economies might develop and respond to shocks within the global economy (e.g. Kohno, Nijkamp, & Poot, 2000).

The literature on the analysis of the effects that spatial interaction and spatial spill-over might have upon the trajectory followed by a regional economy following a national or local economic shock has only been emerging in recent years. The main reason is that the essential tool for such an analysis, spatial econometrics, only became available to the applied researcher in the 1990s after influential contributions by Anselin (1988a) and others. With the advent of fast computers and new software, spatial econometrics has rapidly gained popularity in recent years, leading to incorporation of such models in statistical software and the advent of textbooks such as LeSage and Pace (2009)

So far this revolution in modelling the regional economy has only had very limited application in New Zealand. Recent examples are Grimes and Liang (2010) and Samarasinghe and Sharp (2010), but neither of these studies are concerned with a core aspect of the regional economy, namely the performance of the regional labour market. The aim of this thesis is therefore to analyse the impact of spatial interaction and spatial dependence on local labour markets; and with a clear focus on New Zealand.

The concept of the 'local labour market' is central to this endeavour. While national economic conditions, along with the institutional framework, provide a context for the conditions under which labour supply and demand are matched, such matching of supply and demand occurs at the spatial scale of local rather than national labour markets. Even relatively advantaged groups such as the highly skilled or highly mobile are to some extent tied to specific geographical locations, shaped by their personal circumstances and history (Shuttleworth, 2007, p. 970). In operational terms Fischer and Nijkamp (1987, p. 3) conceive of the local labour market as an area in which there is "a clear labour market pattern defined by the spatial range of employment opportunities open to a worker without changing his place of residence". The boundary condition for a local labour market is such that areas within its boundaries are characterised by high levels of labour market-related interaction while interactions between areas inside and outside a labour market are at relatively low levels (Hoover & Giarratani, 1999). The boundaries of local labour markets will often differ from those of administrative units and be subject to greater change over time as they reflect underlying functional economic relationships. Local labour market boundaries will respond to shocks more readily than legislatively determined boundaries.

While local labour markets are defined in terms of local labour market characteristics, specifically commuting behaviour, and are by definition self contained on this dimension, they nevertheless interact on other dimensions. Such interactions can strongly impinge on their functioning. For instance while the potential supply of labour (the working age population) in a labour market is given in the short run within which migration is limited; demand for this labour maybe influenced by shocks external to the local labour market area. For example, demand for the goods and services provided by an urban labour market may increase due to higher commodity prices for agricultural produce in the contiguous rural labour markets. In effect, the positive conditions in the surrounding areas spill over in this case into the urban. Similarly, as the local labour market is defined in terms of the area over which a worker is willing to commute to employment, any labour market adjustment that triggers migration within a nation will also entail interaction between labour market areas. Such spatial interactions and spill-over preclude the treatment of local labour markets as atomistic entities and necessitate the adoption of methodologies that explicitly deal with spatial interaction. In this thesis this is addressed through the adoption of a variety of spatial econometric techniques that have been developed to cater for the presence of spatial effects, particularly spatial autocorrelation.

1.2 THE NEW ZEALAND CONTEXT FOR THIS STUDY

Just over a quarter of a century ago New Zealand (NZ) was one of the most regulated economies in the OECD, facing however unsustainable fiscal and current account deficits, inflation of over 12 percent, foreign debt at 46 percent of GDP and a foreign exchange crisis. The incoming Lange Labour government (1984-1990) embarked on a path of radical economic liberalisation that led to a significant restructuring and transformation of the economy. The inevitable consequence of such restructuring was a dramatic increase in the level of unemployment, driven in large part by the destruction of employment in the previously heavily protected manufacturing sector.[1] National unemployment peaked at between 10 and 11 percent in 1991-92, compared to 2-3 percent a decade earlier.[2] Subsequently unemployment rates declined markedly through the 1990s and economic growth accelerated, leading to positive assessments of

[1] In addition subsidization of manufacturing exports was also common. Prior to the restructuring period many manufacturing products received effective rates of protection in excess of 100 per cent. Following 1984, tariffs were removed so that the effective assistance rate for manufacturing fell from 30 to around 7 percent in 1996. Contemporaneously with the substantive removal of tariff protection, import licensing was removed from all but a few products (Chatterjee, 1996, p. 29).

[2] It should be noted than even the 2-3 percent unemployment prevailing at the start of the 1980s was a marked departure from the unemployment rates that had been experienced in the period of the so called long boom (Marglin & Schor, 1990) where New Zealand's unemployment rate is estimated to have remained below 1 percent until the final quarter of 1967 (long term data series).

the reform's long-run economic outcomes (such as Evans, Grimes, Wilkinson, & Teece, 1996), although others argued that the social costs had been too high (e.g. Kelsey, 1996). Following similar trends in countries such as the United Kingdom, the Labour Government elected in 1999 stepped back from the neoliberal restructuring programmes of the 1980s and 1990s in favour of a more 'Third Way' approach to economic management.[3]

The decline of the unemployment rate seen after the 1991-92 peaks has been attributed, at least in part, by some commentators (e.g., Evans, et al., 1996) to the extension of the reform process to the labour market with the Employment Contracts Act of 1991 and substantial reductions in benefit payments. However, the formal assessment of the impact of labour market reforms is no easy matter (Gorter & Poot, 1999) and the link between deregulation and labour market performance by no means proven (Baker, Glyn, Howell, & Schmitt, 2004).

The assessment of both the necessity and consequences of the reform process of the 1980s and 1990s is the subject to ongoing debate with views ranging from the positive, emphasising both the necessity and long term gains of the reforms (Evans, et al., 1996) to those, such as Kelsey (1999), who see the period as a colossal failure. The optimistic view of the reforms probably underestimates the effects of medium term increases in unemployment, loss of output and the sub-optimality of the sequencing of some of the reforms, while the pessimistic fail to confront the structural weakness of the New Zealand economy and the inability of traditional forms of economic management to stabilise the economy during the crises of the 1970s and early 1980s or to crystallise a sustainable mode of development. However, there is general consensus that the long-run rate of economic growth of the New Zealand economy has remained undesirably low, leading to a divergence with Australia as signalled by significant Trans-Tasman migration westwards (Poot, 2010). The fundamental reasons for this unsatisfactory performance remain also strongly

[3] Chatterjee et al. (1999) provides a useful collection on this approach from a number of writers who were more or less influential under the Clark Labour government (1999-2008), at least during the first term of that administration.

debated with powerful arguments pointing to the significance of the country's location, population size, density and other aspects of economic geography (McCann, 2009), while others continue to call for further liberalisation (Brash, 2009, 2010).

While the merits of these views will continue to be debated there would seem to be general agreement that the reform process at least coincided with a marked increase in social inequality, a decline in social cohesion and an increase in the vulnerability of certain regions and population groups throughout the 1990s (e.g. Karagedikli, Maré, & Poot, 2000, 2003). Indeed there is evidence to suggest that areas that suffered the most adverse shocks during the reform process have continued to suffer adverse effects, in terms of lower employment rates, lower average incomes and a less skilled workforce into the 21st century (Stillman, Velamuri, & Aitken, 2010). The central theme of this thesis is that in order to gain some understanding of how local labour markets adjust to shocks such as those experienced during the period of restructuring, spatial econometric models are an essential tool.

1.3 AIMS AND SCOPE

As foreshadowed above, this thesis analyses several aspects of local labour market performance in New Zealand. Each of these aspects represents a different feature of the local labour market that together aim to provide a comprehensive understanding of how local labour markets respond to local or external shocks, taking spatial dependencies into account.

The focus is firstly on the dynamics of the employment structure of local labour markets by means of shift-share analysis. The thesis goes beyond the conventional shift-share analysis (see Dunn, 1960) by also calculating local indicators of spatial association (Anselin, 1995) for the industry and competitive effect components of the shift-share analysis, offering new insights into the spatial structure of employment in New Zealand.

The second topic in the thesis focuses on the role of labour mobility. Interregional migration has already been studied extensively in New Zealand (e.g. Maré & Timmins, 2004; Poot, 1986a, 1986b) and a different approach is proposed here. Following the seminal work by Oswald (1996), an inverse relationship is posited between labour mobility and homeownership. This relationship is tested at the local labour market level and shown to exhibit spatial dependence, for reasons that are elaborated in the chapter.

No study of the local labour market is complete without consideration of the welfare state and the role of social security in labour supply decisions. The third empirical analysis in the thesis therefore concerns the extent on non-participation in the labour market in the form of receipt of the unemployment, sickness, invalids and domestic purposes benefits. For this analysis, an innovative spatial seemingly unrelated regression (SUR) approach is adopted.

Finally, the focus in the last empirical analysis is on the dynamic adjustment of the local labour market in relation to infrastructure investment, a popular tool for local economic development (see Stimson, Stough, & Roberts, 2006). Using a modified Roback (1982) model, it is shown that infrastructural investment is endogenous and that a system of spatial simultaneous equations is needed to capture the growth of the local labour market in terms of capital, land value, incomes and population.

While each of the topics considered; employment change, the interaction of homeownership and unemployment, the social security system and the impact of public infrastructure investment, is undoubtedly of significance in explaining disparities in the performance of local labour markets the topics have not been selected because they are the most significant determinants of these disparities, or collectively allow an exhaustive description of the dynamics of local labour market adjustment in New Zealand. Rather these topics have been selected for the following four reasons;

Firstly as the quantitative analysis of sub-national labour markets in New Zealand has received little attention in terms of academic research published in peer reviewed journals it is hoped that the particular topics chosen will show the importance of a 'regional' view of the labour market. Moreover, the different models highlight interesting and different aspects of the labour market rather than representing one particular focus.

Secondly, this study hopes to show that the analysis of sub national labour markets can be usefully conducted using functionally defined local labour markets, as opposed to administrative areas, and that such an approach is practicable given the constraints of existing New Zealand data.

Thirdly, in all four areas the analysis of local labour markets explicitly addresses the presence of spatial interaction and spill-over, not as nuisance factors but as an integral part of the analysis. Further, the use of spatial econometric techniques offers an appropriate methodology for doing so.

Lastly, and rather pragmatically, for each of the topics chosen there exists an established international and/or national literature and data which is readily available in New Zealand. Other topics certainly suggested themselves but lack of suitable data tended to preclude these. In particular, the lack of sub national product (Regional Domestic Product) accounts militated against investigation of regional productivity differentials and determinants.

The organisation of this study is detailed in the following section.

1.4 THE STRUCTURE OF THIS STUDY

Aside from this introductory chapter, the thesis consists of 5 substantive chapters and a concluding chapter. Chapters 2 covers the theoretical background to the thesis along with detailing the characteristics and sources of data used in the estimations in the empirical chapters. In addition, Chapter 2 discusses the selection and derivation of Local Labour Market Areas (LMA), the spatial frame used in the analysis conducted in this work, and the specification of spatial interactions through the spatial weights matrix.

The first empirical chapter (Chapter 3) examines the changes in regional employment outcomes in New Zealand from the restructuring of the

1980's/early 1990's, with its attendant general decline in employment levels, to the relative economic buoyancy of the 2001-2006 period. The analysis is conducted using shift-share techniques supplemented by exploratory spatial data analysis and finds that in general, region specific factors (the competitive effect) were more important than industry mix in explaining total employment change in an LMA. It is also established that there is spatial dependence in this competitive effect and this can be interpreted as evidence that productivity and/or demand shock spill over between regions.

Many theories have been advanced to account for the variation in the level of unemployment both between nations, and, within nations between regions. These explanations have frequently centred on overly generous social security benefits, trade union power, taxes, or wage inflexibility. In a departure from this tradition Oswald (1996) has argued that disparities in unemployment may, at least in part, be attributable to variation in the rate of homeownership as the transaction costs associated with relocation for homeowners discourages workers from seeking employment outside their commuting area. The implication being that a high rate of homeownership increases the natural rate of unemployment and, conversely, that the declines in homeownership increase geographic mobility and labour market flexibility, contributing to the decline in the long-term rate of unemployment. Chapter 4 uses spatial panel models to investigate Oswald's hypothesis in the New Zealand context and finds that the homeownership rate has a positive and significant effect on the LMA unemployment rate close to Oswald's stylized fact of an increase in homeownership of 1 percentage point leading to an increase in the unemployment rate of 0.2 percentage points. Again, the importance of the spatial approach is confirmed by with the preferred spatial model yields parameter estimates some 5-11 percent lower than the standard fixed effects model indicating that in the non-spatial models some of the variation in regional unemployment rates has been incorrectly attributed to the explanatory variables rather than to the presence of some spatial spillover effect of unemployment across regions. To my knowledge this is the first time the Oswald hypothesis has been examined using spatial econometric methods.

Chapter 5 addresses the seemingly paradoxical situation that declines in official unemployment rates have often coincided with increases in hidden unemployment, particularly among low-skilled older workers.

One simple macro-level explanation of this apparent paradox is that periods of rapid job creation coincide with an asymmetry in inflows into and outflows from non-participation. Job creation leads to a falling flow from employment into all forms of non-participation, including retirement and incapacity benefit enrolment. Job creation also leads to an increase in the flow from unemployment into jobs, but the flow from the sickness and invalid benefit rolls into jobs is far less responsive to the upswing in the business cycle, given that benefit receipt does not require active job search and the net financial gains from employment would be relatively little for beneficiaries with low education and skill levels. Using spatial seemingly unrelated regression this chapter analyses the extent to which the spatial-temporal variation in local labour market outcomes and social security benefit uptake can be linked to compositional effects regarding the workers' human capital and demographic characteristics, the level and composition of labour demand, and the geography of local labour markets. Results of the estimations conducted in this chapter show that three factors in particular matter in the determination of participation and social security benefit uptake rates: the age structure of the population, the past performance of the regional labour market and the proportion of solo parents. The first two of these in particular being consistent with the explanatory framework detailed in this chapter.

Public infrastructural investment has been widely used as a tool for regional economic development, motivated by the view that such infrastructure is an intermediate public good that plays an active role in the production process. It is expected that increasing the stock of public infrastructure in a region will improve the productivity of existing firms and induce new firms to locate in the region. Consequently, regional output and employment will grow

(Lall, 2007). Endogenous growth suggests that it is even possible that the region's long-run growth rate will increase.

In the last empirical chapter of the thesis (Chapter 6) a simultaneous equations growth model of real income, population, land rent and public infrastructure investment is developed that allows the impact of local authority infrastructure spending in New Zealand to be assessed for the 1996-2006 period. Following estimation of this system of equations using a spatial three stage least squares (3SLS) procedure we find that an increase in local infrastructure spending increases population growth, real income and land values, but is itself endogenous and spatially correlated.

Each of the empirical chapters outlined above addresses a different strand in the literature on regional labour markets and economics and while not attempting to provide a comprehensive treatment of the evolution of local labour markets in New Zealand over the last several decades these chapters, together, attempt to illustrate the importance of explicitly accounting for spatial interaction in the analysis of regional economies.

The main conclusions of the empirical chapters, along with some discussion of future research directions are summarised in the final concluding chapter (Chapter 7).

CHAPTER 2

LOCAL LABOUR MARKET DATA: THEORETICAL FOUNDATIONS AND OPERATIONALISATION

2.1 INTRODUCTION

This chapter's function is threefold. Firstly it aims to discuss the theoretical foundations for the type of econometric modelling that is conducted in the empirical chapters, secondly it addresses several data issues central to the estimations conducted in this study, namely the delineation of LMA boundaries and the construction of the spatial weights matrix used throughout this study, and lastly the primary sources of data used in the study are identified.

The chapter is structured as follows. The first substantive section, section 2.2, of the chapter provides an overview of the theoretical context in which the empirical chapters are situated, namely the "New Economic Geography" (NEG) as a new paradigm to understand the spatial distribution of economic activity, as well as the need for spatial econometrics. The specific theory underpinning each empirical chapter and the accompanying literature are discussed chapter by chapter. The short introduction to NEG in this chapter is to provide an overarching narrative in which the specific empirical explorations that make up this study are embedded.

Section 2.3 discusses in general terms the analytical perspective adopted in the empirical portions of this study, that of spatial econometrics, and its relationship to NEG. Again the specific spatial econometric techniques used are discussed in the corresponding empirical chapters with the discussion here aimed at acquainting the reader with the defining features of Spatial Econometrics and illustrating the utility of this approach in addressing the problems considered in this study, which is the first one to consistently apply both popular developments in economics during the last two decades to a set of issues concerning New Zealand local labour markets.

As foreshadowed in the introduction, the concept of functional economic areas, and more specifically 'local labour markets', is central to the analysis conducted in this thesis. Section 2.4 is concerned with how the boundaries of the areas used here were determined. A rationale will be provided for the decision to use a reduced set of 58 LMAs rather than the full set of 140 initially derived by Papps and Newell (2002). In addition, some of the criticisms that have been made of the use of travel to work data to define local labour markets and of the Coombes algorithm to calculate the LMA boundaries are addressed.

The fifth and final section addresses the main sources of data used in the estimations conducted in the empirical chapters. Details of the definition and construction of specific variables are discussed in the chapters in which those variables appear.

2.2 ECONOMICS AND SPACE: THE NEW ECONOMIC GEOGRAPHY

From casual observation it is clear that economic activity is not uniformly distributed in space. This can hardly be surprising as different parts of a nation or the world differ in their climates, the fecundity of their soils, their endowment with natural resources and their natural accessibility to other regions, amongst other things (Ottaviano & Thisse, 2005, p. 1707). These features constitute a given in economic geography, and are termed 'first nature'. 'Second nature' is not given and is concerned with the spatial relations between economic agents. The locational choices of these agents, driven by transportation costs and external benefits of scale and co-location lead to agglomeration economies (Fujita & Mori, 2005; Krugman, 1993).

Echoing the concerns of an earlier generations of economic geographers (for example Kaldor, 1957; Myrdal, 1957; Ohlin, 1933) the new economic geography (NEG) of Fujita (1988), Krugman (1991) and Venables (1996) has, over the last twenty years, refocused attention on the uneven distribution of economic activity across space. In contrast to traditional neoclassical approaches which stress first nature explanations for the distribution of economic activity across space, the NEG approach emphasizes second nature geography.[1]

It is argued that that trade and external economies lead to increasing returns to scale and concentration, which in turn produce more specialised regions (e.g. Redding, 2010). Externalities arise as a result of access to specialized labour, the availability of specialist supplier chains, and the presence of technological spillovers, and once established, these lock-in and propagate the advantages of regional specialisation (in what Myrdal already called cumulative causation). As a result, regions become more sensitive to economic and technological shocks and region-specific economic cycles are much more likely (O'Leary, Murphy, Latreille, Blackaby, & Sloane, 2005, pp. 6-7). Opposing these centripetal forces are centrifugal forces that mitigate against specialisation and agglomeration, such as the relative immobility of some factors of production, the cost of transport and the negative externalities generated by excessive concentration, such as congestion, air pollution and demand induced rises in the price of land (Krugman, 1998, pp. 8-9). Thus the NEG story is primarily one of spatial externalities, and the consequences of the continual interplay of centripetal and centrifugal forces.

While many of the features of NEG are hardly new and have been recurrent concerns for a long time in the works of economic geographers and location theorists (Ottaviano & Thisse, 2005, p. 1708) the distinguishing feature of NEG is the use of general equilibrium models `a la Dixit and Stiglitz (1977)’ as a framework to allow these ideas to be subject to empirical scrutiny and policy analysis.

The development of NEG has not been without its critics, particularly amongst the ranks of economic geographers whose response to NEG has generally been unfavourable (Martin, 2011, p. 53). Many of these critiques have contrasted NEG with PEG, Proper Economic Geography. While both NEG and PEG

---

[1] See Fingleton and Fischer (2010) for a recent discussion of the Neoclassical and NEG approaches.

are interested in the spatial agglomeration of economic activity they differ fundamentally in the both their theoretical approach and the explanatory method they employ (Martin, 2011, p. 54). As indicated above NEG's approach has largely been in line with that of main stream economics while PEG theorising is primarily discursive and concerned with developing plausible narratives that emphasize cultural and socio-institutional factors as well as the economic. In Martins words economic geography proper entailed, "a firm commitment to studying real places (the recognition that local specificity matters) and the role of historico-institutional factors in the development of those places (1999, p. 80)."

This leads to a focus on actually existing spatial economic landscapes rather than the more abstract and idealised theorisations of NEG. Indeed PEG's main criticism of NEG is summed up by Martin and Sunley (2011) as being;

> The model world of NEG is a conceptually circumscribed and highly idealized one: a world in which the spatial structure of an abstract (typically two-region) economy is shaped entirely by the specific interaction of labour mobility, capital mobility and transport costs, all based on highly simplified assumptions about worker and firm behaviour, market structure, transport costs, market clearing and competition and congestion effects, while ignoring a whole raft of institutional, cultural and social factors. The claim of NEG theorists to have constructed a 'general model' of the location of economic activity that is applicable at all scales, from the local to the global, expressible in terms of just a few recurring fundamental relationships, is surely misplaced.
>
> (Martin & Sunley, 2011, p. 362)

Proponents of NEG have responded to such critiques by arguing that while approaches that emphasizes the uniqueness of each individual case and the specifics of history have their place they are not able to address the "what if" questions, the questions that ask if something were different, how would that change the economic outcomes? (Krugman, 2011, p. 3). It is questions of this nature that NEG seeks to explore, albeit at the expense of reducing the myriad determinants of the actual geographical structure of an economy to a few key parameters: transportation costs, economies of scale, and factor mobility. This reductionist approach while abstracting from much renders the analysis tractable and generalisable.

NEG is part of a broader concern in economics with spatial interaction. There has also been a push by some economists (such as Anselin, 2003) to shift from considering the individual in purely atomistic ways, and instead focusing on the economic actor as socially embedded and part of extended social networks (e.g. Akerlof, 1997; Glaeser, Sacerdote, & Scheinkman, 1996).

In such models agents' preferences, information, choices or outcomes are affected by other agents' behaviour directly (Conley & Topa, 2002, p. 2), as well as being mediated by markets. Given this construction, such models will frequently be spatial in nature. Conley & Topa (2003) cite an extensive literature dealing with a broad number of issues ranging from explanatory models of criminal offending in which neighbours choices (offend/ not offend) influence agent choices (see e.g. Glaeser, et al., 1996), to the role of local interactions and externalities in models of income inequality, and neighbourhood formation (Benabou, 1993; Durlauf, 1996a, 1996b; Fernandez & Rogerson, 1997) and topics close to NEG concerns such as knowledge spillovers, input-output linkages, and other economies of agglomeration used to explain the observed patterns of spatial concentration of firms in a given industry (Audretsch & Feldman, 1996; Ellison & Glaeser, 1997; Rauch, 1993).

2.3 SPATIAL ECONOMETRICS

The growing concern with spatial interaction resulting from the development of NEG has boosted the need for, and the development of, spatial econometric techniques. What spatial econometrics consists of as a field can be described in a number of ways. Paelink and Klaassen (1979, pp. 5-11) lists 5 definitive features in the first book length treatment of the field:

a) The role of spatial interdependence in spatial models;
b) The asymmetry in spatial relations;

c) The importance of explanatory factors located in other spaces;
d) Differentiation between ex-post and ex-ante interaction; and
e) Explicit modelling of space.

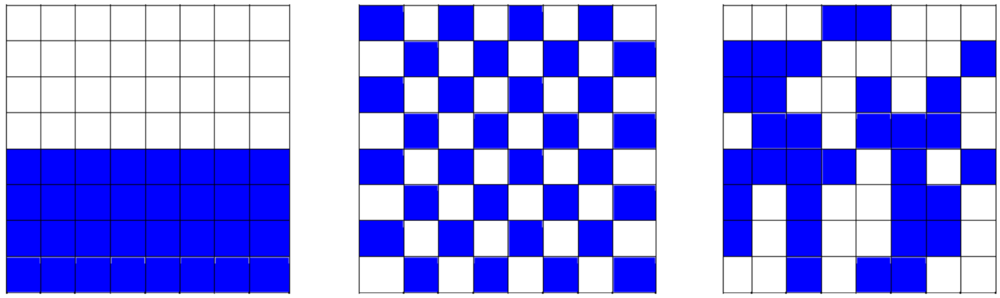
Anselin (1988a, p. 7) defines spatial econometrics as “the collection of techniques that deal with the peculiarities caused by space in the statistical analysis of regional science models” while Le Sage similarly characterises spatial econometrics in functional terms as being delineated from ‘standard’ econometrics by a concern with the problems in the analysis of data that has a locational component, namely spatial dependency and spatial heterogeneity in the relationships being investigated (LeSage, 1999, p. 2). Spatial econometrics can be seen then as arising from a pragmatic concern with the methodological consequences of spatial structure in economic phenomenon and is primarily concerned with:

1) The formal specification of spatial effects in econometric models,
2) The estimation of models that incorporate spatial effects,
3) Specification tests and diagnostics for the presence of spatial effects,
4) Spatial prediction.

Spatial structure can be seen as a consequence of what has come to be known as Tobler’s ‘‘First Law of Geography’’[2] and takes two forms: spatial autocorrelation and spatial heterogeneity. The first of these, spatial autocorrelation, is the term used to describe the presence of systematic spatial variation in a variable (Haining, 2001, p. 14763) and may take several forms.

[2] *“Everything is related to everything else, but near things are more related than distant things.”* (Tobler, 1970, p. 236)

Figure 2.1 Spatial Autocorrelation



Positive spatial autocorrelation   Negative spatial autocorrelation   No spatial autocorrelation

When high or low values of a random variable tend to cluster in space there is said to be positive spatial autocorrelation while when geographical areas tend to be surrounded by neighbours with very dissimilar values there is said to be negative spatial autocorrelation. Lastly when a phenomenon is randomly distributed in space, spatial autocorrelation is not present. Figure 1 graphically illustrates these 3 cases.

Turning to second form of spatial structure, when spatial structure is a result of interaction between neighbouring areas or regions it is quite possible that all areas are not equally influenced by their neighbours. For instance highly accessible places, say metropolitan areas with dense road networks and large concentrations of economic activity, will exert stronger effects on their neighbours than relatively isolated and peripheral regions (Longhi, Nijkamp, & Poot, 2006). Thus 'spatial heterogeneity'[3] results in non-stationarity of the relationship between observations and covariates,[4] clearly violating the constancy of association assumption made in standard econometrics.

In this thesis the focus is on the former of these effects, spatial autocorrelation while the latter, spatial heterogeneity, receives little attention. This is not to imply that spatial heterogeneity is in some way less important or less common than spatial autocorrelation but rather reflects the fact that the techniques developed to address spatial heterogeneity are predominantly

[3] While spatial heterogeneity is an undoubtedly important phenomenon the methods used in the empirical studies in this thesis have largely been developed to deal with the consequences of spatial autocorrelation.

[4] That is, the relationship varies geographically.

concerned with cross sectional data while the data used in this thesis are in the form of a panel.

For many common econometric techniques, particularly ordinary least squares, the potential presence of spatial dependence when using regional data may result in spatially correlated errors in the residuals of estimation, violating the Gauss-Markov assumption of uncorrelated random errors and more broadly the assumption of independence between observations. The consequences of ignoring the presence of spatial dependence in the data are nontrivial and, unlike some other difficulties, such deviations from normality are often not overcome by simple transformations of the data. In the presence of spatial dependence, Rao (1973) and Haining (1990, 2001) have found that OLS estimators are usually not optimal, while Underwood (1997) found that in the presence of positive spatial autocorrelation variance estimates are biased downward thereby increasing the likelihood of type 1 errors. Furthermore the presence of positive spatial autocorrelation that is not taken into account in regression analysis upwardly biases the coefficient of determination, exaggerating the fit of the model (Haining, 1990, 2001). Consequently, neglecting the possibility of spatial autocorrelation can lead to seriously biased parameter estimates and a flawed and misleading investigation (O'Sullivan & Unwin, 2003, pp. 28-30).

Given the difficulties that spatial autocorrelation poses for traditional econometric techniques and the desirability of explicitly modelling spatial heterogeneity, a wide range of techniques have been developed, and continue to be developed, to deal with these effects. Anselin (2010) provides a useful review of the development of these techniques since the foundational works of Paelinck and Klaassen (1979), Bartels and Ketellapper (1979), Bennett (1979) and Hordijk (1979)

Central too most of these methods is the spatial weights matrix (Anselin, Cohen, Cook, Gorr, & Tita, 2000, p. 231). For instance in the commonly used cross sectional spatial lag or spatial autoregression model (SAR) spatial dependence is incorporated by including a function of the dependent variable observed at other locations on the right hand side (Anselin, 1988a, p. 5).

$$y_i = g(y_{J_i}, \theta) + x_i\beta + \varepsilon_i \quad (2.1)$$

where J_i includes all the neighbouring locations *j* of *i* (but of course $j \neq i$). While the function *g* can in principle be very general and non-linear, in practice it is usually a linearly weighted combination of the values of the dependent variable in the neighbouring locations, with the weights together forming a spatial weights matrix. Normally *g* is simplified through the use of the spatial weights matrix *W*, giving the spatial lag model in matrix notation as,

$$y = \rho Wy + \alpha l_n + X\beta + \varepsilon \quad (2.2)$$

with ρ being the spatial autoregressive coefficient[5], l_n an identity matrix and ε an independently and identically distributed (i.i.d.) error term (LeSage & Pace, 2009, pp. 32-33).

Similarly in the case of the spatial error model (SEM), where spatial dependence is introduced through specifying a spatial process for the random disturbance term, we have:

$$y = \alpha l_n + X\beta + u \; with \; u = \theta Wu + \varepsilon \quad (2.3)$$

where *y* is a vector of observations on the dependent variable, *W* is again the spatial weights matrix, *X* is a matrix of observations on the explanatory variables, *u* is a vector of spatially autocorrelated error terms, ε is a vector of *independent and identically distributed (i.i.d.)* errors, and θ and β are parameters (LeSage & Pace, 2009, pp. 32-33).

The spatial weights matrix specifies the nature of the spatial interaction between the regions that make up the area of interest in a particular study and takes the form of a square matrix of dimension equal to the number of observations, with each row and column corresponding to a spatial unit. In its simplest form, an element w_{ij} of the weights matrix *W* is equal to one if locations *i* and *j* are neighbours, and equal to zero otherwise (the diagonal elements w_{ii} also equal zero). Commonly the weights matrix is row standardised so that

[5] The spatial autoregressive coefficient indicates the degree to which the dependent variable at location *i* ,y_i, is influenced by the values of *y* in neighbouring areas, y_{J_i}.

weights add up to one when summing over *j*, as this facilitates interpretation and comparison between models.

A wide range of criteria may be used to specify the spatial weights matrix, with Getis and Aldstadt (2004) identifying no fewer than twelve commonly used methods[6] and a plethora of lesser known or emergent approaches.[7] It should be noted that the construction of spatial weights matrices is not limited to geographic or Euclidean distance (Beck, Gleditsch, & Beardsley, 2006; Leenders, 2002); these matrices may be constructed on the basis of any kind of spatial interaction, such as the flow of goods or persons, or the regularity of air or train services between places. Indeed Conley and Topa (2002) take this even further by constructing indexes of distance between areas based on sociological factors, such as ethnicity and occupational structure. A more detailed discussion of spatial weights matrices can be found in Bavaud (1998).

Unfortunately, though the selection of the spatial weights matrix is a crucial decision in a spatial econometric analysis, there exists no clear cut means of making this decision with most such decisions being done in an ad hoc fashion governed primarily by convenience, convention and rules of thumb (Griffith, 1996, p. 65). In practice this means the researcher is confronted with 3 courses of action concerning the selection of a strategy for specifying the weights matrix (Aldstadt & Getis, 2006, p. 328);

1) They can adopt an a priori weighting scheme based upon such theoretical expectation as may exist. This approach has the advantage of positing an exogenous weighting scheme however it may not represent the reality that is embodied in their study data.
2) The weights matrix might be based on a simple geometric representation of spatial nearness such as contiguity or *n* nearest neighbours that roughly

---

6 Spatial contiguity, inverse distances raised to some power, length of shared borders divided by the perimeter, n^{th} nearest neighbours, ranked distances, constrained weights for an observation equal to some constant, all centroids within distance d and band width as the n^{th} nearest neighbours distance (Getis & Aldstadt, 2004).

7 These include bandwidth distance decay, Gaussian distance decline and tri-cube distance decline functions as examples. Their own AMOEBA methodology should also be added to this list (Aldstadt & Getis, 2006; Getis & Aldstadt, 2004).

capture the spirit of Tobler's first law by according weight to "neighbours". The selection of a simple first order contiguity schema as a basis for the weights matrix has been shown to be superior to *N* nearest neighbours and inverse distance weights matrices (Stakhovych & Bijmolt, 2009, p. 406) in Monte Carlo simulations with synthetic data providing some support for this choice. This approach is course is open to a similar criticism to the first strategy in that the weighting schema is essentially arbitrary though again it possesses the virtue of being exogenous.

3) Lastly, a weights matrix can be developed based on the observed spatial association in the empirical data under investigation. Such weightings might be derived from geostatistical methodologies such as the empirical variogram function or from local indicators of spatial association such as the Getis–Ord local statistic G_i^* (Ord & Getis, 1995). This however produces a weights matrix that is entirely endogenous and of limited power beyond the study region.

Which of these strategies for the specification of the weights matrix is adopted is largely a function of the purpose of the study, the first two strategies being appropriate to studies whose purpose is explanatory while the latter's aim is descriptive (Aldstadt & Getis, 2006, p. 329).

In terms of the above strategies for the specification of a spatial weights matrix, as this thesis's focus is explanatory or causal, this study adopts the first approach and uses a weights matrix based upon the reciprocal of the square of travel times between the largest urban areas in each LMA throughout. It is recognised however that specifying the weights matrix in this manner leads to a relative strongly connected matrix that may result in a downward bias in the estimate of spatial parameters, a reduction in the likelihood of detecting spatial effects and increase in probability that the nature of the spatial relationship will be incorrectly specified (see Florax & Rey (1995), Stetzer (1982) and, more recently, Smith (2009) and Stakhovych & Bijmolt, (2009) for detailed discussions of these issues). It is felt that despite these potential difficulties that this approach remains justifiable on the basis of common practice, the properties of transport cost function, the wide spread use of gravity models (in which spatial interactions are often considered proportional to the inverse of squared distance between centroids of regions, and on the broader ground of Tobler's first 'law' already mentioned earlier. The inverse square relation, of course, by according more weight to near neighbours than those more distant goes some way toward quantifying such a relation.

Turning now to the relationship between spatial econometrics and NEG, this relationship should not be seen in exclusive terms as many neoclassical studies have been conducted using the tools of spatial econometrics (see Koch (2008) for a recent extension of the neoclassical model to incorporate spatial spillovers) however there would seem to be a particular articulation between NEG's concern with spatial externalities and spatial econometrics focus on the estimation of models that incorporate spatial effects. Fingleton (2001) and Fingleton and Fischer (2010) argue that non-spatial econometric techniques are inappropriate to the testing of models congruent with NEG as spatial dependence is an inescapable facet of data at the regional level of resolution. Hence the relationship between NEG and spatial economics is founded on the perhaps trite insight that to test explicitly spatial models one must use spatially explicit methods.

2.4 CONSTRUCTING LOCAL LABOUR MARKET AREAS

It has long been recognised that functional economic areas are the most appropriate unit of analysis for examining regional economic activity (Stabler & Olfert, 1996, p. 206) as administrative areas such as Regional Council regions or territorial authorities tend to be rather arbitrary in terms of their boundaries with respect to economic relations. Administrative areas have largely served as the basis for most regional analyse in the past as most official statistics have been gathered or aggregated to administrative boundaries. These days, however, it is possible to build up regional data with any defined boundaries from very small geographical units of measurement, using GIS and related systems.

Consequently, there has been growth in the use of functional economic areas, notably in the analysis of various labour market phenomena (see for instance ONS and Coombes (1998), Casado-Diaz (2000), Papps and Newell (2002), and Watts (2002, 2004, 2005)).

Papps and Newell (2002) used travel to work data from the 1991 and 2001 census to define LMAs for New Zealand. The methodology used in the creation of the LMAs is discussed at length in Newell and Papps (2001) and Newell and Perry (2005). Briefly, following Coombes, Green, & Openshaw (1986) and Coombes (1996) Papps and Newell applied an algorithm that processed census data in four stages;

1) Area units were ranked according to the proportion of local residents working in the area unit (referred to as supply side or residential self containment) and those in the upper 20 percent or with a high rate of in-commuting were selected as starting points ('foci') to aggregate area units around. In-commuting is measured by the "job ratio" meaning the ratio of jobs at local workplaces to locally resident workers.
2) Foci that had high levels of commuting between them were linked together.
3) All the non-foci area units were assigned incrementally to the foci that they were most strongly attached to. This process commenced with the areas that had the strongest commuting links to the foci and ended with the area with the weakest links to other areas.
4) The 'proto travel to work catchments' were ranked according to the size and self containment criteria. Starting with those proto catchments furthest away from meeting the criteria of 70 percent self containment and 2000 minimum population, area units were reallocated to the emerging labour market area that had satisfied the size criteria or not as yet been rejected. This process continues until all remaining catchments meet the set criteria.

   (Newell et al., 2005, p. 160)

When applied to the New Zealand 1991 census data, the modified[8] Coombes algorithm produced labour markets with comparatively high levels of self-containment (typically at least 85 percent) and average workforce sizes of 9-10,000 though over half of the 140 1991 LMAs had fewer than the prescribed minimum of 2,000. For the 2001 census data the modified Coombes procedure produced 106 LMAs with an average employed population of 13 -14,000. Largely due to the superiority of the quality of 1991 over 2001 data, Papps and Newell recommended using the 1991 boundaries for analysis.

The 140 LMA level of breakdown was, for the kind of macro analysis undertaken in this study, too refined and it proved difficult to link regional characteristics from sources other than the census to this framework. To overcome this limitation the algorithm used to generate the LMAs was recalibrated by Papps and Newell to a larger target population of 17,700 (Papps & Newell, 2002, p. 20). This yielded 56 LMAs however subsequent refinement of the boundaries led to a spatial frame consisting of 58 LMAs (see Figure 2.2).

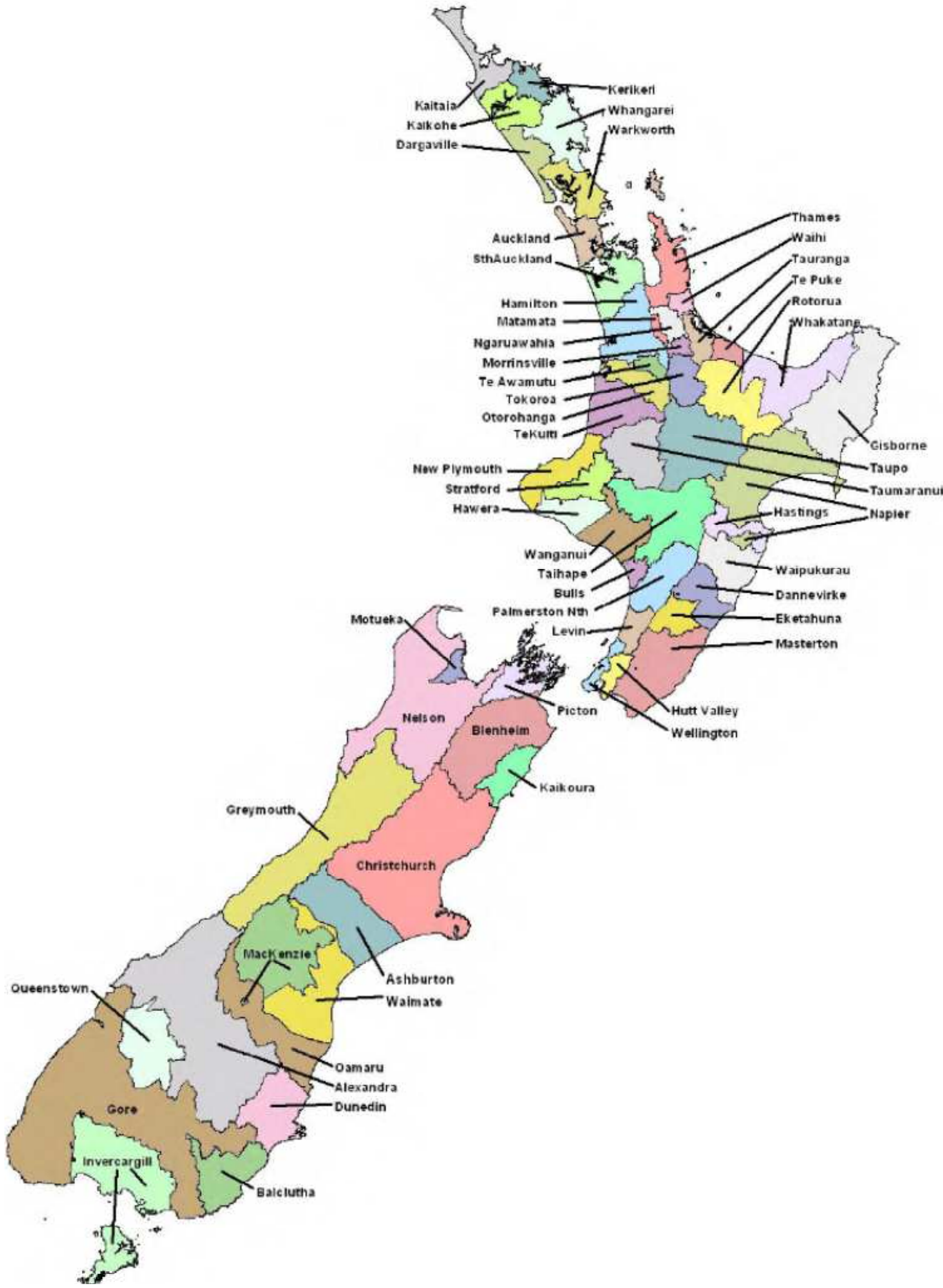
It should be noted that while the 58 LMAs are useful in the exploration of aggregate phenomena they do not completely reflect the underlying commuting patterns that are embedded in the 140 1991 LMAs. The 58 LMA suppress a portion of the heterogeneity in commuting behaviour through the incorporation of some small, but highly self-contained, rural centres into larger regions.

A number of criticisms of the approach taken here to the operationalisation of local labour markets might be made. For instance the use of the Coombes algorithm has been criticised by Mitchell & Watts (2010, p. 26) on the grounds that the geography created by the implementation of the algorithm is the result of a series of arbitrary choices as to parameter values that govern the selection of foci and 'proto travel to work catchments' and that the

[8] In the UK the travel to work data upon which the LMA regionalisation is based is only available as a 10 percent sample of the Census population. In New Zealand this data is available for all employed respondents to the Census allowing the modification of the methodology to allow the identification of smaller LMA than in the UK, particularly desirable given New Zealand’s small low density population (Newell & Perry, 2005, p. 159).

sensitivity of the final solution to these choices is hard to gauge without extensive post hoc experimentation.

Figure 2.2 New Zealand Labour Market Areas (LMA)



Further, while the use of travel to work data to define LMA boundaries maybe appealing it is rendered problematic by the heterogeneity of the commuting experience of different sections of the labour force. It has been well established for example that commuting behaviour varies markedly by, gender, age and skill level. Thus it is likely that the boundaries of LMA will vary by subgroup (Shuttleworth, 2007, p. 971) and hence the problem of defining a single geography of local labour markets will be rendered insoluble (Peck, 1996).

It is true that the methods used to construct the LMA boundaries are subject to a number of subjective judgements, that aggregation suppresses much that is interesting in the heterogeneity of labour market and commuting behaviour. However, the boundaries adopted for use here are defensible on the rather pragmatic grounds that while not perfect they represent an improvement on the administrative boundaries, being grounded in actual economic behaviour. Hence they trade off something in terms of heterogeneity for tractability in analysis and provide an adequate definition of the area over which the matching of supply and demand for labour occurs for a representative or notional worker.

2.5 DATA SOURCES

The data used throughout this thesis has been drawn primarily from the quinquennial New Zealand Census of Population and Dwellings 1986, 1991, 1996, 2001 and 2006 aggregated to the reduced set of 58 LMA boundaries. For the census years 1986, 1991, 1996 and 2001 this aggregation was generously made available by the Motu Economic and Public Policy Research Institute (Motu) while for the 2006 census year the aggregation was performed by the author using the mapping of 2006 census area units to 58 LMA boundaries provided by Motu.

In Chapter 6, data are also drawn from Motu's Quotable Value New Zealand (QVNZ) sales and valuation database, Motu's Regional and Local Authorities Finance database and the statistical profiles of individual councils available from the Department of Internal Affairs. Data from the QVNZ sales and valuation database was made available at census area unit level which was then straightforwardly aggregated to the 58 LMA boundaries. The Regional and Local Authorities Finance database and the statistical profiles of individual councils were available only at Territorial Authority level which required more extensive manipulation to achieve the desired aggregation to these boundaries. Details of how this was done can be found in Chapter 6.

CHAPTER 3

A DYNAMIC SHIFT-SHARE AND EXPLORATORY SPATIAL ANALYSIS OF EMPLOYMENT CHANGE IN NEW ZEALAND LABOUR MARKET AREAS[1]

3.1 Introduction

This chapter provides an analysis of the changes in regional employment outcomes in New Zealand during the period 1986-2006, i.e. from the restructuring of the 1980s and early 1990s, with its attendant general decline in employment levels, to the relative economic buoyancy of the 2001-2006 period.

As noted in Chapter 1.2 the reform process and its aftermath contributed, along with the forces of globalisation, to a widening of the income distribution, both across individuals and across regions, and an increase in sub-national diversity in terms of the regions' demographic, economic and social features (Pool, Baxendine, Cochrane, & Lindop, 2006).

One classic hypothesis is that regional economic wellbeing is a function of a region's 'endowment' of industries. Deviation of regional growth from national growth can then be explained by the presence of industries in the region that have been growing above or below average nationwide. This hypothesis has led to a popular decomposition of regional employment growth into a national growth effect, an industry-mix effect and a residual. The latter is often labelled the competitive or differential effect. Hence this decomposition is referred to in the literature as shift-share analysis, which has been a popular descriptive tool of regional analysis since the 1960s (see for surveys Dinc, Haynes, & Qiangsheng, 1998; Knudsen, 2000; Loveridge & Selting, 1998). Section 3.2 reviews the basic methodology.

[1] An earlier New Zealand shift share analysis, up to 2001, has been published in Cochrane and Poot (2008).

Despite its enduring popularity, shift-share analysis has also attracted severe criticism over the years. The weaknesses of this technique include sensitivity to the level of industry aggregation and the omission of the impact of intra-regional inter-industry linkages. It is clear that shift-share analysis by itself is simply an accounting procedure and does not constitute a model of the regional economy. However, the decomposition of regional employment growth into a national growth effect, an industry mix effect and a residual effect can be a useful stepping stone for the further analysis of causes of regional growth differentials that will be conducted in chapter 6. This motivates the adoption of the shift-share approach in the present chapter.

Shift-share analysis has had little application in New Zealand, with Patterson's (1989) study of regional employment change 1981-86 being one of the few exceptions. We present the results of a classic shift-share analysis of employment growth in New Zealand over four periods: 1986-1991, 1991-1996, 1996-2001 and 2001-2006 in section 3.3.

In a multi-period shift-share analysis it is possible to quantify the effect of changing industry shares on the industry mix component of regional employment change. The results are described in Section 3.4.

Section 3.5 provides some alternative approaches to shift-share analysis that have been introduced in the literature in order to overcome some of the weaknesses of the classic method. However, it is shown that in this New Zealand application these refinements add little to our understanding of the role of the industry-mix effect vis-à-vis the regional shift effects in regional growth.

Shift-share analysis has traditionally been remarkably devoid of an explicitly spatial component. While regions have been treated as geographic entities, interactions between them, based on their geographical location and economic interrelations, have mostly been ignored. However, this situation has started to change in recent years. Nazara and Hewings (2004) proposed an extension to shift-share analysis that takes account of growth in neighbouring regions when decomposing growth in a particular region. You, Chen, Yang, & Huang (2010) modified the traditional shift-share method by supplementing it with an approach derived from the spatial expansion model (Casetti, 1972; Fotheringham, Brunsdon, & Charlton, 2000, p. 106).

Further, Le Gallo and Kamarianakis (2011) have investigated the evolution of regional productivity disparities in the European Union from 1975 to 2002 using a combination of shift –share and spatial econometric techniques, namely exploratory spatial analysis and space–time econometric models.

A straightforward exploratory approach to introducing a spatial element into shift-share analysis is taken in this chapter. Specifically Local Indicators of Spatial Association (LISA) and the Moran scatter plot (Anselin, 2005) are used as tools of exploratory data analysis in the shift-share context. This approach is adopted on the basis that it combines the simplicity and familiarity of the standard non-spatial shift-share approach with recognition of the spatial structure of employment in New Zealand. This places this chapter closer to the work of Le Gallo and Kamarianakis (2011) than that of You et al. (2010) and Nazara and Hewings (2004).

The results of the spatial analysis are presented in section 3.6 while section 3.7 concludes the chapter. As elsewhere in this thesis the spatial frame used is that of the 58 functionally defined labour market areas while the data used are drawn largely from the censuses of population and dwelling over the 1986-2006 period.

3.2 Classic Multi-Period Shift Share Analysis

In a small open economy such as New Zealand, the demand for output in many sectors in any particular region is predominantly a function of national economic conditions and international influences. It is plausible that regions do well when they are ‘endowed’ with industries that are experiencing a growth in demand nationwide, for example due to favourable terms of trade or booming demand overseas. Shift-share analysis is a simple tool to quantify the importance of this endowment effect. Of course, by carrying out the analysis for successive periods, the change in the regional ‘endowment’ of industries can be taken into account.

The impact of a change in industry shares on the industry-mix effect in each region is quantified explicitly in Section 3.4. The shift-share methodology provides a decomposition of employment change but, beyond identifying the importance of an industry-mix effect, it does not constitute a model of regional employment change. It therefore complements rather than substitutes for regional econometric models such as Choy, Maré, & Mawson's (2002) Vector Autoregression (VAR) model of regional employment levels, unemployment rates, labour force participation and wages in New Zealand. The importance of industry composition for the regional business cycles in New Zealand was confirmed by Hall and McDermott (2007). Using various statistical methods, Hall and McDermott identified meaningful regional business cycles and found that relatively rural (i.e. primary sector driven) regions are strongly influenced by external economic shocks such as the terms of trade and the real price of milk solids. Thus, with external influences playing a major role in the relative fortunes of New Zealand industries, the 'endowment effect' of industry composition in regions is likely to be rather important. Shift-share analysis that quantifies the industry mix effect provides therefore useful insight into regional employment growth.

However, before describing the calculations and the results, it is useful to elaborate on the limitations of the methodology (see also, e.g. Mulligan & Molin, 2004). First, the results are sensitive to the extent of disaggregation. The more industries are disaggregated, the more important the industry-mix effect is relative to the regional shift effect. On the other hand, the more refined the regional breakdown, the more important is the latter effect. Interpretation problems also arise when regions are of very different population sizes. In the New Zealand application in this chapter, the size differential between the smallest LMA (Kaikoura) and the largest (Auckland) LMA is a factor of approximately 175 times.

Another common issue is the choice of the reference region, which can be the nation, but alternatively can also be some other benchmark. However, the largest LMA (Auckland) accounts for between 17 to 20 percent of employment and the nation remains the natural benchmark.

Caution is also needed with the interpretation of the competitive effect as indicative of the average degree of competitiveness of all industries in the region. Although the regional shift effect is often referred to as a competitive effect, it is simply calculated as a residual. A region can have a negative competitive effect when most of its industries are highly efficient and have experienced rapid employment growth, but a few large industries in the region are in decline.

Another weakness of shift-share analysis is that it does not take intra-regional inter-industry linkages into account. For example, regional employment growth in an export sector (say, the dairy farming sector) is likely to spill over to sectors such as dairy product manufacturing or those providing farming inputs in that region even though other manufacturing employment may have been in decline. The growth of manufacturing employment in that region is then quantified in the region's shift component of overall employment change, but it would be wrong to interpret this as evidence of growing competitiveness of the manufacturing sector in that region as it is just due to the spillover effect of growth in dairy farming. There is unfortunately no information available on regional input-output transactions in New Zealand. Regional impact studies use multipliers derived by indirect methods such as described by Butcher (1985). Without input-output information, the extent of cross-industry intra-regional spillovers cannot be quantified.

However, the most important weakness of the shift-share methodology is that it says nothing about efficiency and productivity. In certain regions, rapid employment growth may be due to expansion of public services funded by central government. If such expansionary fiscal policy targets specific regions, shift-share analysis will suggest a large competitive growth component in those regions. This is, however, unlikely to be sustainable growth, as the employment is funded with income generated outside the region. Similarly, a boom in new dwelling construction or major infrastructure projects (e.g. motorway construction) in some regions may generate significant employment growth, but again of an unsustainable nature. Ideally, regional growth should disentangle capital productivity growth, labour productivity growth and total factor productivity growth (e.g., Haynes & Dinc, 1997). This line of research would require information on regional sectoral outputs and capital stocks, besides regional employment levels. The absence of such data makes productivity analysis at the regional level infeasible in New Zealand.

Despite these weaknesses, shift-share analysis remains a popular tool for regional economic analysis simply because the data demands are few and the basic idea of accounting for composition effects is as powerful as that of age standardisation in demography. As many authors (such as Dinc, et al., 1998) have noted, the classic shift-share model and it extensions remain a useful descriptive technique that can provide various kinds of information about the regional economy. A formal description of the shift-share decomposition follows. The classic decomposition is (Dunn, 1960):

$$\Delta E_{ij}^{t} \equiv E_{ij}^{t} - E_{ij}^{t-1} \equiv NE_{ij}^{t} + IM_{ij}^{t} + CE_{ij}^{t} \qquad (3.1)$$

where E_{ij}^{t} is employment in the i^{th} industry in the j^{th} region at time *t*, NE_{ij}^{t} is the National Growth Effect on industry *i* in the j^{th} region between times (*t*-1) and *t*; IM_{ij}^{t} is the Industry Mix Effect on industry *i* in the j^{th} region between times (*t*-1) and *t* and CE_{ij}^{t} is the Competitive Effect on industry *i* in the j^{th} region between times (*t*-1) and *t*. The three effects are computed as follows;

$$NE_{ij}^{t} = g_{oo}^{t} \times E_{ij}^{t-1} \qquad (3.2)$$

$$IM_{g}^{t} = (g_{i0}^{t} - g_{00}^{t}) \times E_{ij}^{t-1} \qquad (3.3)$$

$$CE_{ij}^{t} = \left(g_{ij}^{t} - g_{i0}^{t}\right) \times E_{ij}^{t-1} \qquad (3.4)$$

Where g_{ij}^{t} is the growth rate of employment in industry *i* and region *j* between times (*t*-1) and *t*; g_{i0}^{t} is the growth rate of nationwide employment in industry *i* between times *(t-1)* and *t*; and g_{oo}^{t} is the growth rate of in nationwide total employment in region *(t-1)* and *t.*

Using (3.1) to (3.4) it is easy to see that if we aggregate employment in each region *j* over industries *i* and define g_{0j}^{t} as the growth rate of total employment in region *j* between times (*t*−1) and *t,* this growth rate can be decomposed in a national growth rate, a growth rate due to the industry-mix and a residual that is referred to as the competitive growth rate r_j^t. By definition, the competitive growth rate of the region *j* at time *t* can then be expressed mathematically as

$$r_j^t \equiv g_{0j}^t - g_{00}^t - \sum_i w_{ij}^{t-1} \left(g_{i0}^t - g_{00}^t\right) \tag{3.5}$$

Where w_{ij}^{t-1} is the fraction of employment in region *j* that is in industry *i* at time (*t*−1). This equation clearly shows that a region's competitive growth rate is the region's total employment growth rate minus the national employment growth rate minus the growth due to the industry mix in the region. Equation (3.5) also shows that the industry-mix growth rate is a weighted average of national sectoral growth rates, with the weights being the shares of the various sectors in regional employment at the beginning of the period under consideration.

3.3 Results of Classic Shift Share Analysis.

The analysis in this chapter is based on 'head count employment', i.e. no differentiation is made between full and part-time employment, both are treated equally.[2] It is useful to consider first national employment levels and change as a benchmark. Table 3.1 shows the national employment in New Zealand in 1986 was around 1.5 million from a total population of about 3.3 million. Agriculture accounted for 10.9 percent of total employment. Agricultural exports remain a driving force in the New Zealand economy. The share of government and social services (24.1 percent) was greater than that of manufacturing (21.3 percent). Tourism is also important, as indicated by the share of retail and hospitality (19.7 percent).

[2] For a shift-share analysis in terms of fulltime equivalent employment, see Baxendine, Cochrane, & Poot (2005). The results are qualitatively similar.

Table 3.1 National Employment by Sector, 1986 -2006.

		Percentage Change			
	Percent	1986-91	1991-96	1996-01	2001-06
Agriculture	10.9	-12.1	5.5	-4.5	-3.7
Mining	0.4	-25.6	-9.4	-17.3	22.6
Manufacturing	21.3	-27.0	0.6	-3.7	1.0
Utilities	1.1	-29.8	-19.7	-32.6	2.7
Construction	6.9	-16.8	10.8	10.4	42.1
Retail & Hospitality	19.7	-2.7	27.9	6.7	13.4
Transport & Communications	7.5	-23.5	2.1	3.4	11.1
Financial	8.3	31.2	32.8	15.2	28.9
Government & Social Services	24.1	3.0	1.9	15.2	14.5
National Employment	1484847	-7.6	11.4	7.0	14.5

In the decade following 1984, New Zealand embarked on a programme of radical economic policy change, as discussed in chapter 1. Table 3.1 shows that the first half of this period of restructuring was accompanied by significant reductions in employment in all but the financial services and the government and social services sectors. Both the financial services and the government and social services sectors employment growth is high throughout the period considered here (1986-2006), with the exception of 1991-96 when this sector's employment growth was positive (2 percent) but relatively low. Manufacturing in particular suffered a major loss of employment with employment levels falling by 27 percent between 1986 and 1991.[3] Subsequently, there was some recovery, but manufacturing employment never returned to its 1986 levels with only negligible growth in the 1991-96 and 2001-06 periods (around 1 percent) and further decline in 1996-01 (-3.7 percent). In contrast construction grew strongly post 1991, with growth of 10 to 11 percent in each of the periods 1991-96 and 1996-01 and of over 40 percent between 2001 and 2006. Similarly employment in the retail and hospitality sector recovered well post 1991 with strong growth in the 1991-96 period (28 percent) continuing in both 1996-01 (7 percent) and 2001-06 (13 percent).

The potential importance of industry mix can be seen from Table 3.2, which reports Location Quotients for industry sectors by LMA in 1986. The Location

[3] The percentage employment loss in the Utilities Sector was larger than in manufacturing, at -29.8 percent, but utilities share in employment in 1986 was only 1.1 percent compared to manufacturing's 21.3 percent.

Quotient is a common way of quantifying how concentrated a particular industry is in a region as compared to a reference area, in this case the nation as a whole[4]. Formally the Location Quotient is defined as:

$$LQ = \frac{e_{ir}/e_r}{E_i/E} \tag{3.6}$$

Where: e_{ir} is the employment in an area in industry *i*

e_r *is the total employment in an area*

E_i is the total employment in industry *i* in the reference area (the nation)

E is the total employment in the reference area (the nation)

The interpretation of the Location Quotient is straight forward with values less than 1 indicating that the area in question has proportionally less employment in sector *i* than the reference area, 1 an equivalent share and more than 1 a greater share or 'specialization' in an industry than the reference area.

It is clear that there is very little agricultural employment in the main city LMAs Auckland, Wellington, Christchurch and Dunedin, but several small rural LMA have agricultural LQ greater than four. South Auckland and Tokoroa have manufacturing LQs greater than 1.5. The retail and hospitality sector LQ is relatively high in Queenstown (2.01), a major tourist destination.

Government and social services are very important in the capital, Wellington but also in the small LMAs of Bulls and Taihape. These latter two cases can be explained by the presence of a large Royal New Zealand Airforce base in the case of Bulls, and the role of Taihape as a rail hub prior to the electrification of the main trunk line and the restructuring of the railways.

[4] Use of the Location Quotient dates back to at least the work of Florence (Florence, 1939) and Florence, Fritz, & Gilles (1943).

Table 3.2 Location Quotients of New Zealand Labour market Areas 1986, Single Digit Industries.

		1986								
		Industry								
ID	LMA Name	Agriculture	Mining	Manufacturing	Utilities	Construction	Retail & Hospitality	Transport & Communications	Financial	Government & Social Services
1	Kaitaia	2.58	1.59	0.39	0.73	1.39	0.94	0.77	0.57	0.99
2	Kerikeri	2.33	1.95	0.66	0.40	1.09	1.10	0.77	0.63	0.80
3	Kaikohe	2.63	0.47	0.57	1.22	1.09	0.79	0.91	0.41	1.03
4	Whangarei	1.13	0.98	0.87	1.31	2.01	0.95	0.95	0.69	0.92
5	Dargaville	3.57	0.67	0.58	0.96	1.10	0.77	0.58	0.39	0.72
6	Warkworth	3.57	1.00	0.68	0.80	1.16	0.74	0.77	0.49	0.54
7	Auckland	0.19	0.17	1.07	0.63	1.03	1.14	1.14	1.52	0.99
8	SthAuckland	0.43	0.79	1.57	0.70	0.98	1.00	1.01	0.93	0.80
9	Thames	2.50	1.06	0.78	0.84	1.30	0.94	0.63	0.51	0.77
10	Waihi	1.80	3.54	0.90	1.08	1.44	0.97	0.78	0.57	0.79
11	Ngaruawahia	4.60	0.27	0.59	2.74	0.64	0.50	0.34	0.42	0.58
12	Morrinsville	2.51	1.61	0.95	0.78	0.93	0.99	0.66	0.57	0.64
13	Matamata	2.94	1.97	0.71	0.38	1.25	0.94	0.54	0.66	0.63
14	Hamilton	1.07	4.41	0.82	2.06	1.08	0.95	0.78	0.94	1.13
15	Te Awamutu	2.49	0.51	0.51	0.87	1.01	0.79	0.51	0.75	1.18
16	Otorohanga	4.59	1.06	0.34	0.48	0.65	0.64	0.40	0.39	0.77
17	Tokoroa	1.89	0.57	1.67	1.14	0.74	0.73	0.59	0.35	0.65
18	TeKuiti	3.30	9.93	0.37	1.95	0.96	0.78	0.88	0.43	0.75
19	Taupo	1.70	1.65	0.57	4.83	1.61	1.21	0.60	0.55	0.82
20	Te Puke	4.20	0.53	0.82	0.36	0.66	0.63	0.54	0.46	0.47
21	Tauranga	1.28	0.24	0.77	0.88	1.32	1.10	1.16	0.98	0.88

Table 3.2 Location Quotients of New Zealand Labour market Areas 1986, Single Digit Industries. (cont)

		1986								
		Industry								
ID	**LMA Name**	**Agriculture**	**Mining**	**Manufacturing**	**Utilities**	**Construction**	**Retail & Hospitality**	**Transport & Communications**	**Financial**	**Government & Social Services**
22	Rotorua	1.48	0.30	0.76	0.79	1.07	1.13	0.85	0.77	1.02
23	Whakatane	1.86	0.17	1.31	1.11	0.87	0.87	0.55	0.50	0.80
24	Gisborne	2.07	0.46	0.79	0.69	1.05	0.91	0.70	0.68	0.99
25	Hastings	1.49	0.26	1.36	0.84	0.84	0.97	0.48	0.73	0.81
26	Napier	1.27	0.20	0.97	1.24	0.93	0.99	1.17	0.73	0.98
27	Waipukurau	3.20	1.64	0.96	0.68	0.78	0.65	0.59	0.47	0.70
28	New Plymouth	1.34	5.29	0.95	1.98	1.22	0.95	0.91	0.78	0.86
29	Stratford	2.60	2.94	0.74	3.40	1.19	0.81	0.68	0.47	0.76
30	Hawera	2.95	4.09	0.87	1.30	0.71	0.76	0.49	0.49	0.78
31	Taumaranui	2.43	1.20	0.50	2.20	1.07	0.87	1.28	0.40	0.94
32	Taihape	2.70	0.00	0.24	0.74	1.08	0.65	0.79	0.28	1.50
33	Wanganui	0.89	1.04	1.01	1.01	1.17	0.98	0.85	0.81	1.12
34	Bulls	1.63	1.09	0.80	0.42	0.82	0.78	0.65	0.48	1.44
35	Palmerston Nth	0.93	0.10	0.93	1.02	0.90	0.97	0.96	0.79	1.24
36	Dannevirke	3.42	0.56	0.78	0.76	0.68	0.72	0.60	0.50	0.73
37	Eketahuna	3.29	0.00	0.83	1.24	0.82	0.69	0.78	0.49	0.67
38	Levin	1.40	0.26	1.12	1.41	0.88	0.89	0.61	0.44	1.14
39	Hutt Valley	0.08	0.11	1.12	1.23	1.03	1.00	1.16	1.34	1.15
40	Wellington	0.08	0.49	0.60	0.69	0.85	1.00	1.41	1.94	1.39
41	Masterton	2.13	0.68	0.97	0.97	0.89	0.85	0.68	0.66	0.89
42	Motueka	4.53	0.61	0.60	0.36	0.61	0.69	0.54	0.39	0.51

Table 3.2 Location Quotients of New Zealand Labour market Areas 1986, Single Digit Industries. (cont)

		1986								
		Industry								
ID	LMA Name	Agriculture	Mining	Manufacturing	Utilities	Construction	Retail & Hospitality	Transport & Communications	Financial	Government & Social Services
43	Nelson	1.55	3.31	0.83	1.03	1.02	0.94	1.01	0.68	1.01
44	Picton	2.51	0.00	0.67	0.45	0.69	1.10	1.96	0.26	0.62
45	Blenheim	1.58	1.54	0.67	0.93	1.03	0.96	1.08	0.65	1.15
46	Kaikoura	3.21	2.61	0.43	0.60	1.30	0.94	1.34	0.18	0.64
47	Greymouth	1.51	11.62	0.73	1.51	1.01	0.93	1.11	0.51	1.00
48	Christchurch	0.61	0.18	1.13	0.74	0.81	1.05	1.11	0.91	1.10
49	Ashburton	2.90	0.46	0.77	1.19	0.79	0.95	0.69	0.55	0.70
50	Waimate	1.47	0.17	1.08	0.93	0.81	0.97	1.00	0.65	0.93
51	MacKenzie	2.95	0.34	0.10	4.95	1.82	1.25	0.76	0.13	0.68
52	Oamaru	1.71	1.04	1.07	2.68	0.82	1.03	0.68	0.47	0.85
53	Alexandra	2.36	0.91	0.27	1.89	3.07	1.00	0.76	0.51	0.65
54	Queenstown	0.79	0.66	0.16	0.42	1.86	2.01	1.54	0.79	0.70
55	Dunedin	0.36	0.34	0.93	1.12	0.94	1.03	1.17	0.94	1.31
56	Balclutha	3.07	0.82	1.20	0.99	0.63	0.66	0.58	0.35	0.64
57	Gore	3.39	1.13	0.77	1.06	0.66	0.88	0.77	0.39	0.60
58	Invercargill	1.43	2.55	1.10	1.04	0.77	0.94	0.97	0.76	0.89

Table 3.3 reports employment growth in the LMAs in the four inter-censal periods 1986-1991, 1991-1996, 1996-2001 and 2001-2006 as well as the four-period average. The final column of Table 3.3 ranks the LMAs in accordance of their average four period employment growth from the highest, Queenstown (31.8 percent) to the lowest, Tokoroa which declined by 8.3 percent. Table 3.3 also reports a classic shift-share decomposition of this employment growth.

Table 3.3 reinforces the well known fact that the 1986-91 period of radical economic reform, restructuring and a cyclical downturn at the end of the period coincided with sharp employment declines in most sectors as noted above. Overall total New Zealand employment declined by 7.6 percent (see Table 3.1 and the first NE column of Table 3.3) in this period. The 1991-1996 period saw a recovery with employment growth in most sectors, particularly in financial and business services and the hospitality industry, though the utilities and mining sectors continued to experience strong declines while manufacturing stagnated. Although some commentators have interpreted this period as providing clear evidence of the pay-off of post-1984 economic liberalisation and reforms (Evans, et al., 1996), and head count employment recovered strongly, it can be calculated that at the national level full-time equivalent (FTE) employment growth remained insufficient to return to 1986 levels of FTE employment. Total employment growth over this period was 11.4 percent. The discrepancy with FTE employment growth indicates that employment creation in this period was biased in favour of part-time employment. For the period 1996 to 2006 there was overall strong employment growth, 7 percent for 1996-2001 and 14.5 percent for 2001-2006, although the agricultural sector continued to decline and employment growth in manufacturing was sluggish at best.

Table 3.3 Classic Shift-Share Decomposition of Total Employment Growth in New Zealand Labour Market Area.

		1986-1991				1991-1996				1996-2001				2001-2006				Four Period Averages				
ID	Name	ΔE	NE	IM	CE	ΔE	NE	IM	CE	ΔE	NE	IM	CE	ΔE	NE	IM	CE	ΔE	NE	IM	CE	Rank
1	Kaitaia	-12.3	-7.6	0.3	-5.0	15.5	11.4	-1.0	5.1	5.5	7.0	-1.7	0.2	14.1	14.5	-2.8	2.4	5.7	6.3	-1.3	0.7	21
2	Kerikeri	-10.2	-7.6	-0.6	-2.0	5.4	11.4	-0.2	-5.9	28.8	7.0	-0.8	22.5	20.1	14.5	-1.1	6.7	11.0	6.3	-0.7	5.4	5
3	Kaikohe	-23.2	-7.6	-1.0	-14.6	-4.2	11.4	-1.8	-13.9	6.4	7.0	-1.5	0.8	9.3	14.5	-3.7	-1.5	-2.9	6.3	-2.0	-7.3	55
4	Whangarei	-18.3	-7.6	-1.4	-9.3	10.7	11.4	-0.7	0.0	6.6	7.0	-0.6	0.1	18.3	14.5	-0.5	4.3	4.3	6.3	-0.8	-1.2	24
5	Dargaville	-16.4	-7.6	-2.0	-6.9	8.2	11.4	-2.5	-0.8	-2.6	7.0	-4.4	-5.2	3.4	14.5	-5.9	-5.2	-1.8	6.3	-3.7	-4.5	50
6	Warkworth	-3.3	-7.6	-2.8	7.1	19.1	11.4	-2.0	9.6	14.1	7.0	-3.5	10.5	20.1	14.5	-3.0	8.6	12.5	6.3	-2.8	9.0	3
7	Auckland	-2.1	-7.6	1.9	3.6	16.1	11.4	2.2	2.5	10.0	7.0	1.6	1.4	16.8	14.5	2.6	-0.4	10.2	6.3	2.1	1.8	8
8	SthAuckland	-7.9	-7.6	-2.7	2.5	13.5	11.4	0.1	1.9	11.5	7.0	-0.4	4.8	18.8	14.5	0.5	3.8	9.0	6.3	-0.6	3.2	10
9	Thames	0.6	-7.6	-1.7	9.9	14.1	11.4	-1.1	3.7	6.6	7.0	-1.7	1.3	16.6	14.5	-1.6	3.6	9.5	6.3	-1.5	4.7	9
10	Waihi	-9.0	-7.6	-2.1	0.8	10.9	11.4	-1.4	0.9	4.0	7.0	-2.4	-0.6	11.4	14.5	-1.1	-2.0	4.3	6.3	-1.8	-0.2	23
11	Ngaruawahia	-5.2	-7.6	-2.8	5.3	-2.8	11.4	-4.0	-10.2	-6.6	7.0	-5.7	-8.0	8.7	14.5	-7.8	2.0	-1.5	6.3	-5.1	-2.7	49
12	Morrinsville	-6.0	-7.6	-2.4	4.0	7.1	11.4	-1.9	-2.4	5.8	7.0	-3.4	2.1	8.5	14.5	-3.6	-2.4	3.8	6.3	-2.8	0.3	25
13	Matamata	-8.3	-7.6	-1.4	0.7	5.7	11.4	-1.5	-4.2	2.7	7.0	-2.5	-1.8	7.6	14.5	-3.4	-3.5	1.9	6.3	-2.2	-2.2	33
14	Hamilton	-6.2	-7.6	0.5	0.9	12.7	11.4	-0.6	1.9	8.7	7.0	0.2	1.5	16.7	14.5	0.1	2.1	8.0	6.3	0.0	1.6	14
15	Te Awamutu	-6.7	-7.6	1.4	-0.4	9.7	11.4	-1.9	0.1	6.0	7.0	-1.1	0.0	14.2	14.5	-2.4	2.0	5.8	6.3	-1.0	0.4	19
16	Otorohanga	-11.3	-7.6	-0.9	-2.8	6.4	11.4	-3.1	-1.9	1.8	7.0	-4.6	-0.6	6.3	14.5	-7.2	-1.0	0.8	6.3	-4.0	-1.6	40
17	Tokoroa	-21.2	-7.6	-5.8	-7.8	-6.6	11.4	-3.4	-14.6	-2.0	7.0	-3.8	-5.3	-3.3	14.5	-5.2	-12.6	-8.3	6.3	-4.6	-10.1	58
18	TeKuiti	-15.3	-7.6	-1.9	-5.8	4.5	11.4	-3.1	-3.9	5.1	7.0	-4.3	2.4	1.3	14.5	-5.3	-7.9	-1.1	6.3	-3.7	-3.8	46
19	Taupo	-5.7	-7.6	-1.1	3.1	14.5	11.4	-0.5	3.6	6.9	7.0	-1.5	1.3	15.5	14.5	-0.8	1.8	7.8	6.3	-1.0	2.5	15
20	Te Puke	-10.6	-7.6	-3.3	0.3	7.7	11.4	-2.9	-0.8	11.7	7.0	-4.0	8.7	17.4	14.5	-5.7	8.6	6.6	6.3	-4.0	4.2	17
21	Tauranga	-0.2	-7.6	0.2	7.2	24.9	11.4	0.3	13.1	19.8	7.0	-0.2	12.9	25.7	14.5	0.6	10.5	17.5	6.3	0.2	11.0	2
22	Rotorua	-16.3	-7.6	0.4	-9.2	11.2	11.4	0.3	-0.6	2.6	7.0	0.0	-4.5	7.5	14.5	-0.9	-6.0	1.2	6.3	0.0	-5.1	36
23	Whakatane	-14.1	-7.6	-3.3	-3.2	5.8	11.4	-1.7	-4.0	4.9	7.0	-1.8	-0.3	8.2	14.5	-3.0	-3.3	1.2	6.3	-2.5	-2.7	37

Table 3.3 Classic Shift-Share Decomposition of Total Employment Growth in New Zealand Labour Market Area. (cont)

		1986-1991				1991-1996				1996-2001				2001-2006				Four Period Averages				
ID	**Name**	**ΔE**	**NE**	**IM**	**CE**	**ΔE**	**NE**	**IM**	**CE**	**ΔE**	**NE**	**IM**	**CE**	**ΔE**	**NE**	**IM**	**CE**	**ΔE**	**NE**	**IM**	**CE**	**Rank**
24	Gisborne	-20.9	-7.6	-0.3	-12.9	6.0	11.4	-1.8	-3.7	3.3	7.0	-1.3	-2.5	6.8	14.5	-3.2	-4.4	-1.2	6.3	-1.7	-5.9	48
25	Hastings	-9.2	-7.6	-2.3	0.7	4.8	11.4	-1.4	-5.2	4.2	7.0	-1.7	-1.1	12.7	14.5	-2.9	1.1	3.1	6.3	-2.1	-1.1	29
26	Napier	-13.9	-7.6	-1.1	-5.2	11.5	11.4	-1.1	1.1	3.9	7.0	-0.8	-2.4	11.4	14.5	-1.9	-1.2	3.2	6.3	-1.2	-1.9	28
27	Waipukurau	-8.4	-7.6	-3.0	2.3	10.8	11.4	-3.0	2.4	3.1	7.0	-4.7	0.7	6.3	14.5	-6.7	-1.5	3.0	6.3	-4.4	1.0	30
28	New Plymouth	-11.9	-7.6	-1.6	-2.6	4.3	11.4	-1.8	-5.3	-1.5	7.0	-1.2	-7.3	14.4	14.5	-1.3	1.3	1.4	6.3	-1.5	-3.5	35
29	Stratford	-16.4	-7.6	-2.7	-6.2	3.7	11.4	-3.2	-4.5	-0.1	7.0	-3.8	-3.3	2.7	14.5	-5.4	-6.4	-2.5	6.3	-3.8	-5.1	54
30	Hawera	-10.8	-7.6	-2.4	-0.8	4.7	11.4	-3.3	-3.4	-1.7	7.0	-3.9	-4.9	-0.7	14.5	-4.8	-10.4	-2.1	6.3	-3.6	-4.9	51
31	Taumaranui	-19.9	-7.6	-1.5	-10.8	-5.3	11.4	-2.2	-14.5	-6.4	7.0	-2.3	-11.1	1.0	14.5	-4.0	-9.4	-7.6	6.3	-2.5	-11.5	57
32	Taihape	-22.9	-7.6	1.3	-16.6	6.7	11.4	-3.5	-1.2	-10.6	7.0	-1.1	-16.6	1.7	14.5	-5.3	-7.6	-6.3	6.3	-2.1	-10.5	56
33	Wanganui	-12.9	-7.6	-0.2	-5.1	2.9	11.4	-0.8	-7.7	2.5	7.0	0.2	-4.8	5.0	14.5	-1.5	-7.9	-0.6	6.3	-0.6	-6.4	43
34	Bulls	-12.1	-7.6	0.4	-4.9	-2.2	11.4	-3.3	-10.3	-3.8	7.0	-0.6	-10.3	8.2	14.5	-3.1	-3.2	-2.5	6.3	-1.6	-7.2	53
35	Palmerston Nth	-4.4	-7.6	0.4	2.8	10.8	11.4	-1.1	0.5	0.7	7.0	0.5	-6.8	12.6	14.5	-0.4	-1.5	4.9	6.3	-0.2	-1.2	22
36	Dannevirke	-9.0	-7.6	-2.1	0.7	3.4	11.4	-3.0	-5.0	-4.2	7.0	-4.5	-6.7	6.4	14.5	-7.1	-1.1	-0.8	6.3	-4.2	-3.0	44
37	Eketahuna	-8.0	-7.6	-2.8	2.4	0.2	11.4	-3.4	-7.9	-2.6	7.0	-4.0	-5.6	0.5	14.5	-5.8	-8.1	-2.5	6.3	-4.0	-4.8	52
38	Levin	-6.0	-7.6	-1.8	3.4	2.2	11.4	-2.3	-6.9	5.0	7.0	-1.0	-1.1	7.0	14.5	-1.8	-5.7	2.0	6.3	-1.7	-2.6	32
39	Hutt Valley	-10.1	-7.6	1.2	-3.8	1.7	11.4	1.4	-11.1	3.3	7.0	1.8	-5.5	8.9	14.5	2.7	-8.3	1.0	6.3	1.8	-7.2	38
40	Wellington	-5.9	-7.6	5.8	-4.1	7.2	11.4	2.6	-6.8	9.1	7.0	3.4	-1.3	12.7	14.5	3.6	-5.4	5.8	6.3	3.9	-4.4	20
41	Masterton	-10.5	-7.6	-1.5	-1.4	6.7	11.4	-1.3	-3.5	8.0	7.0	-1.6	2.5	9.0	14.5	-2.5	-3.0	3.3	6.3	-1.7	-1.4	27
42	Motueka	-4.6	-7.6	-2.6	5.6	14.0	11.4	-2.5	5.0	6.4	7.0	-4.9	4.3	9.8	14.5	-6.2	1.5	6.4	6.3	-4.0	4.1	18
43	Nelson	-4.1	-7.6	-0.8	4.3	15.7	11.4	-0.9	5.1	7.2	7.0	-1.2	1.4	15.0	14.5	-1.5	2.0	8.5	6.3	-1.1	3.2	12
44	Picton	1.5	-7.6	-3.4	12.6	19.5	11.4	-1.5	9.6	8.5	7.0	-2.9	4.4	12.8	14.5	-3.6	1.9	10.6	6.3	-2.8	7.1	7
45	Blenheim	-0.6	-7.6	0.2	6.9	17.7	11.4	-2.1	8.3	9.0	7.0	-1.4	3.4	16.8	14.5	-3.0	5.3	10.7	6.3	-1.6	6.0	6
46	Kaikoura	-12.6	-7.6	-3.0	-2.0	19.7	11.4	-1.8	10.0	6.3	7.0	-2.4	1.7	20.3	14.5	-3.4	9.2	8.4	6.3	-2.6	4.7	13

Table 3.3 Classic Shift-Share Decomposition of Total Employment Growth in New Zealand Labour Market Area. (cont)

		1986-1991				1991-1996				1996-2001				2001-2006				Four Period Averages				
ID	**Name**	**ΔE**	**NE**	**IM**	**CE**	**ΔE**	**NE**	**IM**	**CE**	**ΔE**	**NE**	**IM**	**CE**	**ΔE**	**NE**	**IM**	**CE**	**ΔE**	**NE**	**IM**	**CE**	**Rank**
47	Greymouth	-16.0	-7.6	-1.8	-6.6	8.8	11.4	-2.8	0.2	0.3	7.0	-2.3	-4.5	13.5	14.5	-2.1	1.1	1.7	6.3	-2.3	-2.4	34
48	Christchurch	-4.7	-7.6	-0.2	3.1	15.6	11.4	0.1	4.0	8.1	7.0	0.2	0.8	16.4	14.5	0.0	1.9	8.9	6.3	0.1	2.5	11
49	Ashburton	-5.0	-7.6	-1.8	4.4	10.9	11.4	-1.9	1.4	7.5	7.0	-3.8	4.2	13.1	14.5	-5.2	3.8	6.6	6.3	-3.2	3.5	16
50	Waimate	-11.9	-7.6	-1.7	-2.6	8.7	11.4	-1.9	-0.9	2.2	7.0	-2.2	-2.7	9.5	14.5	-3.3	-1.7	2.1	6.3	-2.3	-2.0	31
51	MacKenzie	-17.1	-7.6	-1.7	-7.7	18.6	11.4	-1.4	8.6	-2.9	7.0	-3.6	-6.3	4.8	14.5	-4.6	-5.1	0.8	6.3	-2.8	-2.7	39
52	Oamaru	-9.6	-7.6	-2.6	0.6	5.7	11.4	-2.6	-3.1	-2.9	7.0	-3.2	-6.7	8.4	14.5	-4.5	-1.6	0.4	6.3	-3.2	-2.7	41
53	Alexandra	-12.5	-7.6	-1.4	-3.5	12.5	11.4	-0.8	1.9	8.1	7.0	-2.3	3.3	37.9	14.5	-2.0	25.4	11.5	6.3	-1.6	6.8	4
54	Queenstown	16.3	-7.6	2.1	21.8	60.3	11.4	4.8	44.1	15.3	7.0	1.2	7.1	35.3	14.5	2.7	18.1	31.8	6.3	2.7	22.8	1
55	Dunedin	-10.7	-7.6	1.1	-4.2	10.5	11.4	-0.4	-0.5	2.2	7.0	1.4	-6.3	11.3	14.5	0.2	-3.4	3.3	6.3	0.6	-3.6	26
56	Balclutha	-11.6	-7.6	-4.4	0.5	6.0	11.4	-3.8	-1.7	1.7	7.0	-4.9	-0.4	3.3	14.5	-7.0	-4.2	-0.1	6.3	-5.0	-1.5	42
57	Gore	-10.9	-7.6	-2.8	-0.5	8.2	11.4	-2.5	-0.7	-2.3	7.0	-4.6	-4.7	0.5	14.5	-6.7	-7.3	-1.1	6.3	-4.2	-3.3	47
58	Invercargill	-12.4	-7.6	-1.7	-3.1	4.1	11.4	-2.0	-5.4	-4.0	7.0	-1.7	-9.4	8.9	14.5	-3.1	-2.5	-0.9	6.3	-2.1	-5.1	45

The largest LMA in 1986, Auckland, had total employment of close to 250,000, around 17 percent of total national employment while the smallest LMA, Kaikoura, with total employment of 1410 accounted for less than one tenth of a percent of total national employment. The ranking of LMA by employment size changes little over the 1986-2006 period with the median change in rank being between one and two places and there being no change in the rankings of the six largest LMAs.[5]

Standing outside this pattern was Queenstown, which improved its standing by 24 places, and the LMA of Tokoroa and Taumaranui which both experience 10 place declines in ranking.

Of the 58 LMAs only 3 (Queenstown, Picton and Thames) experienced positive employment growth in the 1986-91 period. Queenstown experienced growth of over 16 percent while employment in the two other labour market areas increased at more modest levels of 1.5 and 0.6 percent respectively. In the 55 LMAs that saw contractions in the level of employment, the average fall in employment was around 9 percent with three LMAs (Taihape, Kaikohe and Tokoroa) having declines in employment of over 20 percent.

In the 1991-96 period only 5 LMAs (Ngaruawahia, Bulls, Kaikohe, Tokoroa and Taumarunui) experienced declines in total employment, while in other LMAs total employment grew on average at just over 15 percent, with Queenstown seeing employment growth of over 60 percent, over twice as rapid as the second fastest growing LMA, Tauranga.

For the period, 1996-2001, total employment declined in 15 of the LMAs, by between 0.1 (Stratford) and 10.6 percent (Taihape). Employment growth nationally averaged 7.0 percent with 3 LMAs (Queenstown, Tauranga and Kerikeri) achieving growth of over 15 percent.

[5] In order of size, from largest to smallest, the six largest LMA are: Auckland ,South Auckland , Christchurch, Wellington, Hamilton and Hutt Valley

In the last period, 2001-2006, only two LMA experienced contractions in employment with Hawera's employment levels being close to static (-0.7 percent) while Tokoroa's employment levels contracted by over 3 percent. In contrast, Queenstown and the neighbouring Alexandra LMA both experienced employment growth of over 35 percent while Tauranga (25.7 percent), Warkworth (20.3 percent), and Kaikoura (20.1 percent) grew by over 20 percent.

Figure 3.1 Employment Change (percent) 1986-1991 and 1996-2006 by Labour Market Area.[6]

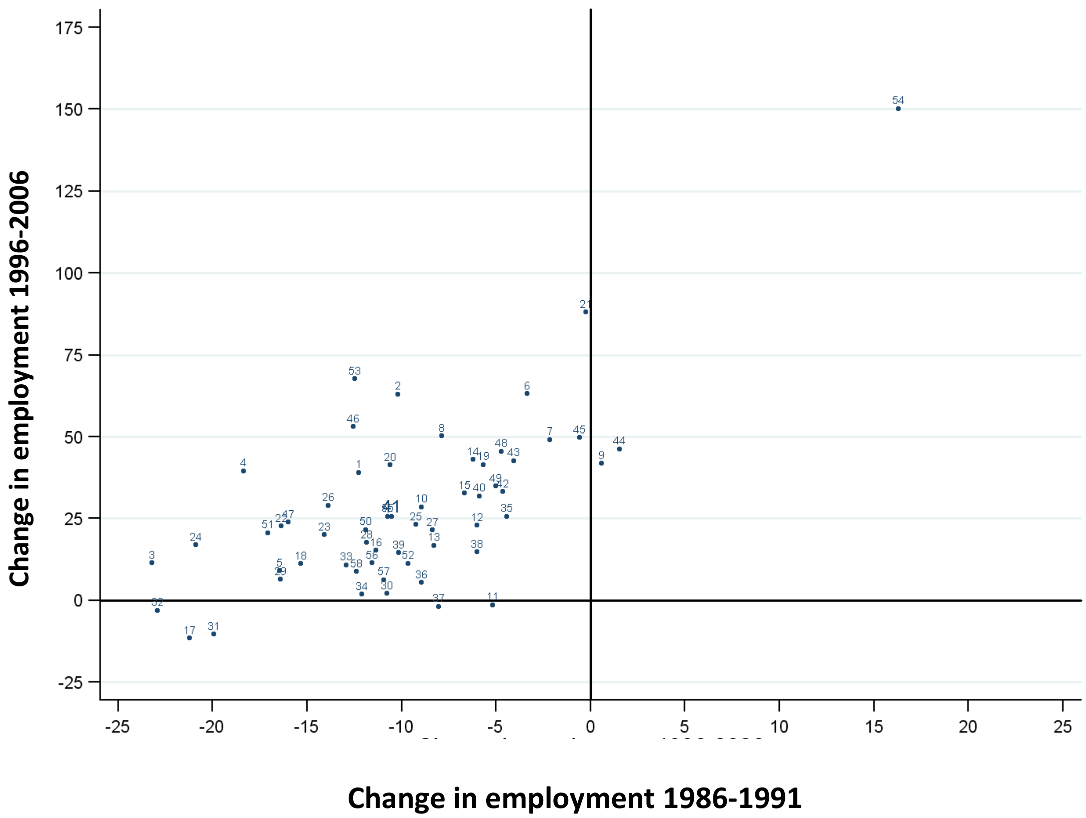


Figure 3.1 summarises the employment growth in the LMA in the 1986-1991 period compared to their performance in the post 1996 period, i.e. 1996-2006. It can be seen from this figure that most LMA, while experiencing negative employment growth in the 1986-1991 period, recovered, in the sense of achieving

6 Numbers refer to Labour Market Area ID number as shown in Table 3.2.

positive employment growth, in the 1996-2006 period. Eight LMA stand out from this pattern with Queenstown, Picton and Thames having positive employment growth both during restructuring (1986-1991) and in the post restructuring period (1996-2006) while Tokoroa, Taumaranui, Taihape, Eketahuna and Ngaruawahia experienced declines in employment in both periods.

With respect to the shift-share components of regional growth, the first point to note is that in virtually all LMA the national growth component is large relative to, particularly, the industry mix and to a lesser extent the regional shift components. This reinforces the point that no New Zealand region was sheltered from the massive restructuring-related employment changes that have taken place since 1986, particularly in the in the first half of the 1986-96 decade.

The industry mix effect is in many regions small relative to the competitive effect. In part this due to the relatively high level of sectoral aggregation hence it would be unwise to read too much into this. More usefully we can consider the ranking of the LMA on the basis of the average industry mix effect for the 1986-2006 period. The six LMA that have had an industry mix most favourable to employment growth are Wellington, Auckland, Queenstown, Hutt Valley, Dunedin and Rotorua. Of these Wellington and Auckland stand out as having particularly favourable industry mixes, being ranked first and third most favourable industry mix, respectively, in most periods. These LMA have high proportions of their employment in the Retail & Hospitality, Financial and Government & Social Services industries. The six LMAs with the least advantageous industry mixes are Balclutha, Ngaruawahia, Waipukurau, Tokoroa, Gore and Eketahuna. It is noteworthy that employment in at least three of these LMAs, namely Balclutha (meat processing), Ngaruawahia (meat processing) and Tokoroa (pulp and paper), has been dominated by a single industry.

Inter-period change in the industry mix exhibits an interesting pattern with considerably more volatility in the earlier part of the 1986-1996 period, during and in the immediate aftermath of restructuring, than in the latter 1996-2006 period.

Overall however the stability in rankings of the industry mix effects suggests that an advantageous or disadvantageous sector structure can only change very gradually, though there are exceptions such as when a large employer in a small LMA closes or restructures its operations. A case in point is Taihape which posessed the fifth most advantageous industry mix in the 1986-1991 period but 56th in the 1991-1996 period due to changes in the rail system. Taihape, as noted earlier, had until the 1980s been a major hub in the national rail transport system when a restructuring of the rail network combined with the electrification of the main rail link in the North Island saw this role largely end. This all points to the conclusion that the only protection from sector-specific employment shocks is sectoral diversification, analogous to portfolio diversification in finance (see also, for example, Munro and Schachter (2000) on this issue in the European Union and Sherwood-Call (1990) with respect to the United States).

3.4 Structural Change

Equation (3.5) above shows that the industry mix effect is calculated by means of industry shares at the beginning of the inter-censal period. The question then arises to what extent over the inter-censal period the regional shares adjust such that employment increases in sectors that are nationally doing well or whether some regions in fact go “against the trend” and increase the share of industries that are nationally contracting. This can be investigated by means of decomposing the industry-mix effect itself in the following way:

$$\sum_i w_{ij}^{t-1}\,(g_{i0}^t - g_{00}^t) \equiv \sum_i w_{ij}^t (g_{i0}^t - g_{oo}^t) + \sum_i \left(w_{ij}^{t-1} - w_{ij}^t\right)(g_{i0}^t - g_{00}^t) \qquad (3.7)$$

The term on the most right now measures the effect of changing industry composition on the regional employment growth rate. This will be referred to as the structural change effect and to the industry-mix effect calculated by means of end-of-period weights as the modified industry-mix effect.

The modified industry mix effect signals the same phenomenon as before. Employment in regions that are primarily urban and service-sector focussed benefited from the growth in services. The industry mix effect in its modified form, plus the structural change effects are reported for the LMAs for all four inter-censal periods in Table 3.4. The modified industry mix effect averaged over the four inter-censal periods exceeds one percent in 12 of the 58 LMAs[7]. These LMAs either contain one of the large metropolitan areas, such as Auckland, Wellington, Christchurch, Dunedin and Hamilton, or have strong connections with either tourism and/or retirement industries, such as Tauranga and Queenstown. In contrast the average industry mix effect was less than negative one percent in 25 of the 58 LMAs.[8] These LMAs are either predominantly focused on rural service centres or smaller provincial cities. In terms of magnitude, the average modified industry mix effect for New Zealand was largest, overall, in 1986-1991 but declined thereafter and was negative for the three inter-censal periods, 1991-1996, 1996-2001 and 2001-2006 periods. The latter result is to be expected as national employment growth was positive and high in these periods (see equation 3.3). The structural effect is negative in all but four cases (Wanganui, Taihape and Blehheim in 1996-2001 and Hawera in 2001-2006).

---

[7] In decreasing order of modified industry mix size these LMAs are Wellington, Queenstown, Auckland, Hutt Valley, Dunedin, Hamilton, Tauranga, Christchurch, Rotorua, Palmerston North, South Auckland and Kerikeri.

[8] In increasing order of modified industry mix size these LMAs are Ngaruawahia, Balclutha, Dannevirke, Waipukurau, Gore, Otorohanga, Eketahuna, Tokoroa, TeKuiti, Hawera, Stratford, Te Puke, Dargaville, Motueka, Ashburton, Oamaru, Morrinsville, Taihape, Taumaranui, MacKenzie, Picton, Waimate, Warkworth, Matamata and Invercargill.

Table 3.4 The Modified Industry-Mix and Structural Change effects on Employment Growth in New Zealand Labour Market Areas.

	Modified Industry Mix Effect				Structural Change Effect			
	1986-91	1991-96	1996-01	2001-06	1986-91	1991-96	1996-01	2001-06
Kaitaia	2.1	-0.2	-1.0	-1.1	-1.8	-0.9	-0.7	-1.7
Kerikeri	1.7	2.2	-0.4	1.2	-2.3	-2.3	-0.4	-2.4
Kaikohe	1.9	-1.1	-1.1	-1.5	-2.9	-0.7	-0.3	-2.2
Whangarei	1.9	0.6	0.3	1.1	-3.4	-1.3	-0.9	-1.6
Dargaville	-0.8	-1.8	-3.3	-4.5	-1.1	-0.6	-1.1	-1.4
Warkworth	-1.3	-1.0	-2.1	-0.1	-1.5	-1.0	-1.4	-2.8
Auckland	5.5	3.7	2.3	3.5	-3.6	-1.5	-0.7	-0.9
SthAuckland	1.0	2.0	0.3	1.5	-3.7	-1.9	-0.7	-1.1
Thames	0.0	0.6	-1.0	0.2	-1.7	-1.6	-0.7	-1.8
Waihi	0.2	-0.7	-0.7	-0.1	-2.4	-0.7	-1.7	-1.1
Ngaruawahia	-2.6	-2.8	-4.9	-5.9	-0.2	-1.3	-0.8	-1.9
Morrinsville	-1.7	-0.7	-2.2	-2.5	-0.7	-1.2	-1.2	-1.1
Matamata	-0.4	0.2	-2.0	-2.2	-1.1	-1.7	-0.5	-1.2
Hamilton	3.3	1.3	0.8	1.3	-2.8	-1.9	-0.6	-1.2
Te Awamutu	1.9	-0.3	-0.7	-1.0	-0.5	-1.6	-0.4	-1.4
Otorohanga	-0.3	-2.4	-4.1	-5.9	-0.5	-0.7	-0.5	-1.4
Tokoroa	-3.4	-2.2	-3.1	-3.6	-2.4	-1.3	-0.7	-1.6
TeKuiti	-0.9	-2.3	-3.9	-4.7	-1.0	-0.7	-0.4	-0.6
Taupo	1.4	1.4	-0.3	0.7	-2.5	-1.9	-1.2	-1.5
Te Puke	-1.8	-1.9	-3.4	-3.7	-1.5	-1.0	-0.6	-1.9
Tauranga	2.2	1.6	0.6	2.1	-2.0	-1.3	-0.8	-1.4
Rotorua	3.3	1.9	0.4	0.0	-2.9	-1.6	-0.4	-0.9
Whakatane	-0.3	-0.6	-1.0	-1.3	-3.0	-1.0	-0.9	-1.7
Gisborne	1.5	-0.5	-1.0	-1.7	-1.9	-1.3	-0.3	-1.5
Hastings	0.2	0.0	-1.2	-1.1	-2.5	-1.4	-0.6	-1.8
Napier	1.5	0.2	-0.4	-0.5	-2.6	-1.3	-0.4	-1.4
Waipukurau	-1.5	-2.7	-4.1	-5.3	-1.5	-0.3	-0.6	-1.4
New Plymouth	0.6	0.2	-0.5	0.3	-2.2	-1.9	-0.6	-1.6
Stratford	-1.4	-1.8	-3.5	-4.3	-1.3	-1.4	-0.4	-1.1
Hawera	-1.6	-1.7	-2.9	-5.2	-0.8	-1.6	-0.9	0.4
Taumaranui	0.0	-1.2	-1.9	-2.7	-1.6	-1.0	-0.4	-1.3
Taihape	2.1	-2.8	-1.6	-3.8	-0.8	-0.8	0.6	-1.5
Wanganui	2.3	0.3	0.2	-0.1	-2.6	-1.1	0.1	-1.5
Bulls	2.1	-1.5	-0.2	-2.4	-1.7	-1.8	-0.4	-0.6
Palmerston Nth	2.8	0.9	1.2	0.6	-2.4	-2.0	-0.7	-1.0
Dannevirke	-1.7	-2.2	-4.2	-6.3	-0.4	-0.8	-0.3	-0.8
Eketahuna	-2.4	-2.1	-3.2	-4.8	-0.4	-1.3	-0.8	-1.0
Levin	0.8	-0.6	-0.4	-0.5	-2.5	-1.7	-0.5	-1.4
Hutt Valley	5.4	2.7	2.4	3.3	-4.2	-1.3	-0.6	-0.6

Table 3.4 The Modified Industry-Mix and Structural Change effects on Employment. (cont)

	Modified Industry Mix Effect				Structural Change Effect			
	1986-91	**1991-96**	**1996-01**	**2001-06**	**1986-91**	**1991-96**	**1996-01**	**2001-06**
Wellington	9.5	3.9	3.8	4.2	-3.6	-1.3	-0.4	-0.6
Masterton	1.9	-0.3	-0.9	-1.1	-3.3	-0.9	-0.7	-1.4
Motueka	-1.3	-1.4	-3.6	-4.1	-1.3	-1.1	-1.3	-2.1
Nelson	1.5	0.6	-0.5	0.1	-2.3	-1.4	-0.7	-1.6
Picton	-2.0	0.1	-2.0	-1.6	-1.4	-1.6	-0.9	-2.0
Blenheim	0.8	-0.7	-1.6	-2.0	-0.6	-1.4	0.2	-1.0
Kaikoura	-0.9	0.3	-1.6	-1.4	-2.0	-2.0	-0.8	-2.0
Greymouth	-0.2	-0.9	-1.3	-1.0	-1.7	-1.9	-1.0	-1.1
Christchurch	2.8	1.5	0.8	1.2	-3.0	-1.4	-0.5	-1.2
Ashburton	-0.7	-0.9	-3.4	-4.5	-1.1	-1.0	-0.4	-0.7
Waimate	-0.2	-0.9	-1.8	-2.4	-1.5	-1.1	-0.4	-1.0
MacKenzie	-0.5	0.8	-3.0	-3.0	-1.2	-2.2	-0.6	-1.6
Oamaru	-1.8	-1.5	-2.6	-3.0	-0.8	-1.1	-0.6	-1.6
Alexandra	0.7	1.0	-1.7	1.2	-2.0	-1.8	-0.6	-3.2
Queenstown	4.4	6.4	1.5	4.8	-2.3	-1.7	-0.3	-2.2
Dunedin	4.3	1.1	1.7	1.1	-3.1	-1.6	-0.3	-0.9
Balclutha	-2.9	-2.8	-4.5	-5.9	-1.5	-1.0	-0.4	-1.1
Gore	-2.1	-1.5	-4.2	-5.6	-0.7	-1.0	-0.4	-1.1
Invercargill	-0.4	-0.1	-1.5	-2.2	-1.3	-1.9	-0.2	-1.0

The negative sign indicates that LMAs have generally not gone against the national trend in terms of structural change, showing that when a sector grows faster (slower) than average nationally, its share in employment increases (decreases) in almost all LMAs.

Turning now to the competitive growth rate as defined in equation 3.5, the results of which are also reported in Table 3.3. The first point to note is that there is less stability in the ranking according to competitive effect than according to industry mix effect with only three LMA enjoying a consistently high positive competitive effect (Warkworth, Tauranga and Queenstown) over the 1986-2006 period. The relative persistence is quantified in Table 3.5 which compares Spearman's rank correlation coefficients for LMA growth rates, industry mix and competitive effects across pairs of inter-censal periods for LMA. The highest rank correlation coefficients are found for the industry-mix growth rates, which reinforces an earlier point on relatively gradual change across regions in industrial composition. The lowest rank correlation is found for the competitive growth rate, excepting the 86/91 comparison with 91/96 where the growth rates themselves have the lowest rank correlation. All the rank correlations in Table 3.5 are significant at the 1 percent level, indicating considerable persistence in the relative importance of the components of employment change across the LMAs.

Table 3.5 Persistence in LMA Employment Change and its Components (Spearmen's Rank Correlation Coefficients).

	LMA Employment growth			
	1986-91	1991-96	1996-01	2001-06
ΔE 1986-91	1			
ΔE 1991-96	0.468	1		
ΔE 1996-01	0.534	0.605	1	
ΔE 2001-06	0.495	0.653	0.782	1
	Industry Mix Effect			
	IM 1986-91	IM 1991-96	IM 1996-01	IM 2001-06
IM 1986-91	1			
IM 1991-96	0.583	1		
IM 1996-01	0.794	0.767	1	
IM 2001-06	0.638	0.878	0.903	1
	Competitive Effect			
	CE 1986-91	CE 1991-96	CE 1996-01	CE 2001-06
CE 1986-91	1			
CE 1991-96	0.473	1		
CE 1996-01	0.509	0.574	1	
CE 2001-06	0.518	0.630	0.668	1

Note: All correlations are significant at 1 percent level

It should be remembered that the competitive effect is residual employment growth after accounting for the national trend and industry mix effects. Such residuals are of course highly variable however it is clear that employment growth in LMAs such as Queenstown, Tauranga, Warkworth, Alexandra, Picton and Blenheim, the six LMAs with the highest four period average competitive effects in Table 3.3, has been considerably more than would have been expected from their industry composition or national effects while Rotorua, New Plymouth, Tokoroa, Taihape, Bulls and Taumaranui (the bottom six) have fared considerably worse.

3.5 Alternative Formulations

A common criticism of classic shift-share analysis is that, in allocating causes of employment change, structural effects (due to differences in the regions between the distribution of employment across sectors) are mixed with regional size effects (due to a region's employment in an industry being small or large relative to national employment in that industry). In simple terms, when the number of persons employed in a particular industry in a particular region is increasing rapidly, this could be due to (i) a buoyant national economy (the national growth rate effect), (ii) rapid national growth in demand for output from that industry (the industry growth rate effect), (iii) slow national growth in demand for output from that industry, but a high proportion of that industry concentrated in that region (a "scale" effect); and (iv) employment creation in the industry having been relatively more than in other regions (the competitive effect). It was noted in the previous section that in classic shift-share analysis, the competitive effect is simply a residual. To separate out the scale effect from a "true" competitive effect, several extensions of the classic model have been suggested in the literature. These are reviewed by Loveridge and Selting (1998)

The scale effect referred to above tends to generate in some applications an inverse correlation between the industry mix effect and the competitive effect. This is particularly the case when the regions are of very different sizes and have very different sectoral compositions. To remove this correlation and account separately for a scale effect and a competitive effect, the extensions to shift share analysis first calculate so-called homothetic employment in industry *i* and region *j*, which is the expected level of employment in an industry *i* in a region *j* if the distribution of employment in that region across industries is the same as nationwide:

$$EH_{ij}^{t-1} = \frac{E_{i0}^{t-1}E_{0j}^{t-1}}{E_{00}^{t-1}} \quad (3.8)$$

Using homethetic employment, Esteban-Marquillas (1972) then proceeds to decompose the competitive effect as:

$$CE_{ij}^{t} \equiv CEH_{ij}^{t} + AE_{ij}^{t} \equiv \left(g_{ij}^{t} - g_{i0}^{t}\right) \times EH_{ij}^{t-1} + \left(g_{ij}^{t} - g_{i0}^{t}\right) \times \left(E_{ij}^{t-1} - EH_{ij}^{t-1}\right) \quad (3.9)$$

The homothetic competitive effect CEH_{ij}^{t} measures a region's comparative advantage or disadvantage in industry *i* relative to the nation. To maintain the accounting identity, a new residual component is introduced, AE_{ij}^{t} which is referred to by Esteban-Marquillas (1972) as the allocation effect.

The same distinction between homothetic and actual employment can also be made in terms of the industry-mix effect. Together, the resulting accounting identity is referred to as Esteban-Marquillas' (1972) second decomposition (hereafter EM2). Hence:

$$E_{ij}^{t} - E_{ij}^{t-1} \equiv \Delta E_{ij}^{t} \equiv NEEM_{ij}^{t} + IMEM_{ij}^{t} + CEH_{ij}^{t} + AE^{t} \quad (3.10)$$

$$NEEM2_{ij}^{t} = g_{i0}^{t} \times EH_{ij}^{t-1} \quad (3.11)$$

$$IMEM2_{ij}^{t} = g_{i0}^{t} \times (E_{ij}^{t-1} - EH_{ij}^{t-1}) \quad (3.12)$$

in which $NEEM2_{ij}^{t}$ is the Esteban-Marquillas modified National Growth Effect on industry *i* in the *j*th region between times (*t*-1) and *t*, $IMEM2_{ij}^{t}$ is the Esteban Marquillas modified Industry Mix Effect on industry *i* in the *j*th region between times (*t*-1) and *t*, and CEH_{ij}^{t} and AE_{ij}^{t} are defined as above.

In applications, CEH_{ij}^{t} is generally less correlated with IM_{ij}^{t} than CE_{ij}^{t}. This is considered somewhat of an advantage of the homothetic method, because in this case the industry-mix and competitive effect appear to measure "different" (orthogonal) forces. It will be shown that in the present application the correlation between IM_{ij}^{t} and CE_{ij}^{t} is already small and statistically insignificant, so that CEH_{ij}^{t} provides little advantage over CE_{ij}^{t}.

It can be shown (Keil, 1992) that the totals aggregated over industries of the revised national effects $NEEM2_{ij}^{t}$ and industry mix effects $IMEM2_{ij}^{t}$ in each region are the same as in the classic decomposition, i.e.

$$\sum_i NEEM2_{ij}^{t} = \sum_i NE_{ij}^{t} \text{ and } \sum_i IMEM2_{ij}^{t} = \sum_i IM_{ij}^{t} \tag{3.13}$$

Consequently, the industry-mix effects reported for each region in Tables 3.3 remain the same when using EM2. There are some additional relationships between the classic method and EM2. First, it can be easily seen that CEH_{ij}^{t} is CE_{ij}^{t} divided by the location quotient:

$$CEH_{ij}^{t} = \frac{CE_{ij}^{t}}{LQ_{ij}^{t}} \tag{3.14}$$

In which LQ_{ij}^{t} is as defined in equation 1 (the LQ for 1986 are reported in Table 3.2 for each LMA and industry). Also using the idea of homothetic employment, Bishop and Simpson (1972) modify equations (3.3) and (3.4) to calculate alternative national growth and industry-mix effects as follows:

$$\Delta E_{ij}^{t} \equiv E_{ij}^{t} - E_{ij}^{t-1} \equiv NEBIS_{ij}^{t} + IMBIS_{ij}^{t} + CE_{ij}^{t} \tag{3.15}$$

$$NEBIS_{ij}^{t} \equiv g_{00}^{t} \times E_{ij}^{t-1} + (g_{i0}^{t} - g_{00}^{t}) \times EH_{ij}^{t-1} \tag{3.16}$$

$$IMBIS_{ij}^{t} \equiv (g_{i0}^{t} - g_{00}^{t}) \times \left(E_{ij}^{t-1} - EH_{ij}^{t-1}\right) \tag{3.17}$$

Where $NEBIS_{ij}^{t}$ is the Bishop-Simpson modified national growth effect on industry *i* in the *j*th region between times (*t*-1) and *t*, and $IMBIS_{ij}^{t}$ is the Bishop-Simpson modified industry-mix effect on industry *i* in the *j*th region between times (*t*-1) and *t*.

Table 3.6 Simple Correlations between Shift-share Components, 58 Labour Market Areas 1986-2006.

1986-1991	IM	CE	CEH	AE	NEBIS	IMBIS	NEEM2	IMEM2
IM	1							
CE	-0.049	1						
CEH	0.097	0.926	1					
AE	-0.099	-0.204	-0.557	1				
NEBIS	0.24	0.92	0.866	-0.24	1			
IMBIS	0.998	-0.105	0.049	-0.092	0.189	1		
NEEM2	-0.198	-0.951	-0.892	0.237	-0.946	-0.143	1	
IMEM2	0.997	0.031	0.165	-0.113	0.316	0.991	-0.274	1

1991-1996	IM	CE	CEH	AE	NEBIS	IMBIS	NEEM2	IMEM2
IM	1							
CE	0.5	1						
CEH	0.433	0.963	1					
AE	-0.117	-0.514	-0.727	1				
NEBIS	0.515	0.921	0.89	-0.49	1			
IMBIS	0.999	0.468	0.402	-0.098	0.487	1		
NEEM2	0.631	0.986	0.941	-0.482	0.919	0.602	1	
IMEM2	0.935	0.161	0.103	0.075	0.209	0.947	0.316	1

1996-2001	IM	CE	CEH	AE	NEBIS	IMBIS	NEEM2	IMEM2
IM	1							
CE	0.049	1						
CEH	0.076	0.958	1					
AE	-0.09	-0.479	-0.711	1				
NEBIS	0.173	0.672	0.667	-0.392	1			
IMBIS	1	0.04	0.067	-0.086	0.168	1		
NEEM2	0.333	0.951	0.923	-0.492	0.7	0.325	1	
IMEM2	0.992	-0.073	-0.04	-0.036	0.092	0.993	0.217	1

2001-2006	IM	CE	CEH	AE	NEBIS	IMBIS	NEEM2	IMEM2
IM	1							
CE	-0.3435	1						
CEH	0.2176	0.755	1					
AE	-0.1991	-0.4866	-0.8229	1				
NEBIS	0.1631	0.7491	0.7598	-0.4992	1			
IMBIS	0.38	0.306	0.2533	-0.1983	0.5373	1		
NEEM2	0.3026	0.7904	0.9184	-0.6346	0.8681	0.5528	1	
IMEM2	0.3501	0.1563	0.0721	-0.0767	0.3934	0.9809	0.3809	1

Note: Correlations in bold numerals are significant at the 5 percent level

In order to gauge how closely related the different measures that were introduced above are, Pearson correlation coefficient have been calculated for each period and each measure with 9 industries and 58 LMA, i.e. 522 observations per period. The results are shown in Table 3.6. The results are similar to those of Loveridge and Selting (1998) for 77 industries across 87 counties of the state of Minnesota over the period 1979-88. That is, the correlation between alternative measures for the same effect is very high. IM is highly correlated with IMBIS and IMEM2; CE is correlated with AE, and NEBIS is highly correlated with NEEM2. Moreover, IM and CE are largely uncorrelated. The conclusions are straightforward. There is no gain in measuring the industry-mix effects by IMBIS or IMEM2. The much more easily interpretable IM effect generates similar numbers. Similarly, CE and CEH appear to provide the same information.

All the models above can be referred to as accounting-based models. Employment change in each region is decomposed into a set of deterministic components. There are no stochastic elements. Knudsen (2000) reviews probabilistic forms of shift-share analysis, such as analysis of variance (ANOVA) models and information-theoretic models. These have some advantages over the accounting methods in that it is straightforward to carry out hypothesis tests about the estimated parameters, such as specific industry or regional effects. However, it can be shown that there is a close relationship between the various approaches. For example, Berzeg (1984) shows that ANOVA models estimated with weighted least squares (WLS) may generate identical effects to those of the classic shift-share model. Generally speaking, the type of information used in shift-share analysis is of the form of a panel of grouped data: groups of workers (by industry etc.) observed in different region over time. It is clear that panel models for grouped data are directly applicable. As the primary focus of this thesis is on the spatial aspects of labour market outcomes, and the literature suggests that there is frequently little to be gained in the use of these methods rather than those of traditional shift-share, these non-spatial econometric methodologies are not pursued here. The next section introduces a recent innovation in shift-share analysis: the use of Exploratory Spatial Data Analysis (ESDA) to explore the spatial structure of the Industry and Competitive effects derived from the classic shift-share analysis.

3.6 Exploratory Spatial Analysis of Shift-Share Components

The aim of this section is to undertake an analysis of the spatial distribution of the industry mix and competitive effect components of the shift share decomposition. This will be undertaken using a commonly used measure of global spatial auto correlation, Moran's *I*, and the derived measures of local spatial association (LISA) suggested by Anselin (1995).

The Moran's *I* statistic may be thought of as a translation of a non-spatial correlation coefficient, such as the Pearson's correlation coefficient, to a spatial context (O'Sullivan & Unwin, 2003, pp. 197-201). Mathematically, the similarity is strong with both the Pearson's correlation coefficient and Moran's *I* having a covariance term as numerator and the sample variance as a denominator. Also like the correlation coefficient, the values of Moran's *I* range from close to +1 meaning strong positive spatial autocorrelation, to 0 meaning a random pattern, to close to -1 indicating strong negative spatial autocorrelation (Oliveau & Guilmoto, 2005, pp. 2-3). Negative spatial autocorrelation is however rare in spatially referenced data (O'Sullivan & Unwin, 2003, pp. 197-201).

The precise definition of Moran's *I* is given below for a variable *z*, observed at location *i*, with *i* = 1, 2, ..., *n*.

$$I = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} W_{ij}\,(z_i - \bar{z})(z_j - \bar{z})}{\sigma^2} \tag{3.18}$$

where W_{ij} are spatial weights (that add up to 1 when summing over *j*), $\bar{z}$ is the sample mean of *z* and σ^2(z) is the sample variance of *z*.

However, the Moran's *I* statistic is a global statistic in the sense that it provides a summary statistic that allows us to assess whether or not a spatial configuration is autocorrelated as a whole. This tends to average local variations in the strength of spatial autocorrelation and is of little use in identifying areas where values of a variable are significantly more extreme (spatial outliers) or geographically homogenous (clusters, hotspots and cold spots). To remedy this shortcoming a number of local indicators of spatial association (LISA) have been developed, most notably by Getis and Ord (1992) and Anselin (1995, p. 94) defines a Local Indicator of Spatial Association (LISA) as any statistic satisfying two criteria:

(i) The LISA for each observation gives an indication of significant spatial clustering of similar values around that observation;

(ii) The sum of the LISA for all observations is proportional to a global indicator of spatial association.

In the case of the local version of Moran's *I* statistic, the local Moran can be derived easily by rewriting equation (18) as below:

$$I = \frac{1}{n\sigma^2(z)} \sum_{i=1}^{n} [(z_i - \bar{z}) \sum_{j=1}^{n} W_{ij} (z_j - \bar{z})] \equiv \frac{1}{n\sigma^2(z)} \sum_{i=1}^{n} I_i \qquad (3.19)$$

The expression in square brackets in equation (18) is referred to as the local Moran statistic, I_i. Anselin (1995, pp. 95-96) discusses several issues related to the assessment of the significance of the local Moran statistic.

Firstly, the local Moran's *I* is not approximately normal distributed. This difficultly has been overcome in practice in a relatively straightforward manner by using a conditional randomisation or permutation approach to yield empirical pseudo significance levels (Anselin, 1995, p. 96).

A second complicating factor arises from the fact that the LISA statistics for individual locations will tend to be correlated which, along with the related problem of multiple comparisons, will lead to a flawed interpretation of the level of significance. Anselin suggests employing either the Bonferroni or Sidak corrections to account for the multiple comparisons. However, the assumption of multivariate normality in the case of the Sidak correction is unlikely to be met by spatial data, while the Bonferroni correction may be too conservative (Anselin, 1995, p. 96).[9]

Individual LISA statistics allow areas to be classified into one of five types:

- Locations with high values with similar neighbours: high-high (*hot spots*).
- Locations with low values with similar neighbours: low-low (*cold spots*).
- Locations with high values with low-value neighbours: high-low (*spatial outliers*).
- Locations with low values with high-value neighbours: low-high (*spatial outliers*).
- Locations with no significant local autocorrelation.

Both global and local measures of spatial association can be presented in several graphic formats. The Moran scatterplot is a plot with the standardised value of the variable of interest in an area, or at a point, on the x-axis and the spatial lag on the y-axis – the spatial lag being the standardised average value of the variable of interest in the neighbouring areas or points (Anselin, 1996). The slope of a regression line fitted to these points is equal to the Moran's *I* of the spatial configuration in question (Anselin, 1995, p. 127) and the quadrants of the scatter plot correspond to the distinctions made in the classification above.

Statistically significant individual LISA statistics maybe mapped either according to their level of significance (LISA Significance Maps) or according to the type of spatial association as in the above classification (Anselin, 1995; Anselin, Syabri, & Kho, 2004).

The analysis conducted here consists of presenting firstly Moran scatter plots, and secondly LISA significance and cluster maps for the industry mix and competitive effect components of the simple shift share analysis. The values for the industry mix and competitive effect components used are the average of the four inter-censal

---

[9] The Bonferroni correction suggests that for an overall significance level of a, the individual significance level must be set to $\frac{a}{m}$ where m is the number of observations. The Sidak correction sets the individual significance level to 1- $(1 - a)^{\frac{1}{m}}$ (see Abdi (2007) for a discussion of the use of Bonferonni and Šidák corrections for multiple comparisons).

periods while the weights matrix used is as described in Chapter 2, i.e. a row standardised matrix based on the reciprocal squared travel time between the main urban centre of each LMA. All calculations were performed using the spatial econometric .ado files provide by Maurizio Pisati for use with Stata 11.

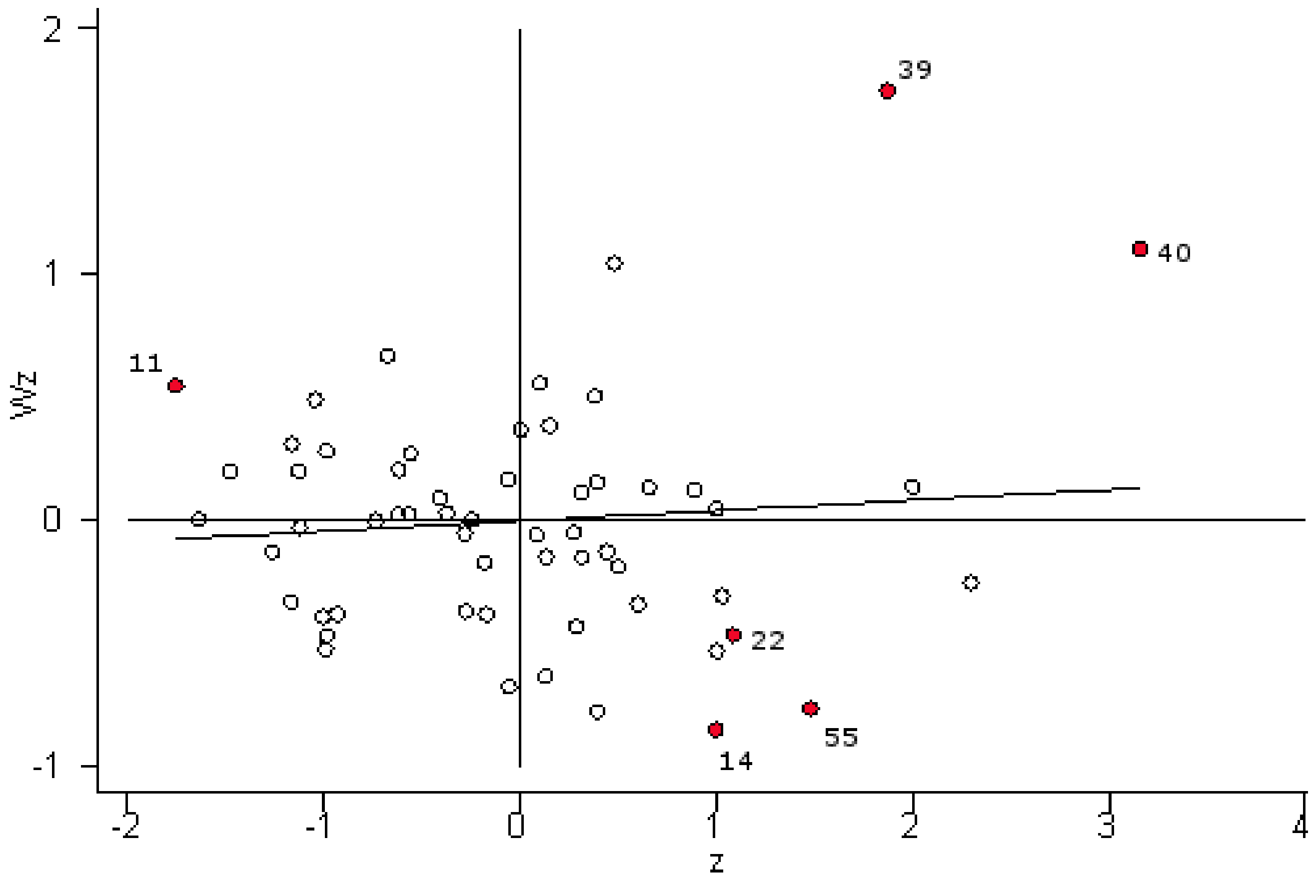
The Moran Scatter Plot for the average industry mix effect is shown in Figure 3.2. Moran's *I* is positive (0.042) but insignificant (pseudo p = 0.239), indicating that there is no overall pattern of spatial association for the industry-mix effect. Inspection of the industry mix significance and cluster maps (see Figures 3.3 and 3.4 respectively) shows some evidence of local clusters with Hi-Hi clusters focused on the Wellington and Hutt Valley LMA, Hi-Low clusters centred on the Hamilton, Rotorua and Dunedin LMA and one Low-Low cluster around the Ngaruawahia LMA. Further inspection of the significance map shows that the clusters centred on the Rotorua, Hamilton and Ngaruawahia LMA are only significant at the 5 percent level. These pseudo significance levels are uncorrected for the effects of multiple comparisons, as discussed in the methodology chapter, and hence these results should be treated as indicative at best.[10]

Turning to the Competitive Effect, the Moran scatter plot (see Figure 3.5) generates a positive (0.190) and significant Moran's *I,* indicating the presence of spatial autocorrelation in the spatial configuration of the CE. The CE significance and cluster maps (see Figures 3.6 and 3.7 respectively) show the presence of three Hi-Hi clusters centred on the LMAs of Te Puke, Picton and the adjacent Blenheim, Alexandra and the bordering Queenstown. In the central south western North Island there is a large Low-Low cluster focused on the LMAs of Taihape and Taumaranui. The CE significance map also indicates that the clusters around the Queenstown, the contiguous Alexandra LMA and the Taihape LMA are pseudo significant at the one percent level.

---

[10] Anselin (2005, p. 140) cautions in respect of the GeoDA software "It should be noted that the results for p = 0.05 are somewhat unreliable, since they likely ignore problems associated with multiple comparisons (as a consequence, the true p-value is likely well above 0.05)".

Figure 3.2 Moran Scatter Plot, Industry-Mix Effect (Moran's *I* = 0.042, Pseudo *p* = 0.239).



Note: Significant local Moran statistics are indicated by a filled marker, the accompanying number is the identification number of the LMA concerned

Figure 3.3 LISA- Industry Mix Significance Map (4 inter-censal period average)

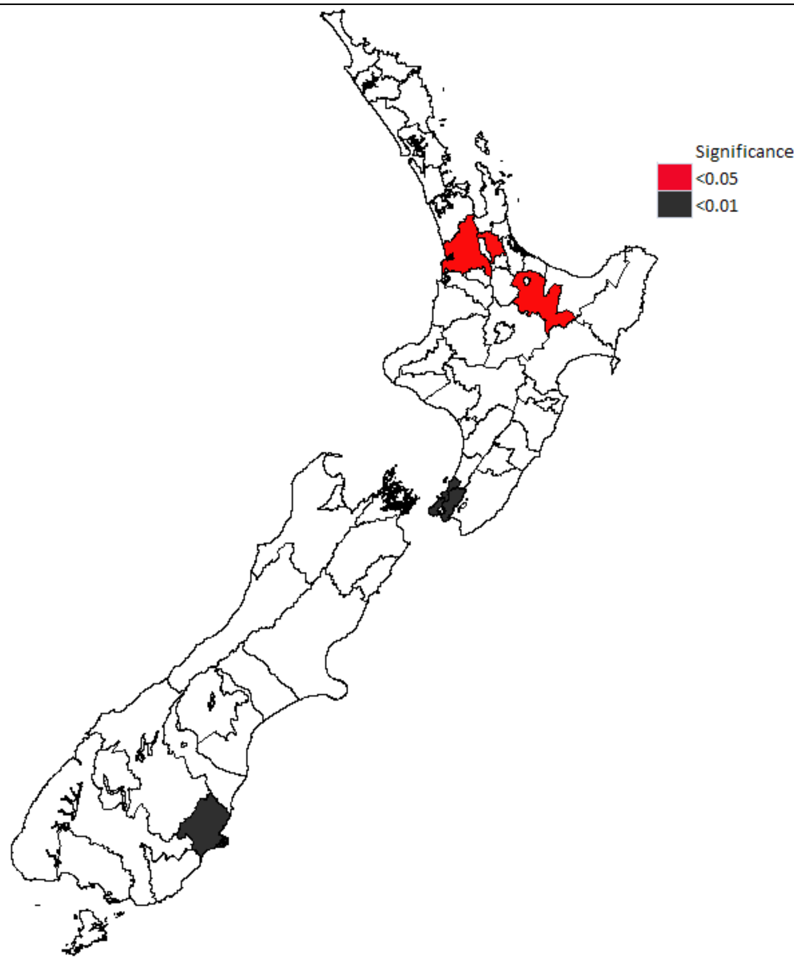


Figure 3.4 LISA- Industry Mix Cluster Map (4 inter-censal period average)

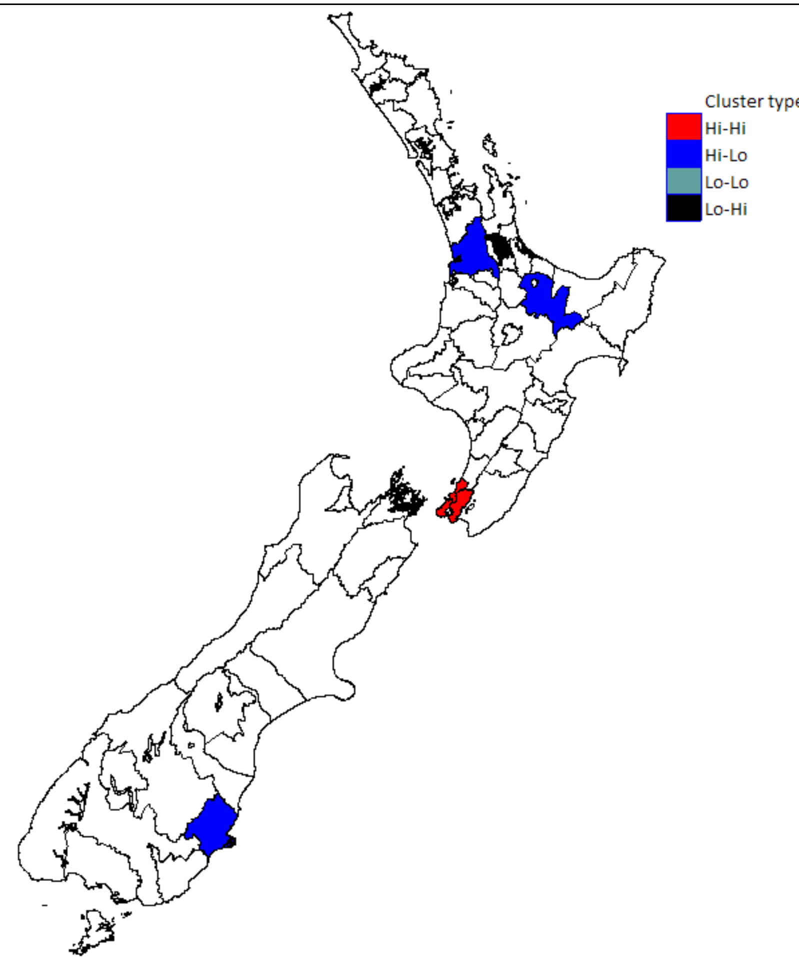
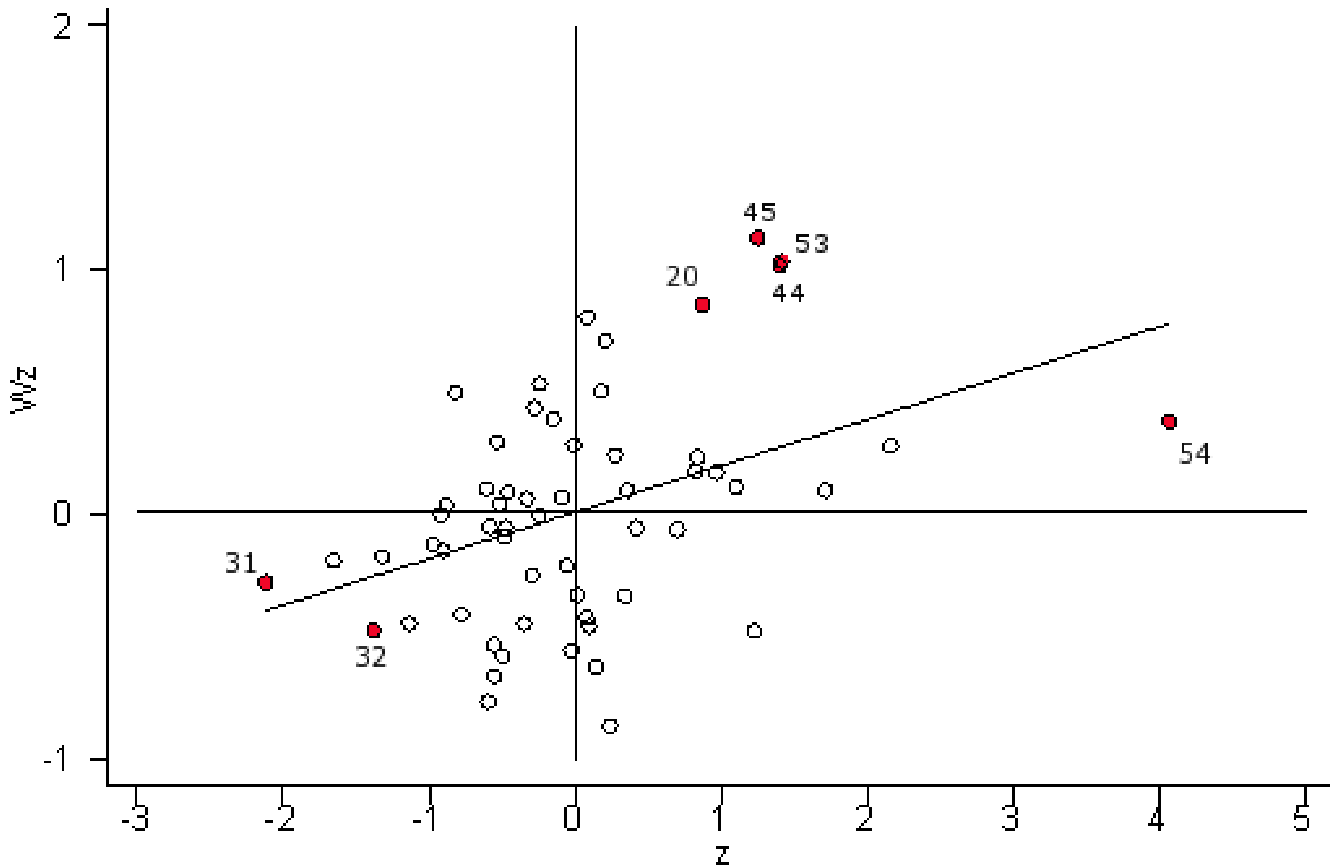
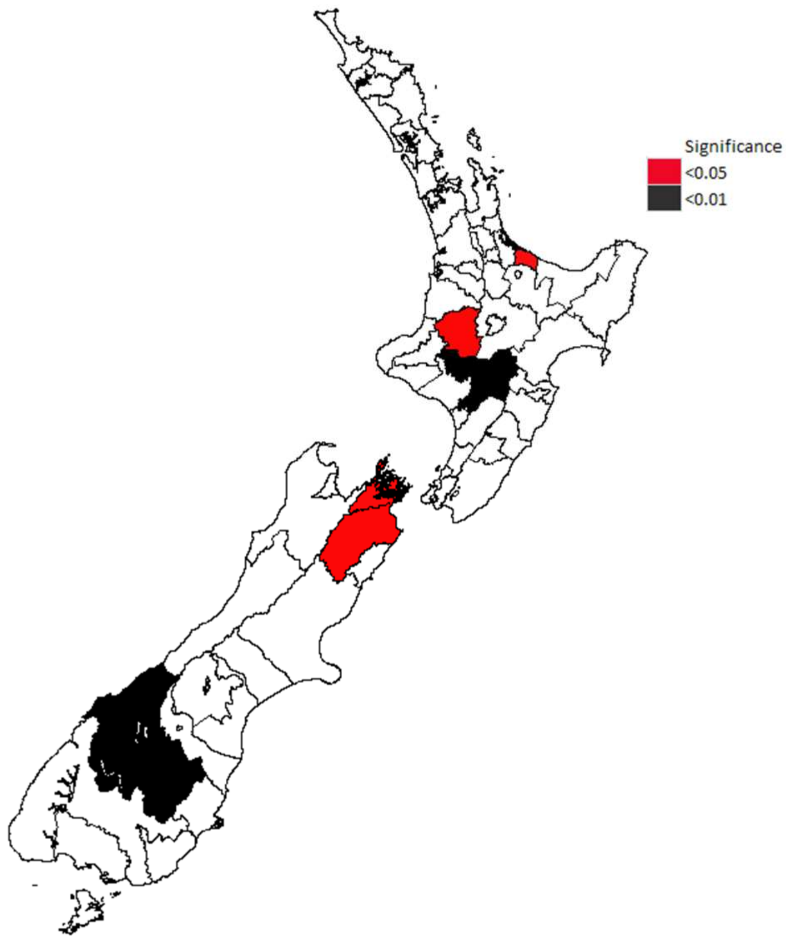
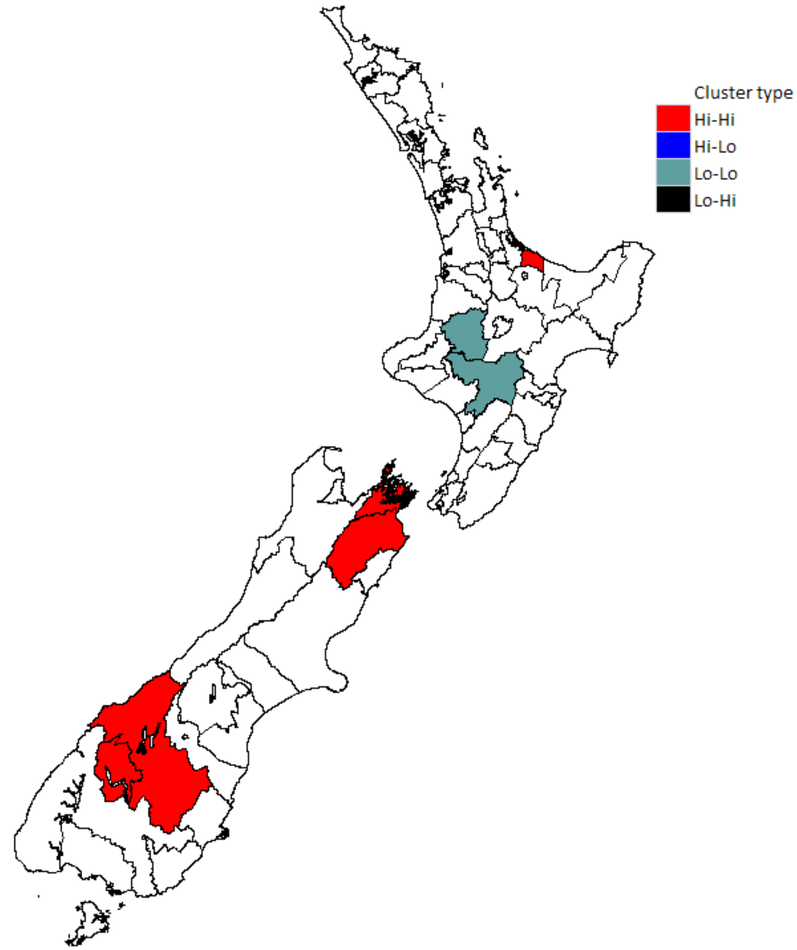


Figure 3.5 Moran Scatter Plot, Competitive Effect (Moran's *I* = 0.190, Pseudo *p* = 0.006)



Note: Significant local Moran statistics are indicated by a filled marker, the accompanying number is the identification number of the LMA concerned.

Figure 3.6 **LISA- Competitive Effect Significance Map (4 inter-censal period average)**	**Figure 3.7** **LISA- Competitive Effect Cluster Map (4 inter-censal period average)**
	

The analysis above has an interesting economic interpretation. Firstly, the insignificance of the spatial correlation in the case of the industry mix effect suggests that New Zealand LMAs are in a spatial sense uniquely defined in terms of industry structure. Thus, while there are LMAs that have similar industrial structures, these are not in close proximity. This type of spatial configuration suggests that labour market adjustment might require worker migration over significant distances. The research of Choy et al. (2002) does suggest that migration plays a major role in labour market adjustment.

On the other hand, the spatial significance of the competitive effect measures suggests that regionally-specific shocks in employment do spill over to surrounding regions. This can be both through inter-regional inter-industry linkages, as well as final purchases and sales between regions. However, given the way the LMAs have been defined, such employment spillover effects cannot be due to changes in cross-boundary commuter spending in the home region after an employment shock in the work region, because such cross LMA commuting is negligible by the statistical design of the LMA.

3.7 Conclusion

This chapter utilised classic shift-share analysis and several variants to identify some forces of New Zealand regional employment change over the 1986-2006 period, which included a decade of drastic economic restructuring, liberalisation and reform. The introduction of the regional dimension increases fifty eight fold the number of 'stories' to tell about the changes that have taken place in the New Zealand labour market. Shift-share analysis is a simple technique to make such a description of change more manageable. This has been further enhanced by the use of ESDA.

In terms of the forces of change, shift-share analysis shows that the national growth effect has been dominant in all regions. No region could escape from the massive national changes that took place since 1984 (and since 1986 in the available data). Industry endowment also played a certain role, but not a major one in terms of its contribution to regional employment growth. Nonetheless, we do find that no region has been going against the trend: where industry mix signalled a disadvantage, the industry-structure was modified in the 'right' direction to ameliorate this disadvantage. The analysis also confirmed that most of the structural change took place during the first five years of the 1986-2006 period. Furthermore, regions exhibited rather spatially unique industry mix effects. Spatial correlation in employment growth due to industry mix is statistically insignificant.

The dichotomisation between the metropolitan regions, and their satellite cities, on the one hand, and the declining peripheral and rural regions on the other that has been identified in earlier research (Karagedikli, et al., 2000, 2003) is reinforced here with some LMAs, notably Queenstown, recovered rapidly from the 1986-1991 period while in others, such as Tokoroa, Taumaranui and Taihape, employment growth has been sluggish or negative throughout. By and large however most of the lagging regions have recovered to some degree in the buoyant economic conditions of the 2001-2006 period. From a longer term perspective, it can be argued that the regions that have done well during the period of this analysis have been those that have responded most effectively to globalization trends, i.e. regions that are innovative in primary production and related processing, provide knowledge-economy linked services, or prosper through international tourism (Poot, 2005).

CHAPTER 4

THE OSWALD HYPOTHESIS

4.1. Introduction

One consequence of the restructuring of the 1980s and early 1990s was a dramatic increase in the level of unemployment, driven in large part by the destruction of employment in the previously heavily protected manufacturing sector.[1]

As can be seen from Figure 4.1 national unemployment peaked at between 10 and 11 percent in 1991-92, compared to 2-3 percent a decade earlier.[2] Subsequently unemployment rates declined markedly through the 1990's and continued to fall after the election in 1999 of a Labour government that has stepped back from the neoliberal restructuring programs of the 1980s and 1990s in favour of a more 'Third Way' approach to economic management.[3] The decline of the unemployment rate seen after the 1991-92 peaks has been attributed, at least in part, by some commentators (Evans, et al., 1996) to the extension of the reform process to the labour market by means of the Employment Contracts Act of 1991 and substantial reductions in benefit payments in the same year. However, the formal assessment of the impact of labour market reforms is no

---

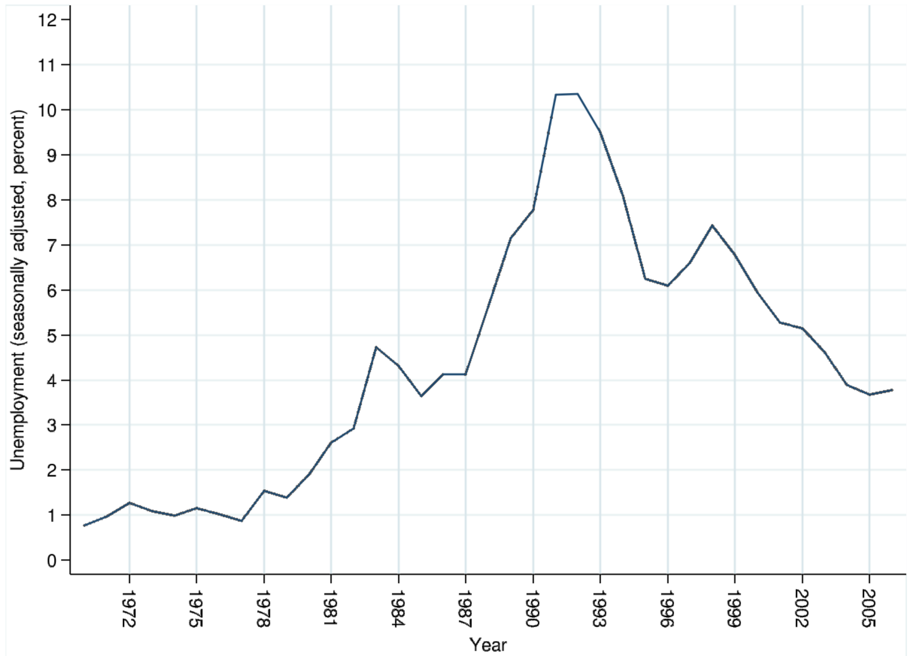
1 Prior to the restructuring period many manufacturing products received effective rates of protection in excess of 100 per cent. In addition subsidization of manufacturing exports was also common. Following 1984, tariffs were removed so that the effective assistance rate for manufacturing fell from 30 to around 7 per cent in 1996. Contemporaneously with the substantive removal of tariff protection, import licensing was removed from all but a few products (Chatterjee, 1996, p. 29).

2 It should be noted than even the 2-3 percent unemployment prevailing at the start of the 1980's was a marked departure from the unemployment rates that had been experienced in the period of the so called long boom (Marglin & Schor, 1990) where New Zealand's unemployment rate is estimated to have remained below 1 percent until the final quarter of 1967 (Gorbey, Briggs, & Chapple, 1993).

3 Chatterjee et al. (1999) provides a useful collection on this approach from a number of writers who have been more or less influential under the Clark Labour government.

easy matter (Gorter & Poot, 1999) and the link between deregulation and labour market performance by no means proven (Baker, et al., 2004).

Figure 4.1 New Zealand Unemployment Rate 1971-2006.



Source: Gorbey et al (1993)

One trend that has coincided with the long term decline in unemployment from the peaks of the early 1990s has been a long run decline in the rate of homeownership, at least as measured by owner-occupied dwelling rates. The number of persons owning one or more rental properties has increased, but the proportion of households living in owner occupied-dwellings has declined[4] from 72- 73 percent in 1986 and 1991, to 68 percent in 1996, 65 percent in 2001 and 63 percent in 2006 (Morrison, 2008, p. 14). This is shown in Figure 4.2.

[4] The percentage of households renting increased by around 4 percentage points from 23 percent to nearly 27 percent between 1986 and 2006 (Morrison, 2008, p. 14). It should be noted that the classification of household tenure is not a simple binary classification between rental and owner-occupied but also includes categories for those who receive free housing (around 4 percent of households in 2006) or whose dwelling is owned by a family trust (nearly 12 percent in 2006).

Figure 4.2 The Homeownership Rate in New Zealand 1971- 2006.

Source: Morrison (2008, p. 14)

Various causes have been posited for this decline in homeownership. Housing New Zealand (HNZ) identified the following as possible contributory factors (Housing New Zealand, 2005, pp. 37-38):

- Increased competition between first home buyers and residential property investors,
- House prices rising faster than household incomes, resulting in a diminishing supply of homes that first home buyers can afford,
- Increasing uptake of tertiary education and student loans, along with people having families later in life,
- Increased levels of consumer debt,
- Removal of specific assistance for entry into homeownership.

However, the decline in homeownership has not been limited to New Zealand as there is significant international evidence of a shift in allocation of households across tenure categories away from homeownership in a number of countries (Morrison, 2008, p. 15), though New Zealand would appear to be unusual in not holding homeownership levels at the levels reached in the late 1980s (Morrison, 2008, p. 13). In a series of working papers and a letter to the Journal of Economic Perspectives written in the late 1990s, Andrew Oswald (1996, 1997a, 1997b, 1999) argues that a high rate of homeownership increases the natural rate of unemployment because, primarily, the transaction costs associated with relocation discourage workers from seeking employment outside their commuting area. Conversely, following this argument, the decline in homeownership observed in New Zealand since the 1980s would have increased geographic mobility and labour market flexibility, contributing to the decline in the long-term rate of unemployment.

Aside from the paper by Cochrane and Poot (2006), on which this chapter builds, there has not been any formal assessment in New Zealand of this possible link, despite Oswald's hypothesis having generated empirical studies in a number of other countries. Skilling (2004, p. 19) refers to this hypothesis in a paper that advocates more widespread asset ownership among the New Zealand population, including of dwellings, but then downplays the possibility of homeownership having what he calls a "dark side" (in terms of generating unemployment) by referring to US evidence by Glaeser and Shapiro (2002) and Australian evidence by Flatau, Forbes, Hendershott, & Wood (2003) that does not appear consistent with the Oswald hypothesis. Indirectly, some NZ econometric modelling by Maré and Timmins (2004) also contradicts the Oswald claim. Maré and Timmins estimate the responsiveness of the number of internal migrants to relative employment conditions in origin and destination regions and then interact this effect with homeownership rates. They find that responsiveness to relative employment performance is greater when more homes are owner-occupied, which is the opposite of what the Oswald hypothesis would suggest. However, their model analyses the spatial variation in mobility rates rather than unemployment rates per se.

The purpose of this chapter is to investigate the Oswald hypothesis directly using a panel of observations (see section 4.3 for a discussion of the variables used) on the New Zealand labour market areas from 1986-2006.

Unfortunately, aggregate data of this type impose limitations on the extent to which Oswald's hypothesis might be explored. However, the use of panel techniques ameliorates some problems, such as missing variable bias, that typically plague purely cross sectional analysis. Moreover the use of spatial econometric panel techniques addresses the often overlooked problem of spatial autocorrelation.

The chapter is structured as follows; the next section (section 4.2) provides a more detailed account of the hypothesis and briefly considers the international literature generated by the hypothesis and its relevance in the New Zealand context. Section 4.3 outlines the data used in the modelling. Section 4.4 discusses the results of the modelling for a standard OLS specification of a model explaining the regional variation in the unemployment rate and then expands this discussion to consider the results of a standard fixed effects panel model and a variety of explicitly spatial models. The final section is by way of conclusion and offers some indications as to further directions to be followed by this research.

4.2. The Oswald hypothesis

As noted above, Andrew Oswald (Oswald, 1996, 1997a, 1997b, 1999) has taken the view that, contrary to prevailing wisdom, high unemployment was not primarily the result of overly generous benefits, trade union power, taxes, or wage inflexibility[5] (Oswald, 1999, p. 14) but instead argued that a significant proportion of the increase in the unemployment rates of most OECD countries between the 1960's and the 1990's was due to a "a secular change that has happened in all but a few Western housing markets -- the rise of homeownership and the decline in private renting" (Oswald, 1996, p. 2). Using largely OLS estimates[6] for a number of data sets for varying time periods and collections of nations and sub regions he obtains a parameter estimate of approximately 0.2

[5] Oswald is not alone in questioning the role of these factors in explaining the rise in the levels of European unemployment; see for instance Baker et al (2004).

[6] A panel model with regional and time period fixed effects was used for the "State-level US Unemployment Regressions with Housing Owner-Occupation as an Independent Variable, 1986-1995" and the "Region-level UK Unemployment Regressions with Proportion of Housing Privately Rented as an Independent Variable, 1973-1994", tables 4 and 5 respectively in Oswald (Oswald, 1996, pp. 27-28).

on the homeownership variable in his regressions leading him to conjecture that a 1 percentage point increase in the rate of homeownership leads to a 0.2 percentage point increase in the unemployment rate.

Oswald (Oswald, 1999, pp. 3-4) identifies 5 causal mechanisms that might underpin this relationship:

- There is what might be called the first order effects of homeownership. These stem from the fact that selling a home is not a costless exercise. Indeed the cost of selling a home can be substantial, amounting to over a fifth of the value of the property being sold in some nations (see table 4.1). This expense is compounded if another property is purchased as in most nations costs are incurred both when buying and when selling properties[7]. Hence the transaction costs associated with the purchase and sale of properties pose an impediment to the mobility of home owners thus making them relatively more vulnerable to adverse employment shocks.
- Secondly, areas with high levels of homeownership, by definition, have low levels of rental tenure therefore high levels of homeownership block entry to such areas by the capital constrained. Basically the unemployed are unable to enter areas of high homeownership to search for a job due to a combination of a thin rental market and a capital constraint.
- In an economy with low levels of spatial mobility matching between employers and workers is adversely affected with the result that many workers end up doing jobs for which they are not particularly suited while employers must select employees from a limited, and perhaps inadequate, pool of talent. These inefficiencies raise the cost of production and lower real wages in comparison to more mobile societies.

[7] This is termed the 'round trip' transaction cost.

Table 4.1 **Roundtrip Transaction Cost Range (as percentage of property value, selected countries).**

	Total Cost		Buyer Range		Seller Range	
Country	*Low*	*High*	*Low*	*High*	*Low*	*High*
Australia	3.80	21.15	1.80	9.35	2.00	11.80
Austria	9.40	12.45	7.60	10.35	1.80	2.10
Belgium	13.90	22.10	10.90	18.10	3.00	4.00
Canada	4.68	11.42	1.00	3.00	3.68	8.42
Czech Rep	6.70	9.21	3.70	6.21	3.00	3.00
Denmark	1.31	3.04	0.81	1.04	0.50	2.00
Finland	7.71	10.20	4.05	4.10	3.66	6.10
France	11.06	19.35	8.67	13.37	2.39	5.98
Germany	7.88	12.64	6.09	9.07	1.79	3.57
Greece	11.39	19.01	10.14	16.01	1.25	3.00
Hungary	6.21	13.85	2.61	7.85	3.60	6.00
Iceland	1.91	2.52	1.91	2.52	0.00	0.00
Ireland	2.56	15.42	2.56	15.42	0.00	0.00
Italy	10.00	22.10	7.60	18.50	2.40	3.60
Japan	5.76	9.00	6.00	10.00	0.00	0.00
Korea	20.57	21.22	20.57	21.22	0.00	0.00
Luxembourg	11.15	15.65	7.70	12.20	3.45	3.45
Mexico	4.32	17.78	1.28	11.69	3.05	6.09
Netherlands	10.52	13.74	9.33	11.36	1.19	2.38
New Zealand	4.25	5.74	0.21	0.74	4.04	5.00
Norway	3.75	5.70	3.75	5.70	0.00	0.00
Poland	5.55	9.93	5.55	9.93	0.00	0.00
Portugal	5.63	16.05	2.00	10.00	3.63	6.05
Slovakia	2.01	5.50	2.01	5.50	0.00	0.00
Spain	10.66	14.24	8.16	11.24	2.50	3.00
Sweden	4.51	7.50	1.51	2.50	3.00	5.00
Switzerland	3.48	8.93	0.25	3.55	3.23	5.38
Turkey	9.85	10.75	4.60	5.50	5.25	5.25
UK	2.89	14.41	0.54	5.15	2.35	9.26
US	7.56	11.20	1.05	2.20	6.51	9.00

(Global Property Guide, 2009)

- Where there are high concentrations of homeowners they may well act to restrict the development of land for non-residential purposes, or the activities that might be undertaken within existing commercial or industrial areas. This may well discourage the expansion of existing enterprises and deter new entrepreneurs from setting up enterprises within an area, resulting in lower levels of employment creation.

- Lastly, home owners may commute much more than renters and over longer distances, partially offsetting their lower propensity to move residences. Oswald contends that this may raise the relative cost of commuting due to traffic congestion and the concomitant increase in travel time. Such an increase in the cost of working has the effect of making work less attractive compared to inactivity thereby increasing the level of unemployment.

In terms of the causal priority assigned to these mechanisms most stress has been placed, in the literature upon the first of these, the relative immobility of homeowners. That homeowners are relatively immobile when compared to renters is certainly plausible in the New Zealand context as the median years at the usual residence data obtainable from the census indicates that owner occupiers have been resident at their current address around 3 times longer than those resident in dwellings which they do not own (Statistics New Zealand, 2007).

The international literature generated by the debate ensuing from Oswald's conjecture has been extensive and has been reviewed by Munch, Rosholm, & Svarer (2008) and Rouwendal and Nijkamp (2007). Hence the review here will be brief and primarily focused on the seemingly contradictory evidence, particularly between micro and macro studies.

There would be general agreement that geographic mobility involves costs and benefits and that, as costs increase for given benefits, mobility will therefore decrease. There would also be general agreement that there are significant transaction costs in the sale and purchase of a dwelling and owners may therefore be less inclined to look for employment opportunities outside the commuting range, as compared with renters. In addition, increasing duration of residence yields a non-pecuniary benefit in the form of attachment to the dwelling and its location that tends to be greater for owners than renters as the former have a greater opportunity to modify the dwelling attributes (in terms of alterations, landscaping etc.) to suit individual tastes. These modifications are a type of location fixed capital that is lost with a move.

Besides the plausible arguments why homeowners have lower migration rates (and are more likely to commute over longer distances) there is also plenty of empirical evidence that confirms that migration rates among homeowners are lower, all else being equal. For New Zealand, see e.g. Statistics New Zealand (2007) or Stillman & Maré (2008). The question is whether it is possible to identify an unbiased causal effect of ownership rates, via the mobility and job search effects, on the natural rate of unemployment.

The macro-level studies initially supported the Oswald hypothesis (see Pehkonen (1999) using Finish regional data; Partridge and Rickman (1997) using US state data; and Layard and Nickell (1999) using OECD country data, but some subsequent studies are less conclusive (e.g., Flatau, Forbes, Hendershott, O'Dwyer, & Wood, 2002 using Australian data; Flatau, et al., 2003) or even reject the hypothesis (e.g., Green & Hendershott, 2001, using US data). More recently Munch et al. (2008) have raised the possibility that, due to the transactions costs associated with moving, owners will have higher reservation wages for more distant than local employment. This implies, in opposition to Oswald, that ownership maybe accompanied by higher employment but at lower wages – a view supported by Brunet and Havet (2009, as cited in Isebaert, Heylen, & Smolders (2010)). However, Isebaert et al. (2010), using a panel of 42 Belgian regions (arrondissements) from 1970-2005 and instrumental variable (IV) 3SLS to control for potential endogeneity in homeownership, find evidence in favour of the Oswald hypothesis.

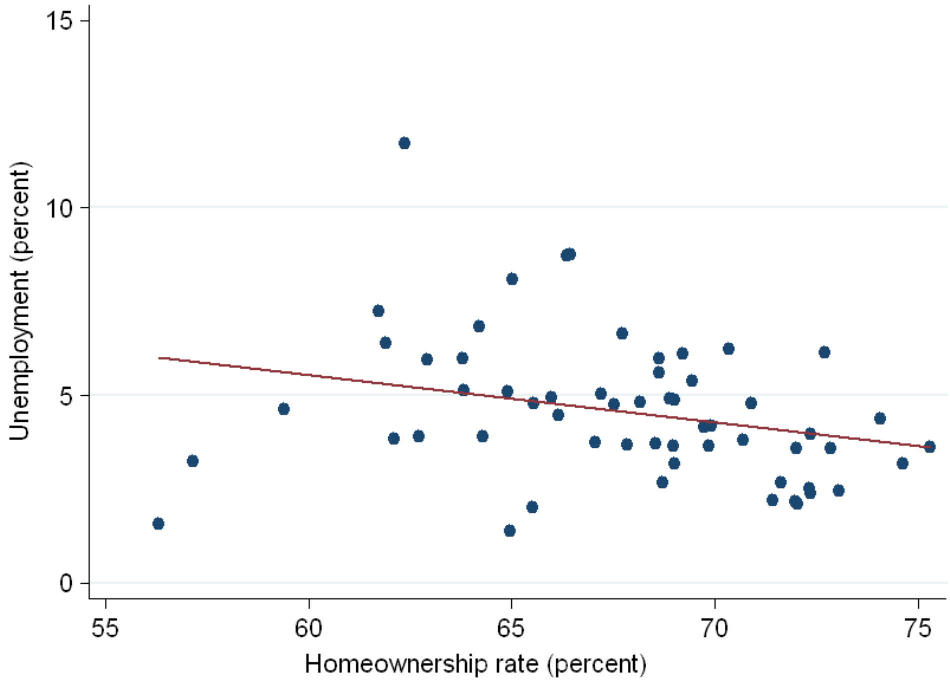
One explanation for differences between macro studies is the extent to which the estimates are driven by cross-sectional (i.e. static) variation or by changes over time within each region (such as by means of the Fixed Effects estimator in panel data). Even without a formal meta-analysis, it is plausible that cross-sectional data are likely to yield an on average larger effect, as was confirmed by Oswald's original study (Oswald, 1996, p. 15). The reason is that cross-sectional composition effects on the supply side, such as age and education, and labour demand effects (higher incomes in more prosperous regions) shift the regression coefficient in the opposite direction, suggesting an inverse cross sectional relationship between a region's unemployment rate and the proportion of dwellings owner-occupied. In the New Zealand case, this is illustrated in figure 4.3 that provides a cross-sectional scatter plot of unemployment rates and homeownership rates derived from 2006 census data. Figure 4.3 displays a negatively sloped linear cross-sectional relationship across the 58 LMA.

As will be discussed in section 4.3, maps of unemployment in New Zealand show that there is significant spatial correlation: LMA with high/low unemployment rates are likely to be surrounded by other LMA with high/low unemployment rates and similarly for homeownership rates. Over time, all regions experienced qualitatively similar changes in homeownership rates and unemployment rates as displayed in Figures 4.1 and 4.2 at the national level. Thus, results from regression modelling are likely to depend on, firstly, the extent to which the results are driven by cross-sectional versus time series variation and, secondly, the extent to which co-variates and the estimation technique are likely to account for omitted variable bias, simultaneity and spatial dependence.

There is also a measurement issue with respect to homeownership that is important. Homeowners without mortgages have significant wealth and may search for jobs locally for longer than those whose mortgage repayment obligations lower their reservation wage (see e.g. Flatau et al. (2002; 2003) for Australian evidence and Goss and Phillips (1997) using US panel data). In addition, renters of public housing may lose their subsidy with migration and have therefore lower mobility than owners (see McCormick (1997)).

Household structure matters too. Single persons, particularly younger single persons, are more likely to be in a rental (or 'flatting" situation) and therefore less likely to have job search constrained by the "tied stayer" phenomenon (where a potential wage gain from migration would be more than offset by an implied wage loss for the partner, see Swain and Garasky (2007), Battu, Ma, & Phimister (2006) or Mont (1989)).

Figure 4.3 The Homeownership and Unemployment rates: 2006 census.



The micro level research that followed the earlier macro level studies of the Oswald hypothesis have been specifically focussed on such issues as the impact of the type of ownership and the structure of households on quits and job search behaviour.

These studies are also reviewed in Munch, Rosholm, & Svarer (2006) and Rouwendal and Nijkamp (2007). However as this chapter is concerned with LMA data, such studies will not be reviewed here. Rouwendal and Nijkamp (2007) conclude that the micro level studies almost unanimously reject the Oswald hypothesis[8]. There is general empirical support for the idea that homeownership lowers geographic mobility but it does not logically follow that homeowners therefore experience longer unemployment spells. Instead, even controlling for human capital characteristics, homeowners appear to have higher exit rates from unemployment (Munch, et al., 2006). They argue that further research should focus on:

---

[8] Isabaert et al. (2010) make a similar point in respect of the post 2006 literature, citing such studies as Coulson and Fisher (2009).

(1) The extent to which the macro level evidence is spurious, or at least robust under a wide range of econometrics specifications, and

(2) The need for a theoretical reconciliation of the macro and micro evidence.

The latter has already been attempted by Dohmen (2005) but here we revisit the former issue with New Zealand data and specifically take account of spatial dependence, an issue that in the context of the Oswald hypothesis had not yet been considered before.

4.3 Data and Descriptives

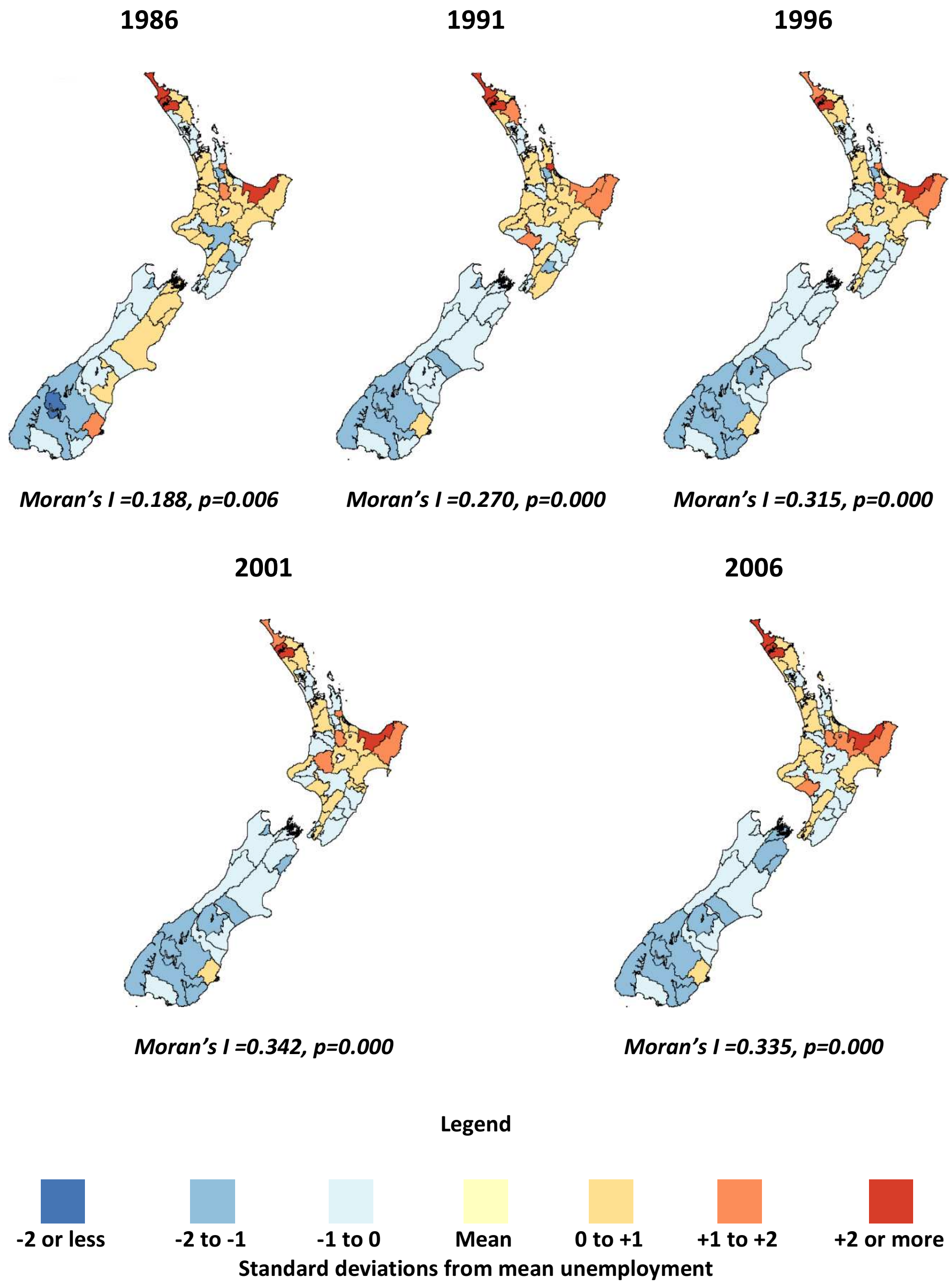
The dependent variable in the regression analysis is the LMA unemployment rate[9]. As noted earlier the unemployment rate rises from the early 1970's until peaking in the early 1990's then falling to around 4 percent in 2006. This is still around 4 times higher than the starting point in the early 1970's, though of comparable magnitude to that experienced immediately prior to the restructuring period (see figure 4.1). What is not apparent from figure 4.1's depiction of the national level unemployment rates is the growth in the dispersion of unemployment rates between LMAs, as evidenced by the rise in the coefficient of variation of unemployment rates from 0.27 (1986) to 0.42 (2006), and the concentration of unemployment in certain LMAs overtime. This latter point is illustrated in Figure 4.4 which shows the changing spatial distribution of LMA unemployment 1986-2006.

Taking the dependent variable in our model of the relationship between the unemployment rate and homeownership to be the LMA unemployment rate the Oswald hypothesis holds that the coefficient of the homeownership variable will be positive and likely to be around 0.2. Homeownership (home_ownership**)** is defined as the percentage of the LMA population in owner-occupied dwellings at the time of the previous census.

---

[9] General descriptive statistics for each of the explanatory variables and unemployment are available in table 4.2.

Figure 4.4 The Spatial Distribution of Unemployment in New Zealand 1986-2006.



The one census period temporal lag is used to mitigate the effects of reverse causality. Strictly speaking a more complex IV strategy should be used to identify the causal effect of homeownership on unemployment (see the discussion in section 6.2) however the approach taken here is justified on the grounds that it remains close to Oswald's original regressions and that any causal impact of unemployment on homeownership is likely to be numerically smaller than the impact of homeownership on unemployment. The latter point is largely a matter of the relative magnitudes of the homeownership and unemployment rates, the homeownership rate being 7-10 times larger than the unemployment rate. Hence the instantaneous impact of unemployment on ownership rates will be small (e.g. through mortgagee sales) while, as the home ownership rate and labour force participation rates are high, homeowners influence labour supply and thereby the unemployment rate.

Figure 4.5 maps homeownership rates over the LMA for the years 1986-2006 as standard deviations from the mean LMA homeownership rate. The significant Moran statistics indicate the presence of spatial correlation of the homeownership rate while the reduction in the cross sectional standard deviations of the homeownership over time points to sigma convergence of LMA level homeownership rates (i.e. the dispersion of LMA level homeownership rates is decreasing over time).

Figure 4.6 shows the change in homeownership rates 1986-2006 against the homeownership rate in 1986 and offers some informal evidence of beta convergence (i.e. the LMA with the highest levels of homeownership in 1986 experienced the greatest declines in homeownership 1986-2006).

In addition controls for a number of other variables that may influence local unemployment levels have been included.

Figure 4.5 The Spatial Distribution of Homeownership in New Zealand 1986-2006.

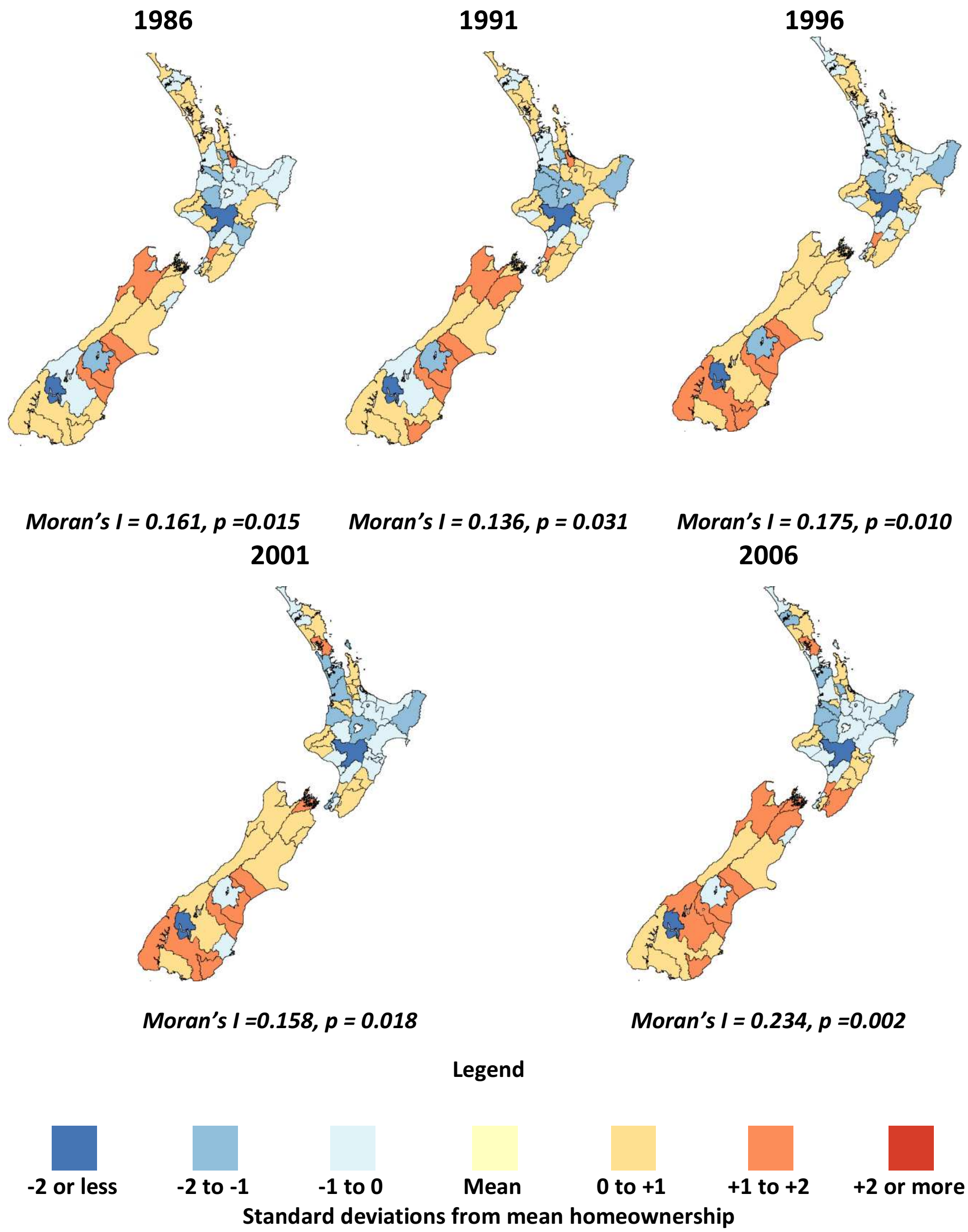


Figure 4.6 Change in homeownership 1986-2006.

It has been argued, largely on the grounds of differences in transaction costs (Mincer, 1978) that single person households are more mobile than family households. However, in the New Zealand context the median time of occupancy of the current residence for single person household is higher than for any other household composition over the last three censuses, suggesting a relatively immobile single person population (Statistics New Zealand, 2007).[10] Given that the single person household population in New Zealand would appear to be relatively immobile it would be expected that there higher proportions of single person households in an LMA would be associated with higher unemployment rates. The variable “single_household”, defined as the percentage of the LMA population in single person households at the time of the previous census, has been introduced to control for this.

The demographic structure of the population has significant and well documented effects on labour market dynamics (see Kuhn & Ochsen, 2009 for example), with younger populations tending to have both higher participation,

[10] These are predominantly widows and other older persons without partners.

job turnover and unemployment levels than older. Here we control for the effect of demographic structure through the introduction of a variable (older_population) for the percentage of the LMA population aged 40 years and over in the previous census period. This variable is expected to have a negative coefficient as one would expect lower levels of unemployment in areas with larger older populations.

Māori experience a considerably worse set of labour market outcomes than the New Zealand population as a whole with higher levels of unemployment, lower levels of educational attainment and wage growth (Department of Labour, 2007) along with greater vulnerability to macro-economic shocks (Te Puni Kōkiri (Ministry of Māori Development), 2009). To capture the labour market experience of Māori a variable (māori) is included, being the percentage of the LMA population identifying as Māori in the previous census period. The coefficient on this variable is expected to be negative.

It should be noted that the concept of ethnicity that is currently used in the New Zealand census allows individuals to select more than one ethnicity to identify with (Errington, Cotterell, von Randow, & Milligan, 2008, pp. 44-49) hence the variable "māori" used here will include persons who identify with multiple ethnicities as well as Māori alone.

The Asian population in New Zealand, though by no means homogenous (Department of Labour, 2010, p. 16), contains a relatively high proportion of youthful recent migrants who frequently have difficulty in obtaining employment as their overseas qualifications are often not fully recognised, they lack New Zealand work experience and, in some cases, have language difficulties (Department of Labour, 2009). This results in a lower than average level of participation in employment and the labour market and a higher than average rate of unemployment, though not to the same extent as Māori (Department of Labour, 2010, p. 25). The variable "asian' is included in our model to account for the impact of the recent relatively large flows of Asian migration on the unemployment rate and is expected to have a positive coefficient. Similarly to the variable "māori", "asian" is defined as the percentage of the LMA population identifying as Asian in the previous census period.

Employment of unskilled or manual labour has declined throughout the period considered by this thesis. In part this has been due to the fall in the employment share of industries heavily dependent upon such labour, manufacturing for instance (see table 1, chapter 3) as a result of the withdrawal of protective trade barriers during the period of economic restructuring[11] and in part to underlying changes in the nature of skills demand in the contemporary economy (Hyslop & Maré, 2009). To capture the impact of the change in demand for unskilled or manual labour, the variable "manual" (the percentage of employment in manual occupations in the preceding census period) is included in the model and is expected to have a positive coefficient.

The impact of migration on local unemployment levels has received ongoing attention in the literature where the topic is fraught with controversy (Longhi, Nijkamp, & Poot, 2010). On the supply-side in neo-classical models, workers move from areas of high unemployment to areas of low unemployment, equalising unemployment rates across regions. While the in-migration of workers induces higher expenditure on goods and services, and consequently higher investment levels and new demand for labour, the supply-side effects could dominate and thereby reduce regional disparities in unemployment. Equally high net migration may result in high short-term unemployment because migrants are more engaged in job search than the established population. In either eventuality the expectation here would be that areas with high levels of net migration would experience increases in the level of unemployment.

In NEG models such as that proposed by Epifani and Gancia (2005), the demand side dominates as migration flows – perhaps triggered by a reduction in travel costs - to the core regions of the economy generate agglomeration economies which lead to higher profits, and hence labour demand, and a reduction in the level of unemployment. The reverse occurs in the peripheral

[11] Prior to the restructuring period many manufacturing products received effective rates of protection in excess of 100 per cent. In addition subsidization of manufacturing exports was also common. Following 1984, tariffs were removed so that the effective assistance rate for manufacturing fell from 30 to around 7 per cent in 1996. Contemporaneously with the substantive removal of tariff protection, import licensing was removed from all but a few products (Chatterjee, 1996, p. 29).

regions with reduced profits leading to decreasing demand for labour (Basile, Girardi, & Mantuano, 2010, pp. 4-6).

To control for the impact of migration in the model the variable net_migration is included. Net migration is measured as the net migration[12] for a given LMA in the preceding inter-census period as a percentage of the end of period population for that LMA. The sign on this coefficient is ambiguous depending on whether supply or demand side effects dominate and the likely effect size will, according to recent meta analysis (Longhi, et al., 2010), be small.

Lastly, as argued in chapter 3, the employment level in an LMA is in part explained by the presence of industries in the region that have been growing above or below average nationwide. That is the level of employment, and by implication the level of unemployment, is to a large extent the product of the industry mix of the LMA. This effect is captured by the inclusion of the variable "predicted_employment" which is the predicted percentage employment growth over the pre-census intercensal period in which it is assumed that each industry in the region grew at the national growth rate of that industry[13]. The coefficient is expected to be negative.

In addition time period and LMA dummy variables are used as needed. The year 1996 is excluded where time period fixed effects are used, and LMA 7 (Auckland) is excluded, where LMA fixed effects are included. Hence the year 1996 and LMA 7 serve as reference categories. All variables used are drawn from the census of population and dwellings in the relevant year, as per the discussion in chapter 3.

The weights matrix used to specify the spatial relations between LMA in the spatial models presented below is row standardised and based on the reciprocal of the square of travel time between LMA as discussed in chapter 2.

[12] In the absence of adequate data on inter-regional migration in New Zealand net migration rates have been calculated by the Census Survivorship method (Siegel & Swanson, 2004, p. 506).

[13] The actual measure used here is the Bartik index (T. J. Bartik, 1991). The Bartik index estimates employment growth, within a region (*j*), between time periods t_0 and t_1 by applying the national growth rates between t_0 and t_1 to a region's initial industry/occupation groups.

It should be noted that the descriptive statistics presented in table 4.2 are not weighted by population, that is, the mean value of a variable represents the average LMA not the average individual.

4.4 Estimation Results[14]

This section presents the main empirical findings of the chapter, in particular it deals with the following models: pooled OLS, non-spatial panel with LMA-level fixed effects, pooled spatial lag model and pooled spatial error models, spatial lag and spatial error panel models with LMA level fixed effects and finally spatial lag and spatial error panel models with LMA level and time period fixed effects.

The results of a standard pooled OLS regression are shown in Table 4.3, along with the standard diagnostics for spatial autocorrelation in the residuals of the OLS regression. Robust standard errors are used in this regression and in the other estimations presented in this chapter to guard against the possibility of heteroskedasticity – one possible source being the marked variability in the size of the LMAs which, in terms of the census usually resident population, vary between around 5000 in Kaikoura and 775000 in the Auckland LMA (see LMA descriptive statistics in Chapter 2).

In accordance with Oswald's hypothesis the coefficient on the homeownership variable is positive and significant though markedly larger than hypothesised by Oswald (0.379 versus the hypothesised 0.2). All the remaining variables reach statistical significance at the 5 percent level however the sign on the manual employment variable is negative, indicating that unemployment is lower in areas with high levels of manual employment, rather than the expected positive sign.

[14] Most estimations were carried out in Stata version 11 using the built in 'reg' command or the user provided ado's of Maurizio Pisati (spatcorr, spatdiag, spatgsa, spatlsa, spatreg, spatwmat). Some estimations were carried out with the freely available MatLab econometric toolbox by James Le Sage (available from http://www.spatial-econometrics.com/) and the Matlab spatial panel m files of J. P. Elhorst.

Table 4.2 Descriptive Statistics for Variables in Oswald Hypothesis Models.

Statistic	home-ownership	single_household	older_population	asian	manual	net_migration	predicted_employment	Unemployment
	1986					**1986-1991**		**1991**
Mean	71.56	18.05	34.21	0.75	13.28	-1.87	-7.95	10.38
Median	72.45	18.18	33.92	0.54	13.40	-2.00	-8.38	9.98
Max	80.15	22.34	42.59	3.68	18.56	21.75	-0.72	21.02
Min	47.99	13.51	23.12	0.09	8.31	-22.07	-11.96	6.00
SD[1]	5.77	2.19	3.65	0.68	2.06	7.11	1.88	2.85
CV[2]	0.08	0.12	0.11	0.90	0.15	-3.80	-0.24	0.27
	1991					**1991-1996**		**1996**
Mean	72.52	20.14	37.31	1.20	11.60	-1.74	14.89	7.51
Median	73.29	20.27	37.04	0.79	11.59	-2.29	14.29	7.07
Max	81.14	24.69	46.23	5.80	14.67	41.14	22.14	18.87
Min	51.18	15.32	27.13	0.23	7.22	-17.06	9.36	2.37
SD[1]	5.43	2.02	3.87		1.60	8.76	2.90	2.86
CV[2]	0.07	0.10	0.10	0.00	0.14	-5.04	0.19	0.38
	1996					**1996-2001**		**2001**
Mean	70.03	21.08	39.97	1.73	13.23	-2.41	4.06	7.00
Median	70.64	21.04	39.50	1.02	13.13	-2.40	3.99	6.31
Max	79.15	25.36	48.50	9.56	17.75	16.47	9.40	18.00
Min	51.39	16.03	29.96	0.46	8.49	-19.64	0.37	2.47
SD[1]	4.96	2.00	4.03	1.92	1.68	6.56	1.90	2.87
CV[2]	0.07	0.10	0.10	1.11	0.13	-2.72	0.47	0.41
	2001					**2001-2006**		**2006**
Mean	69.78	24.46	44.37	2.17	13.94	1.69	12.28	4.57
Median	70.50	24.60	44.39	1.24	13.66	-2.55	12.14	4.27
Max	77.80	28.79	55.85	13.47	18.55	82.17	18.28	11.72
Min	55.12	17.79	36.35	0.46	9.34	-17.31	7.89	1.39
SD[1]	4.35	2.14	4.48	2.57	1.98	16.29	2.48	1.94
CV[2]	0.06	0.09	0.10	1.19	0.14	9.62	0.20	0.42

1 SD = Standard deviation

2 CV= Coefficient of variation

Table 4.3 Oswald Hypothesis Ordinary least squares results with spatial diagnostics

Nobs	232
F(8, 223)	83.120
Prob > F	0.000
R-squared	0.765
Root MSE	1.656

	Coef.	Robust std error	t	P>|t|	[95% Conf. Interval]	
home_ownership	0.379	0.027	14.280	0.000	0.327	0.431
singe_household	0.130	0.072	1.810	0.072	-0.012	0.271
older_population	-0.337	0.042	-8.030	0.000	-0.419	-0.254
māori	0.203	0.013	15.340	0.000	0.177	0.229
asian	0.289	0.039	7.430	0.000	0.212	0.365
manual	-0.317	0.069	-4.590	0.000	-0.453	-0.181
net_migration	0.063	0.015	4.110	0.000	0.033	0.093
predicted_employment	-0.146	0.017	-8.520	0.000	-0.180	-0.112
_cons	-7.974	1.834	-4.350	0.000	-11.588	-4.361

Test	**Statistic**	**df**	**p-value**
Moran's I	3.25	1	0.001
Spatial error			
Lagrange multiplier	7.45	1	0.010
Robust Lagrange multiplier	1.37	1	0.240
Spatial lag:			
Lagrange multiplier	20.66	1	0.000
Robust Lagrange multiplier	14.58	1	0.000

The expectation that the sign on the manual employment variable would be positive was founded on the not unreasonable believe that as these occupations suffered the most during restructuring areas with high levels of initial employment in these occupations would experience higher levels of unemployment. However, in a pooled data regression as opposed to a panel fixed effects model, the emphasis is likely to be on cross-sectional variation and not change over time. Hence in the pooled model one would expect a negative coefficient on the manual variable as areas which continued to have high levels of manual employment throughout the period (despite the restructuring) are likely to have lower levels of unemployment.. The initial expectation of a positive coefficient would however be expected to hold in the panel fixed effects models as the logic here would be that the areas that experienced the greatest inter census declines in manual employment levels would see relatively larger increases in unemployment. Inspecting the results for the spatial panel fixed effects models in table 4.10 one can indeed see that the coefficient on the manual employment variable is positive, albeit insignificant.

The pooled OLS approach suffers from a number of short comings. Firstly, while the data here is of a panel nature, that is repeated observations on the same areas over time, this is not exploited by a pooled OLS estimator. As the model is unlikely to encompass all the determinants of unemployment across the LMAs, and some of these omitted variables are likely to be correlated with included variables, OLS may yield seriously biased parameter estimates. Additionally the effect of a variable changing over time within a region may differ markedly from the effect of the same variable changing cross-sectionally relative to other LMA. These short comings are relatively well known and covered in the econometrics literature (see for example Stock and Watson (2003, ch.8), Verbeek (2004, ch.10) or for a more advanced treatment Baltagi & Hani (2005). An alternative to, and improvement upon, the pooled OLS estimation procedure is the simple LMA level fixed effects model. The advantages of such models are well established, they are able to control for cross sectional heterogeneity, are more informative than either pure time-series or cross-sectional models, present more variability and less collinearity, and can provide more efficient parameter estimates (Baltagi & Hani, 2005). In this instance it was felt that there was a strong *a priori* preference for fixed over random effects, as the data do not refer to a random draw of spatial units from a very large population but rather an exhaustive sampling (Nerlove & Balestra, 1996, p. 4) of LMAs in New Zealand and the effects that are in this particular population.[15] Nevertheless it was thought prudent to conduct the standard Hausman specification test (Baltagi, Bresson, & Pirotte, 2003, p. 362) for distinguishing between fixed and random effects models. The results confirmed that the fixed effects specification is preferred.

Comparing the fixed effects (Table 4.4) and pooled OLS (Table 4.3) estimations, it can be seen that while in the panel model the coefficient on the homeownership variable (home_ownership) continues to have the expected sign and is still statistically significant its magnitude is now close to half that of the pooled OLS estimate and identical to the "stylised fact" suggested by Andrew Oswald. Of the other variables, the percentage of the population aged 40 and over (older_population), net migration (net_migration) and the expected employment growth (predicted_employment) all attain statistical significance at the 5 percent level, with the expected signs. The remaining variables, percentage Asian (asian), percentage in manual occupations (manual) and the percentage of the population in single person households (singe_household) do not attain statistical significance in Table 4.4 but have the expected signs. Of some note is that the coefficient of the percentage in manual occupations variable has in table 4.4 the initially expected sign (positive).

[15] This point, in the context of spatial panels, is discussed in more depth in Elhorst (2003, 2010).

Table 4.4 Oswald Hypothesis Non spatial FE panel model*

R-sq:			Nobs	232
within	0.922		Groups	58
between	0.051			
overall	0.410		F(8,166)	243.54
corr(u_i,xb)	-0.052		Prob > F	0.000

	Coef.	Robust std error	t	P>|t|	[95% Conf. Interval]	
home_ownership	0.199	0.032	6.170	0.000	0.135	0.263
singe_household	-0.118	0.073	-1.630	0.106	-0.261	0.025
older_population	-0.312	0.050	-6.230	0.000	-0.410	-0.213
māori	0.006	0.048	0.130	0.893	-0.087	0.100
asian	0.023	0.066	0.350	0.728	-0.107	0.153
manual	0.020	0.053	0.370	0.713	-0.086	0.125
net_migration	0.017	0.009	1.980	0.049	0.000	0.035
Predicted_employment	-0.080	0.009	-8.570	0.000	-0.099	-0.062
_cons	-7.974	1.834	-4.35	0.000	-11.588	-4.361
sigma_u	2.525					
sigma_e	0.721					
	F test that all u_i=0:	F(57, 166) = 17.74		Prob > F = 0.0000		

** Regional results excluded from table for brevity, LMA 7 (Auckland) excluded*

Another problem with pooled OLS can occur when using spatially referenced data as it is probable that spatial dependency will be present in such data. As discussed in Chapter 2, such dependency may take two forms: spatial autocorrelation which is the presence of systematic spatial variation in a variable (Haining, 2001, p. 14763) or spatial heterogeneity which refers to changing structure or changing association across space or, more formally in a regression setting, structural instability in the form of non-constant error variances (heteroskedasticity) or model coefficients (variable coefficients, spatial regimes). The two are not mutually exclusive and may be observationally equivalent in a given set of cross sectional data (Anselin, 1999).

Inspection of the spatial diagnostics for the pooled OLS estimation in table 4.3 confirms the presence of spatial auto correlation, with Moran's *I* being significant at the 0.1 percent level, while the Lagrange multiplier tests support the adoption of a lag specification, at least in a cross sectional context. The presence of correlated errors violates the Gauss-Markov assumption of uncorrelated random errors and more broadly the assumption of independence between observations. The consequences of ignoring the presence of spatial dependence in the data are nontrivial and unlike some other difficulties, such deviations from normality are not often overcome by simple transformations of the data. In the presence of spatial dependence, Rao, (1973) and Haining (2001) have found that OLS estimators are usually not optimal, while Underwood (1997) found that in the presence of positive spatial autocorrelation variance estimates are biased downward thereby increasing the likelihood of type 1 errors. Furthermore the presence of positive spatial autocorrelation that is not taken into account in regression analysis upwardly biases the coefficient of determination, exaggerating the fit of the model Haining (2001). Consequently, neglecting the possibility of spatial autocorrelation can lead to seriously biased parameter estimates and a flawed and misleading investigation (O'Sullivan & Unwin, 2003, pp. 28-30).

The estimates reported in Tables 4.5 and 4.6 are a first attempt to address the problem of the presence of spatial auto correlation using simple

Cliff-Ord (1981) type models of the kind discussed in Chapter 2. Of the lag and error models the spatial diagnostics indicate that the lag specification, following Anselin (2005, pp. 198-200) is to be preferred. However, both lag (Table 4.5) and error models (Table 4.6) are presented here for comparative purposes. Comparing the spatial lag model with the pooled OLS estimates the homeownership variable (home_ownership) is both significant and of the expected sign though slightly smaller. Of the other explanatory variables all attain significance at the 5 percent level however the percentage in manual occupations (manual) variable has a negative sign, the opposite to that initially expected, though in accordance with the explanation offered in the pooled OLS section above.

In the pooled spatial error model the homeownership variable is comparable in magnitude to that obtained in the pooled spatial lag model and is hence somewhat less than that obtained in the pooled OLS estimation. With the exception of the percentage in manual occupations (manual) variable all other variables attain significance at the 5 percent level and possess the expected sign. The manual occupations (manual) variable again has a negative sign and just fails to attain significance at the 5 percent level.

Combining the advantages of the spatial modelling approach with those of the panel data modelling approach, Tables 4.7 and 4.8 present a panel spatial lag model and a panel spatial error model respectively. [16] The coefficient on the homeownership variable (home_ownership) under the panel spatial lag model remains significant and of the expected sign but is over 50 percent smaller than that obtained in the pooled OLS model and is around 14 percent smaller than that obtain in the fixed effects model without the incorporation of spatial lag. Hence it is smaller than the value of 0.2 suggested by Oswald. Of the remaining variables only the percentage of the population aged 40 and over (older_population), percentage Asian (asian) and the expected employment growth (predicted_employment) attain significance at the 5 percent level.

[16] For a full discussions of the specification of spatial panel models see Elhorst (2003, 2010) and Anselin, LeGallo, & Jayet (2008).

Table 4.5 Oswald Hypothesis Spatial lag model

Number of obs	232
Variance ratio	0.780
Squared corr.	0.791
Sigma	1.530
Log likelihood	-431.01

	Coef.	Robust std	t	P>|t|	[95% Conf. Interval]	
home_ownership	0.337	0.027	12.360	0.000	0.284	0.391
singe_household	0.233	0.067	3.460	0.001	0.101	0.365
older_population	-0.321	0.041	-7.870	0.000	-0.401	-0.241
māori	0.186	0.015	12.620	0.000	0.157	0.215
asian	0.289	0.041	7.000	0.000	0.208	0.370
manual	-0.176	0.070	-2.500	0.013	-0.314	-0.038
net_migration	0.054	0.014	3.870	0.000	0.026	0.081
predicted_employment	-0.104	0.019	-5.540	0.000	-0.141	-0.067
_cons	-11.977	1.790	-6.690	0.000	-15.486	-8.468
rho	0.331	0.072	4.600	0.000	0.190	0.473

Wald test of rho=0:	chi2(1)	21.172	0.000
Lagrange multiplier test rho=0:	chi2(1)	20.657	0.000
Acceptable range for rho: -1.229 < rho < 1.000			

Table 4.6 Oswald Hypothesis Spatial error model.

Number of obs	232
Variance ratio	0.664
Squared corr.	0.755
Sigma	1.550
Log likelihood	-435.92

	Coef.	Robust std error	t	P>|t|	[95% Conf.	Interval]
home_ownership	0.352	0.044	7.980	0.000	0.266	0.438
singe_household	0.197	0.087	2.260	0.024	0.026	0.367
older_population	-0.327	0.055	-5.940	0.000	-0.435	-0.219
māori	0.210	0.015	13.530	0.000	0.179	0.240
asian	0.341	0.077	4.420	0.000	0.190	0.492
manual	-0.213	0.109	-1.940	0.052	-0.427	0.002
net_migration	0.053	0.019	2.730	0.006	0.015	0.091
predicted_employment	-0.140	0.029	-4.860	0.000	-0.196	-0.083
_cons	-9.349	2.099	-4.450	0.000	-13.464	-5.234
lambda	0.430	0.241	1.790	0.074	-0.042	0.902

Wald test of lambda=0:	chi2(1)	3.187	-0.074
Lagrange multiplier test lambda=0:	chi2(1)	7.451	-0.006
Acceptable range for lambda: -1.229 < lambda < 1.000			

Table 4.7 Oswald Hypothesis Panel Spatial lag model. *

Number of obs	232
Variance ratio	0.969
Squared corr.	0.971
Sigma	0.570
Log likelihood	-203.138

	Coef.	Robust std error	t	P>|t|	[95% Conf.	Interval]
home_ownership	0.172	0.030	5.720	0.000	0.113	0.231
singe_household	-0.049	0.070	-0.700	0.482	-0.185	0.087
older_population	-0.233	0.050	-4.690	0.000	-0.330	-0.136
māori	0.027	0.039	0.680	0.496	-0.050	0.103
asian	0.098	0.044	2.220	0.026	0.012	0.184
manual	0.065	0.051	1.290	0.195	-0.034	0.165
net_migration	0.010	0.007	1.310	0.189	-0.005	0.024
predicted_employment	-0.049	0.011	-4.440	0.000	-0.071	-0.027
_cons	0.291	2.508	0.120	0.908	-4.625	5.206
rho	0.374	0.078	4.810	0.000	0.221	0.526

Wald test of rho=0:	chi2(1)	23.11	0.000
Lagrange multiplier test rho=0:	chi2(1)	20.47	0.000
Acceptable range for rho: -1.229 < rho < 1.000			

** Regional results excluded from table for brevity, LMA 7 (Auckland) excluded*

Table 4.8 Oswald Hypothesis Panel Spatial error model *

Number of obs	232
Variance ratio	0.965
Squared corr.	0.966
Sigma	0.580
Log likelihood	-207.5

	Coef.	Robust std error	t	P>|t|	[95% Conf.	Interval]
home_ownership	0.210	0.030	6.890	0.000	0.150	0.269
singe_household	-0.091	0.083	-1.100	0.273	-0.253	0.071
older_population	-0.302	0.049	-6.210	0.000	-0.398	-0.207
māori	-0.033	0.053	-0.620	0.535	-0.137	0.071
asian	0.005	0.057	0.090	0.929	-0.106	0.116
manual	0.024	0.052	0.460	0.647	-0.078	0.126
net_migration	0.008	0.009	0.860	0.389	-0.010	0.025
predicted_employment	-0.083	0.010	-8.400	0.000	-0.103	-0.064
_cons	6.272	2.639	2.380	0.017	1.099	11.446
lambda	0.364	0.106	3.440	0.001	0.156	0.572

Wald test of lambda=0:	chi2(1)	11.816	0.00
Lagrange multiplier test lambda=0:	chi2(1)	12.328	0.000
Acceptable range for lambda: -1.229 < lambda < 1.000			

* *Regional results excluded from table for brevity, LMA 7 (Auckland) excluded*

Turning to the panel spatial error model, the homeownership variable (home_ownership) is again significant and of the correct sign. However it is slightly larger than under both the spatial lag panel and simple panel fixed effects models. The results for the remaining variables are similar to that obtained with the spatial lag panel model with the exception that the percentage Asian (asian) variable is now not significant.

The final set of results expands on the previous model through the introduction of time period fixed effects to the spatial lag and error models. Starting with the spatial lag models with time period fixed effects the coefficient on the homeownership variable (home_ownership) is identical, to three decimal places, to that obtained in the spatial fixed effects model without time period fixed effects. The only other explanatory variable to reach significance at the 5 percent level is that for the percentage of the population aged 40 and over (older_population). This of very similar magnitude to that obtained without the inclusion of time period fixed effects and smaller by round a third than that estimated by the non-spatial panel model. Finally it should be noted that the results reported in Table 4.9 are in fact not supportive of time fixed effects: none of the three time dummies are statistically significant.

The inclusion of time period fixed effects into the spatial error panel model (results reported in Table 4.10) reduces the coefficient on the homeownership variable (home_ownership), which remains significant and of the appropriate sign, by over 10 percent. Among the other explanatory variables, the percentage of the population aged 40 and over (older_population) and the percentage Asian (asian) attains significance at the traditional level.

For ease of comparison, all the regression results of Tables 4.3 to 4.10 are summarised in Table 4.11. The issue arises of which of the spatial models, lag or error, is most appropriate in this instance. One may take a number of approaches to this. Firstly a purely technical approach might be taken in which model selection is made on the basis of some formal test, usually a Lagrange multiplier (Anselin, 1988b) or Rao Score test (Anselin, 2001). Secondly the choice as to which model is appropriate might be based on an *a priori* theoretical consideration such as whether we consider the relationship between the unemployment rate in a given region and its neighbours to arise from interaction, through trade or migration for instance, (the lag model) or through spillovers arising from specific shocks (the error model). Thirdly, and lastly, Arbia, Basile, & Piras (2005, p. 26) take a pragmatic approach to differentiate between lag and error models basically by asking the question whether or not the parameter estimates differ appreciably from those obtained by a classical fixed effects approach.

In the present context, the preference is for a lag model, based on the second and third of these considerations and given that the object of this chapter speaks to long term structural relations as opposed to transient shocks hence our interest is in models of interaction such as those that are implicit in the lag approach.

In this chapter three specifications of the lag model have been presented: a straight forward spatial lag model of pooled data, a panel spatial lag model and a spatial lag model with time period fixed effects. As the first and second of these is nested within the third the choice of the best model is easily done by taking account of the standard result that twice the difference in log likelihood has a chi square distribution with degrees of freedom equal to the number of parameter restrictions. On this basis the preferred model is clearly the lag panel spatial model. Consequently, the New Zealand data provides conclusive evidence for the Oswald hypothesis. Taking the panel spatial lag model as the preferred specification, the results suggest that a 1 percentage point decline in homeownership would decrease the unemployment rate by about 0.17 percentage points.

Table 4.9 Oswald Hypothesis Panel Model with time FE spatial lag model *

Number of obs	232
Variance ratio	0.969
Squared corr.	0.971
Sigma	0.570
Log likelihood	-202.919

	Coef.	Robust std error	t	P>|t|	[95% Conf. Interval]	
home_ownership	0.172	0.033	5.270	0.000	0.108	0.237
singe_household	-0.027	0.089	-0.300	0.765	-0.202	0.148
older_population	-0.237	0.063	-3.770	0.000	-0.360	-0.114
māori	0.014	0.061	0.230	0.818	-0.106	0.134
asian	0.104	0.058	1.790	0.074	-0.010	0.217
manual	0.075	0.053	1.410	0.160	-0.029	0.179
net_migration	0.010	0.008	1.270	0.205	-0.005	0.024
predicted_employment	-0.036	0.028	-1.310	0.190	-0.090	0.018
_cons	-0.271	2.675	-0.100	0.919	-5.513	4.972
1991	0.323	0.711	0.460	0.649	-1.069	1.716
2001	0.160	0.343	0.470	0.640	-0.512	0.832
2006	-0.069	0.507	-0.140	0.892	-1.062	0.925
rho	0.365	0.084	4.320	0.000	0.199	0.530

Wald test of rho=0:	chi2(1)	18.698	0.000
Lagrange multiplier test rho=0:	chi2(1)	18.305	0.000
Acceptable range for rho: -1.229 < rho < 1.000			

** Regional results excluded from table for brevity, LMA 7 (Auckland) and 1996 excluded*

Table 4.10 Oswald Hypothesis Panel Model with time FE spatial error model *

Number of obs	232
Variance ratio	0.974
Squared corr.	0.967
Sigma	0.570
Log likelihood	-203.294

	Coef.	Robust std error	t	P>|t|	[95% Conf. Interval]	
home_ownership	0.181	0.033	5.470	0.000	0.116	0.246
singe_household	-0.003	0.094	-0.030	0.975	-0.187	0.181
older_population	-0.227	0.065	-3.470	0.001	-0.355	-0.099
māori	-0.004	0.066	-0.060	0.953	-0.134	0.126
asian	0.134	0.065	2.060	0.040	0.006	0.262
manual	0.083	0.054	1.540	0.124	-0.023	0.189
net_migration	0.003	0.009	0.370	0.710	-0.014	0.020
predicted_employment	-0.035	0.033	-1.050	0.295	-0.100	0.030
_cons	1.209	2.660	0.450	0.649	-4.005	6.424
1991	1.472	0.785	1.880	0.061	-0.066	3.011
2001	-0.036	0.421	-0.090	0.932	-0.860	0.788
2006	-1.290	0.510	-2.530	0.011	-2.290	-0.290
lambda	0.394	0.095	4.160	0.000	0.208	0.580

Wald test of rho=0:	chi2(1)	17.282	0.000
Lagrange multiplier test rho=0:	chi2(1)	15.473	0.000
Acceptable range for rho: -1.229 < rho < 1.000			

** Regional results excluded from table for brevity, LMA 7 (Auckland) and 1996 excluded*

Table 4.11 Oswald Hypothesis Results Summary

	OLS		Regional fixed effects model		Spatial lag model		Spatial error model		Panel spatial lag model*		Panel spatial error model*		Panel with time FE spatial lag model*#		Panel with time FE spatial error model*#	
Log likelihood	_		_		-431.01		-435.92		-203.138		-207.5		-202.919		-203.294	
	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|
home_ownership	0.379	0.000	0.199	0.000	0.337	0.000	0.352	0.000	0.172	0.000	0.210	0.000	0.172	0.000	0.181	0.000
singe_household	0.130	0.072	-0.118	0.106	0.233	0.001	0.197	0.024	-0.049	0.482	-0.091	0.273	-0.027	0.765	-0.003	0.975
older_population	-0.337	0.000	-0.312	0.000	-0.321	0.000	-0.327	0.000	-0.233	0.000	-0.302	0.000	-0.237	0.000	-0.227	0.001
māori	0.203	0.000	0.006	0.893	0.186	0.000	0.210	0.000	0.027	0.496	-0.033	0.535	0.014	0.818	-0.004	0.953
asian	0.289	0.000	0.023	0.728	0.289	0.000	0.341	0.000	0.098	0.026	0.005	0.929	0.104	0.074	0.134	0.040
manual	-0.317	0.000	0.020	0.713	-0.176	0.013	-0.213	0.052	0.065	0.195	0.024	0.647	0.075	0.160	0.083	0.124
net_migration	0.063	0.000	0.017	0.049	0.054	0.000	0.053	0.006	0.010	0.189	0.008	0.389	0.010	0.205	0.003	0.710
predicted_employment	-0.146	0.000	-0.080	0.000	-0.104	0.000	-0.140	0.000	-0.049	0.000	-0.083	0.000	-0.036	0.190	-0.035	0.295
_cons	-7.974	0.000	-7.974	0.000	-11.977	0.000	-9.349	0.000	0.291	0.908	6.272	0.017	-0.271	0.919	1.209	0.649
1991	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.323	0.649	1.472	0.061
2001	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.160	0.640	-0.036	0.932
2006	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-0.069	0.892	-1.290	0.011
rho/lambda	n/a	n/a	n/a	n/a	0.331	0.000	0.364	0.001	0.374	0.000	0.364	0.001	0.365	0.000	0.394	0.000

* *Regional results excluded from table for brevity, LMA 7 (Auckland) excluded*

\# *Regional results excluded from table for brevity, LMA 7 (Auckland) and 1996 excluded*

4.5 Conclusion

This chapter provided the macro-level evidence of a relationship between homeownership and unemployment in New Zealand. Given that New Zealand experienced a notable decline in the proportion of the population in owner-occupied dwellings at the same time as the rate of unemployment has been on a downward trend, a study of whether a link between these two trends is either spurious or instead robust to well-specified econometric models is clearly of scientific interest as well as of policy significance.

Various econometric models were estimated by means of pooled data on 58 Labour Market Areas observed at the times of the 1986, 1991, 1996, 2001 and 2006 population census. It was found that the homeownership rate has a large positive and statistically significant effect on the LMA unemployment rate in a standard OLS specification, and that this effect diminishes but remains significant across a wide range of specifications that account for departures from the standard linear model. These include the use of regional fixed or random effects and the presence of spatial dependence. All estimates are of the order of 0.172 to 0.4, and the statistically most satisfactory model, the spatial lag panel model, yields a coefficient of 0.172, somewhat smaller than Oswald's suggested stylized fact of an increase in homeownership of 1 percentage point leading to an increase in the unemployment rate of 0.2 percentage points. Given that homeownership rates have declined by around 10 percentage points nationally since the national unemployment peak of 11 percent in the early 1990's, approximately a quarter of the decline in unemployment could be attributable to the change in homeownership levels.

The question thus arises why the macro evidence in the literature that has tended to be supportive of the Oswald hypothesis in several countries (but not in others) appears inconsistent with the micro evidence, which has been reviewed by Rouwendal and Nijkmap (2007) and which finds a near unanimous rejection of the hypothesis.

While a formal reconciliation of this apparently contradicting evidence at macro and micro levels is beyond the scope of this thesis, it can be suggested here that the key issue may be the differences in job-market related characteristics of home owners and renters that in aggregate yield general (dis)equilibrium effects of decreases in homeownership leading to a more flexible labour market and lower unemployment.

People with better labour market outcomes are more likely to be home owners. However, when housing affordability declines, as it did in New Zealand during the last decade and a half, the younger workers among these find themselves less able to purchase and have consequently greater mobility. The international literature does confirm this greater geographical mobility. However, these “potential owners turned renters” may have a lower risk of unemployment (given their human capital characteristics) than those who are the traditional long-term renters. The greater geographical mobility of these “new renters” lowers pressure on the local labour market and therefore permits the existing renters a greater proportion of hires in the improving labour market, lowering the local unemployment rate. Thus, a possible reconciliation of the micro and macro evidence is that it is not that home owners have necessarily longer unemployment spells (their unemployment rate will be low at the macro level) but their lower geographic mobility creates greater competition for jobs in the local labour market, thus lowering employment opportunities for the local renters. This type of “dual labour market” interpretation would be consistent with both the macro and micro evidence.

One could of course raise the objection to this suggestion that renters would simply move to a more favourable labour market. This view ignores the fact that workers tend not to migrate, despite low local chances of obtaining employment, if the chance of finding employment in other areas is also low. Hence renters with poor labour market characteristics are unlikely to move in the face of a shock to a labour market as their chances of gaining employment elsewhere are also low and any employment that they did gain is unlikely to be sufficiently well remunerated to offset the, albeit -relative to homeowners - small, cost of relocating (Mauro & Spilimbergo, 1998). Basically what is argued here is that high skilled workers who rent will be more likely to migrate than homeowners or low skilled renters and that the homeowners, possessing superior labour market characteristics, will outcompete the geographically immobile low skilled renters.

Chapter 5

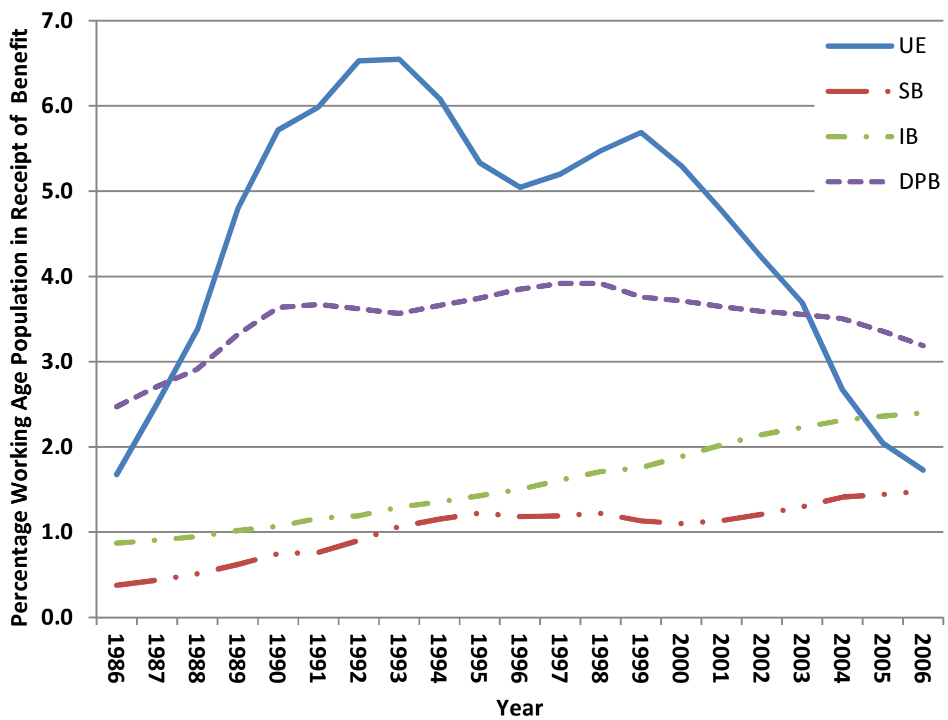
REGIONAL LABOUR MARKET ADJUSTMENT AND SOCIAL SECURITY BENEFIT UPTAKE IN NEW ZEALAND

5.1 Introduction

In many countries, governments have pursued policies to enhance labour market flexibility and reduce long-term unemployment. Such policies have contributed to improved labour market outcomes, although it was already noted in the previous chapter that it is sometimes difficult to separate out the effects of the policies from the impact of concurrent buoyant economic conditions. In any case, declines in official unemployment rates have often coincided with increases in hidden unemployment, particularly among low-skilled older workers, who end up on long term social security benefits, such as the sickness or invalids benefit, or who may (semi) retire.

International research has shown that there are large regional differences in the uptake of social security benefits, but formal econometric modelling of this spatial variation has to date been relatively limited (McVicar, 2006). There are many examples in the literature of regions in which certain traditional industries such as textile manufacturing, mining or agricultural produce processing were the primary source of employment that vanished during the globalisation and liberalisation of regional economies in recent decades. Particularly older and low-skilled workers, whose jobs vanished in this economic transformation process, have found it difficult to obtain employment in emerging, usually knowledge intensive, sectors. Geographic mobility of such workers tends to be low. The stresses of layoffs, job insecurity and unemployment are likely to impact on physical and mental health of the older workers. Some form of incapacity benefit is then often institutionally (through implicit understandings between employers, medical practitioners and social security providers) seen as a preferred outcome compared with long-term unemployment. This is particularly the case in peripheral regions. The example of mining towns in the UK, where hidden unemployment remains extensive, is well documented in the literature (e.g., Beatty, Fothergill, & Powell, 2007).

Figure 5.1 Working age population in receipt of benefit by benefit type and year (percent) 1986 - 2006



In New Zealand, the number of people receiving the unemployment benefit halved between 2001 and 2006, as a result of buoyant economic conditions and a high rate of job creation. Similarly, the number of persons receiving the domestic purposes benefit (primarily females) dropped by 12 percent. Yet at the same time there was a sharp increase of one third in the number receiving the sickness benefit and a growth in the number receiving the invalids' benefit of 11.6 percent and 18.6 percent for males and females respectively. The long run trajectory of the main benefit types from 1986-2006 is shown in figure 5.1, using data from the Ministry of Social Development (2009, p. 42).

A simple explanation at the macro-level of this apparent paradox, of measured unemployment declining in the upswing of the business cycle but hidden unemployment concurrently increasing, is that periods of rapid job creation coincide with an asymmetry in inflows into and outflows from non-participation. Job creation leads to a falling flow from employment into all forms of non-participation, including retirement and incapacity benefit enrolment. Job creation also leads to an increase in the flow from unemployment into jobs, but the flow from the sickness and invalid benefit rolls into jobs is far less responsive to the upswing in the business cycle, given that benefit receipt does not require active job search and the net financial gains from employment would be relatively little for beneficiaries with low education and skill levels.

At the regional level, the outcomes in terms of non-participation and benefit uptake will depend on compositional factors with respect to the characteristics of the population and the local labour market, but also on institutional factors, where there may be some regionally-specific variation in implementation of policies, even within a nationally determined framework. In addition, geography may matter, particularly with respect to labour market outcomes in surrounding local labour markets and their impact on local wage setting and geographic mobility.

This chapter analyses the determinants of labour force participation and regional benefit usage by category (viz., unemployment, sickness, incapacity and single parents caring for dependent children) in New Zealand using data drawn from the 5 yearly Census of Population and Dwellings aggregated to 58 functionally defined local labour market areas (LMAs). Three waves of census data are considered (1996, 2001 and 2006), with 1991 data used where lagged variables are required. While it would have been desirable to extend this period back to the 1986 census, consistent with the time periods considered in chapters 4 and 5, this would have required aggregating the categories of sickness and invalids benefit receipt as the 1986 census income question does not differentiate between these categories. It was felt that the loss of detail entailed in lengthening the time series to include 1986 was not justified by the gains to be had by employing a longer time series.

The theoretical framework that drives the specification of the models used in this chapter are intended to take account of changes in the level and structure of the demand for labour, the composition of the labour force and changes in eligibility rules. This framework builds on, for example, research by Beatty, Fothergill, & MacMillan (2000) in the UK and by Bartik (2002) in the US.

Preliminary analysis of New Zealand social security data, using time series of social welfare data, rather than census data, indicated that the buoyant economic conditions of the new millennium years up to 2004 benefitted all regions, but not all workers, and comparable workers in different regions often in different ways (Baxendine, et al., 2005). Nonetheless, there appeared to be some spatial convergence in aggregate benefit uptake outcomes across LMAs for younger people: peripheral regions with high aggregate benefit uptake rates under the age of 40 during the 1990s experienced the greatest declines in these rates during the economic boom. Overall, however, regional dispersion in benefit uptake rates has been steadily increasing across New Zealand regions since 1986 (see Pool, et al., 2006, pp., Table 5.4) and the results at LMA level reported below in this chapter show that this trend has continued since 2001.

This chapter is organised as follows:

- Section 5.2 provides some context by briefly outlining the main features of the social security system in New Zealand;
- Section 5.3 covers the sources of data, the variables used and provides some discussion of the descriptive features of the dependent variables;
- Section 5.4 discusses the various estimators used, particularly to the introduction of a spatial lag variant of the seemingly unrelated regression estimator;
- Section 5.5 reports and discusses the results of the application of these estimators as well as comparing the estimators themselves;
- Section 5.6 is by way of conclusion.

5.2 The New Zealand social security system[1]

The broad structure of the New Zealand social security system stems from the Social Security Act 1938,[2] though antecedents maybe found dating back to the Old Age Pensions Act 1898 (Stephens, 2008, 28-30). The SSA 1938 had three main objectives;

- To substitute for the existing system of non-contributory pensions a system of monetary benefits to which citizens would contribute according to their means and from which they could draw according to their need;
- To provide a universal superannuation; and
- To inaugurate a universal system of medical care benefits.

The established scheme rejected the notion of social insurance, i.e. that access to benefits was limited by and to contributions to the Social Security Fund, but instead embraced the view that the care and welfare of the nations citizenry was a national responsibility, that this responsibility extended to ensuring that every citizen enjoyed a reasonable standard of living and that all citizens were protected against the *vaguarities of economic fortune from which they could not protect themselves* (Brocklehurst, 1966).

Overtime the ethos that motivated the original legislation has moved from one in which the aim was to provide an entitlement to all New Zealand citizens to a standard of living sufficient, as the Royal Commission on Social Security 1972 would have it, to “belong to and participate in the community” (Stephens, 2008, p. 29) to one in which, while poverty alleviation remains an objective, the level of benefit payment is set to incentivise participation in the labour market and the receipt of benefits is couched in terms of a contract

---

1 For accounts of the development of New Zealand’s social security system see Brocklehurst, (2009) who gives a condensed overview of the early development of the social security system while McClure (1998) provides a more comprehensive account. Lunt et al (2008) cover contemporary developments to the end of the 4th Labour government in 2008.

2 There have been a number of notable innovations to the system since this time, particularly the introduction of New Zealand Superannuation in the mid 1970’s and the introduction of the Domestic Purposes Benefit (DPB) following the recommendation of the Royal Commission on Social Security (1972).

between the individual and the State with a strong emphasis on transition to paid employment (Stephens, 2008, pp. 32-34).

Table 5.1 Main social security benefits and basic eligibility criteria[3]

Benefit	Basic eligibility criteria
Unemployment (UEB)	• Need to be aged 18 or over, or aged 16-17 and living with a partner and children you support • Not be working full-time, but actively looking for a full-time job • Able to start work now
Sickness (SB)	• In a job now but have had to stop working or reduce your hours and income because of sickness, injury, pregnancy or disability, or • Unemployed or working part-time, and find it hard to look for and do full-time work because of sickness, injury, pregnancy or disability
Invalids (IB)	• 16 or over and: • Unable to regularly work 15 hours or more a week because of a sickness, injury or disability which is expected to last at least 2 years • Your life expectancy is expected to be less than 2 years and you are unable to regularly work 15 hours or more a week • Blind with a specified level of restriction in your visual field or in the sharpness of your vision
Domestic Purposes (DPB)	• you are the parent of a child under 18 who is dependent on you and • you are not living with the other parent or a partner and • have lost the support of, or are not being adequately maintained by a partner and • you are 18 or over (or 16-17 if you were legally married or in a civil union).

The New Zealand social welfare system provides for four major transfer payments for the working age population: the unemployment benefit, the sickness benefit, the invalids benefit and the domestic purposes benefit.[4].

A brief description of the eligibility criteria for each benefit is contained in Table 5.1. It should be noted that while the broad categories of persons covered by each of the benefit types has remain relatively constant overtime there have been myriad changes to specific benefit eligibility overtime. In particular in April of 1991 eligibility criteria for accessing benefits was tightened , the period before benefit payments commenced following application was increased and the

[3] Full details of current benefit entitlement criteria are available at http://www.workandincome.govt.nz/individuals/a-z-benefits/index.html .

[4] In addition to these four main benefits there exist a wide variety of other benefits for widows, orphans and veterans. Details of the available benefits, payment rates and eligibility criteria are available from http://www.winz.govt.nz/ .

average benefit payments were reduced by around 10 percent (Stephens, 1992). Despite changes in government and policy direction since then these changes have remained entrenched.

As noted above, these taxable benefits are statutory rights as opposed to insurance based payments with eligibility continuing as long as a person meets the eligibility criteria and is under 65, at which point eligibility for New Zealand Superannuation commences.[5] The level of payment available under these benefits is typically modest relative to the median wage, having been reduced in value markedly in the early 1990s (Stephens, 1992), though provision exists to supplement these payments through various additional allowances for hardship, accommodation and the like. In addition, beneficiaries with children may be eligible for the 'Working for Families Tax Credit'.6

5.3 Data, variables and descriptives

Data sources and the definition of the spatial boundaries used in this chapter are discussed in chapter 2 while the basic descriptive statistics for the dependent variables – the unemployment benefit rate, the sickness benefit rate, and the invalids' benefit rate, the domestic purposes benefit rate and the participation rate - are shown in table 5.2.

For each of the benefit types, domestic purposes, invalids, unemployment and sickness, the dependent variables are calculated as 100 times the number of persons in an LMA who indicate that they have received income from a particular benefit in the past year divided by the usually resident population aged 15-64 years in that census year.

Similarly the labour force participation rate was calculated as 100 times the number of persons employed, either full or part-time, or unemployed,

[5] New Zealand superannuation is a non-means tested, non-contributory payment made to those aged 65 and over. The gross payment for a single person living alone is currently around 50 percent of the median wage.

[6] For details see http://www.workingforfamilies.govt.nz/ .

divided by the sum of those employed, either full or part-time, unemployed or not in the labour force but aged 15-64 years.

Table 5.2 Descriptive statistics for benefit rates

	Benefit				
	Unemployment	**Sickness**	**Invalids**	**Domestic purposes**	**Participation rate**
Year/Period			1996		
Mean	10.32	2.68	2.23	4.83	65.02
Median	9.92	2.58	2.10	4.72	64.89
Max	21.17	5.23	4.89	9.28	80.65
Min	5.40	1.32	0.38	1.78	55.20
SD[1]	2.88	0.76	0.74	1.44	4.50
CV[2]	0.28	0.28	0.33	0.30	0.07
Year/Period			2001		
Mean	7.91	2.39	3.23	4.76	66.26
Median	7.60	2.33	3.07	4.65	66.30
Max	14.97	4.59	6.41	9.51	80.10
Min	4.08	1.15	0.53	1.51	56.79
SD[1]	2.20	0.63	1.10	1.51	4.36
CV[2]	0.28	0.26	0.34	0.32	0.07
Year/Period			2006		
Mean	3.60	2.70	3.36	3.75	68.42
Median	3.52	2.60	3.25	3.81	68.69
Max	9.89	5.85	8.07	7.37	82.89
Min	0.53	0.43	0.30	0.53	58.65
SD[1]	1.89	0.86	1.32	1.38	4.35
CV[2]	0.53	0.32	0.39	0.37	0.06

1 SD = Standard deviation

2 CV= Coefficient of variation

The benefit rates have been calculated on the basis of the census question regarding the sources of income. This question asks about the sources from which an individual aged 15 years and over received personal income in the 12 months prior to the census enumeration date. Hence it is not a point measure of the percentage of persons in receipt of a benefit on census day nor does it exclude the possibility that a person has moved between benefits or between a benefit and paid employment over the course of the year.

Despite these drawbacks it would seem reasonable that these rates are indicative of the level of uptake of these benefits in a LMA and indeed the benefit rates for 2006 calculated on the basis of these data are consistent with those from Ministry of Social Development administrative data at a Territorial Authority level for the same period (Cochrane, McNeill, & Roskruge, 2010). Further, whatever the shortcomings of this approach, no other data on benefit uptake are readily available at this level of spatial disaggregation.

Considering the descriptive statistics shown in Table 5.2 the unemployment benefit rate falls from a LMA level mean of over 10 percent in 1996 to somewhat under 4 percent in 2006 while the DPB rate also falls but by a comparatively modest 1 percentage point over the 1996-2006 period. The sickness benefit rate remains fairly static at 2.7 percent, having fallen 1996-2001 then increased again 2001-2006. However, the mean invalids benefit rate increases by over 50 percent to 3.4 percent in 2006. The coefficient of variation for each of the benefit rates increases between 1996 and 2006 and nearly doubles in the case of the unemployment benefit rate. This indicates growing regional disparities in the experience of benefit uptake.

The mean participation rate for the period considered, 1996-2006, increases by over 3 percentage points while the coefficient of variation falls through the period indicating a lessening of disparities between LMA in labour market participation rates. The steady decline in the standard deviation of both the unemployment rate and the labour force participation rate over the 1996 to 2006 period is also indicative that the improvement in national labour market conditions over this decade coincided with spatial convergence in labour market outcomes. The juxtaposition with the growing dispersion in benefit uptake rates is therefore intriguing. The reasons for this are to be uncovered by regression analysis.

Figure 5.2 Spatial distribution of unemployment benefit receipt 1996-2006

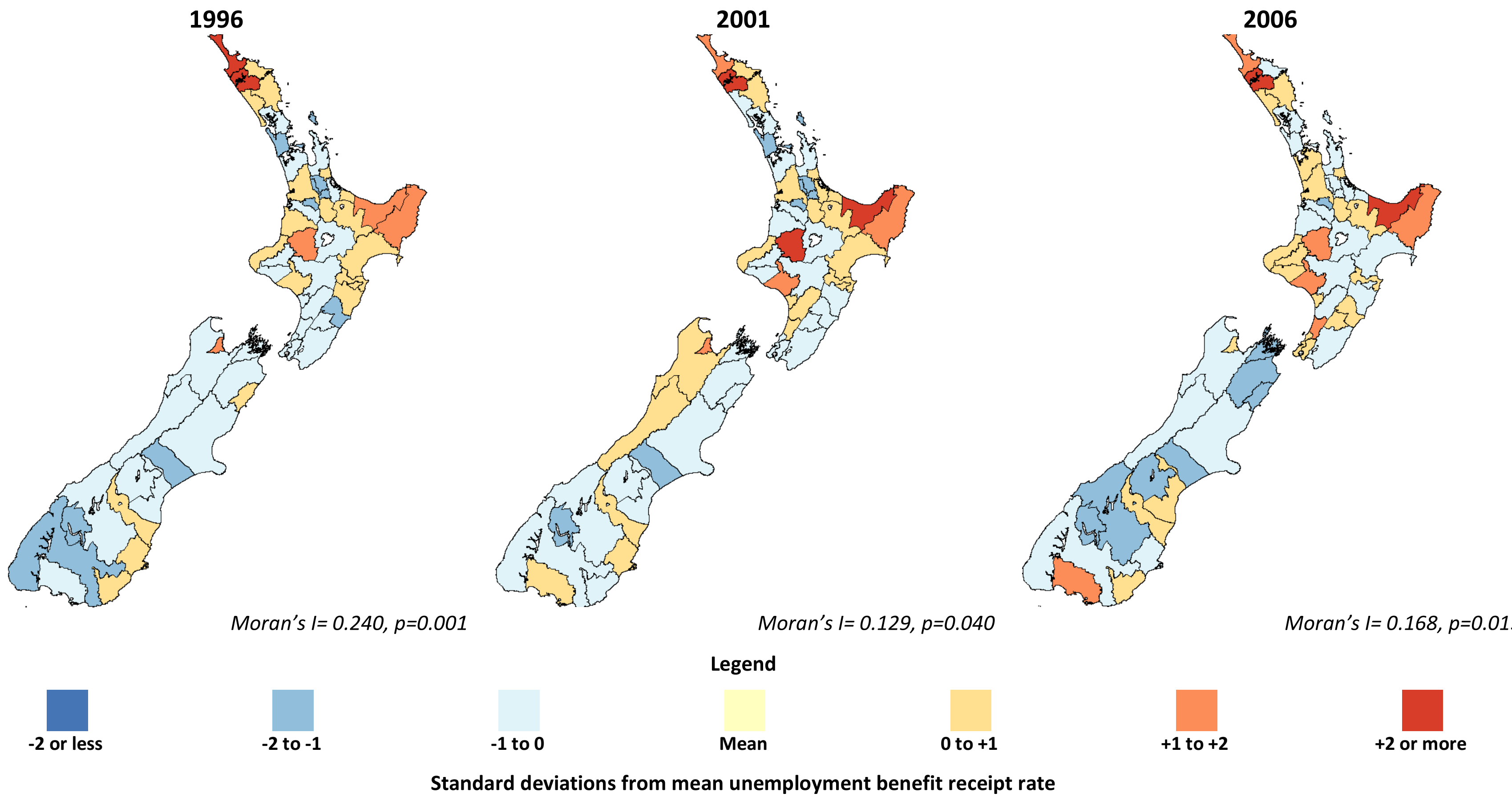


Figure 5.3 Spatial distribution of sickness benefit receipt 1996-2006

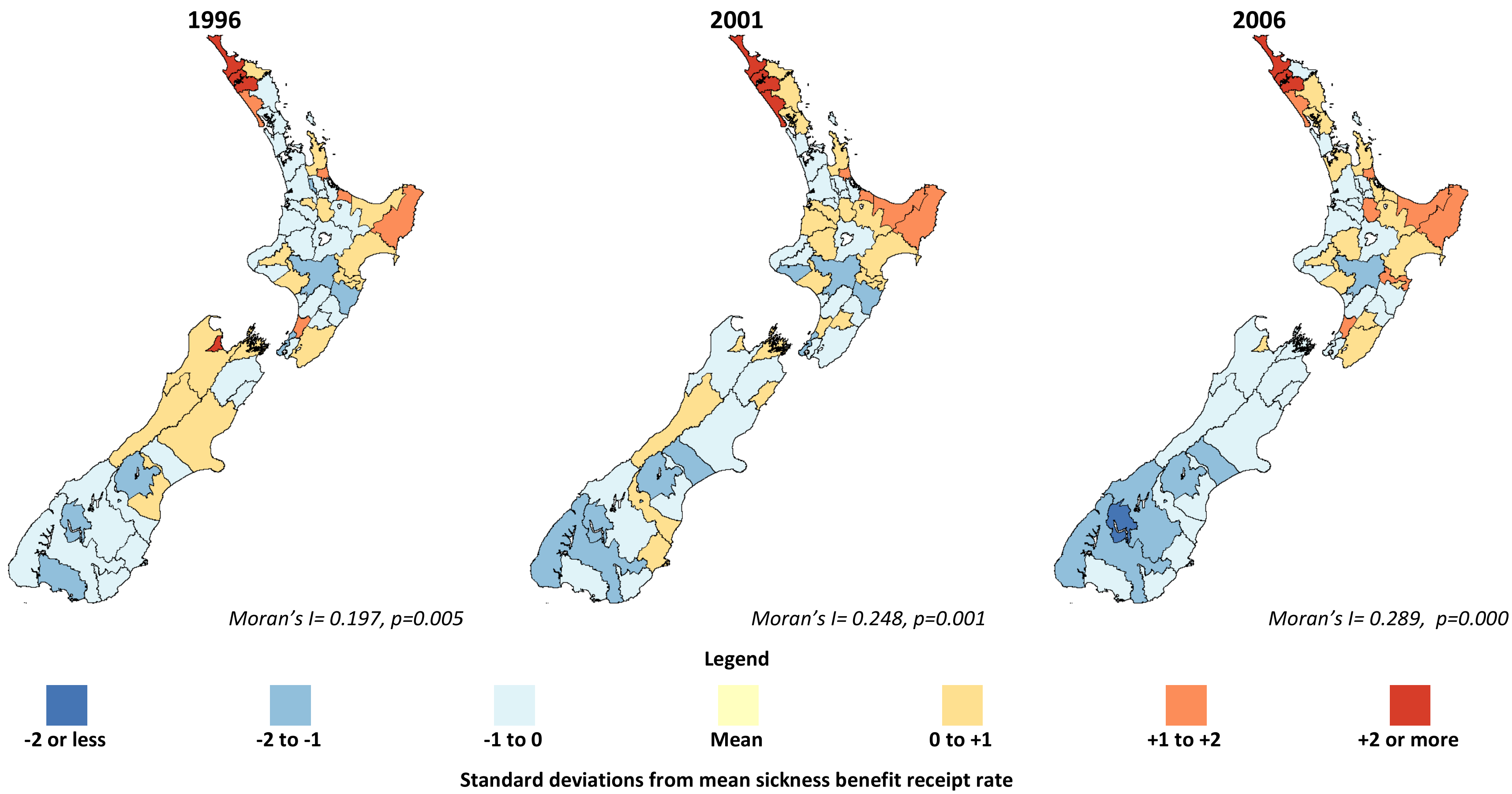


Figure 5.4 Spatial distribution of Invalids benefit receipt 1996-2006

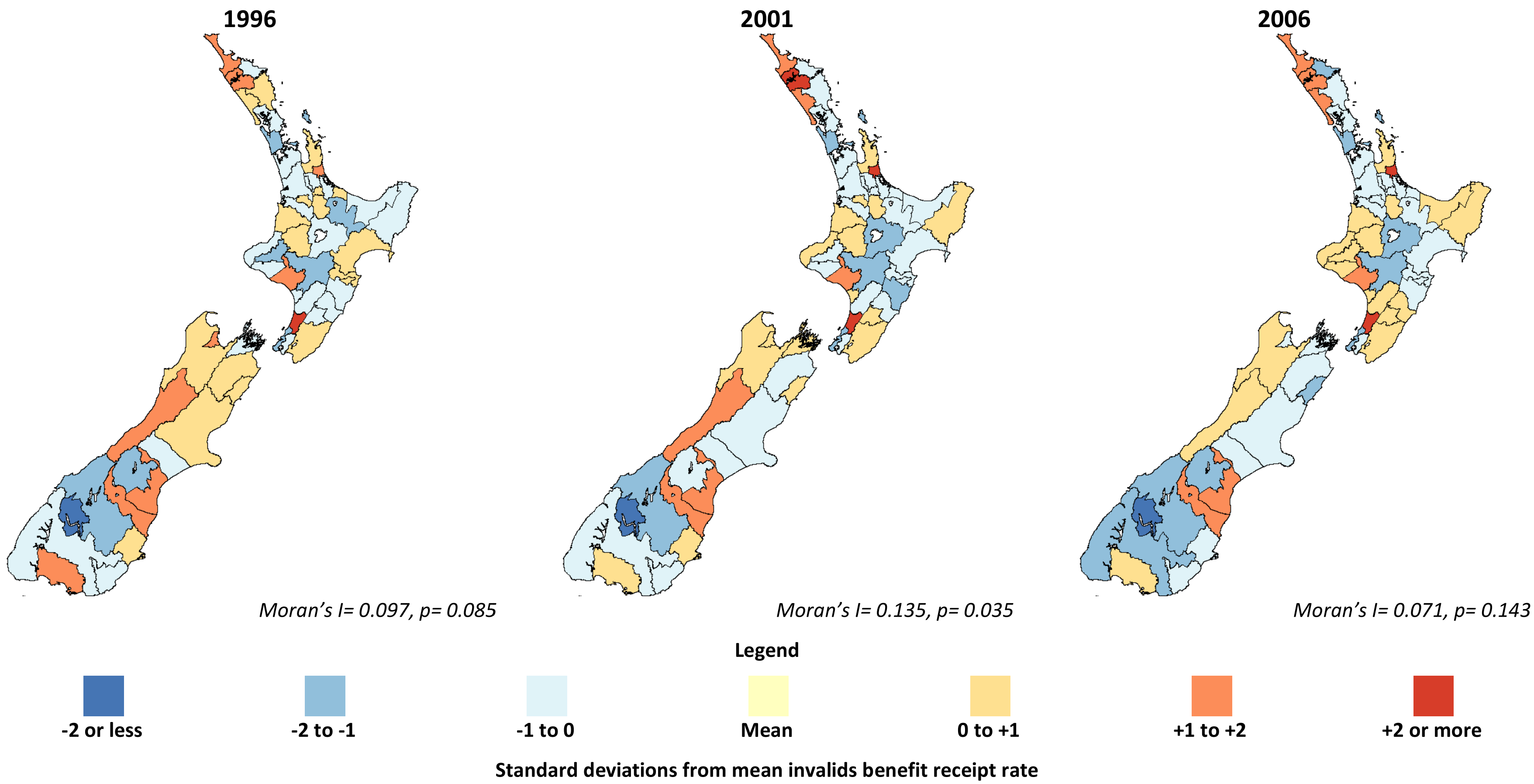


Figure 5.5 Spatial distribution of Domestic purposes benefit receipt 1996-2006

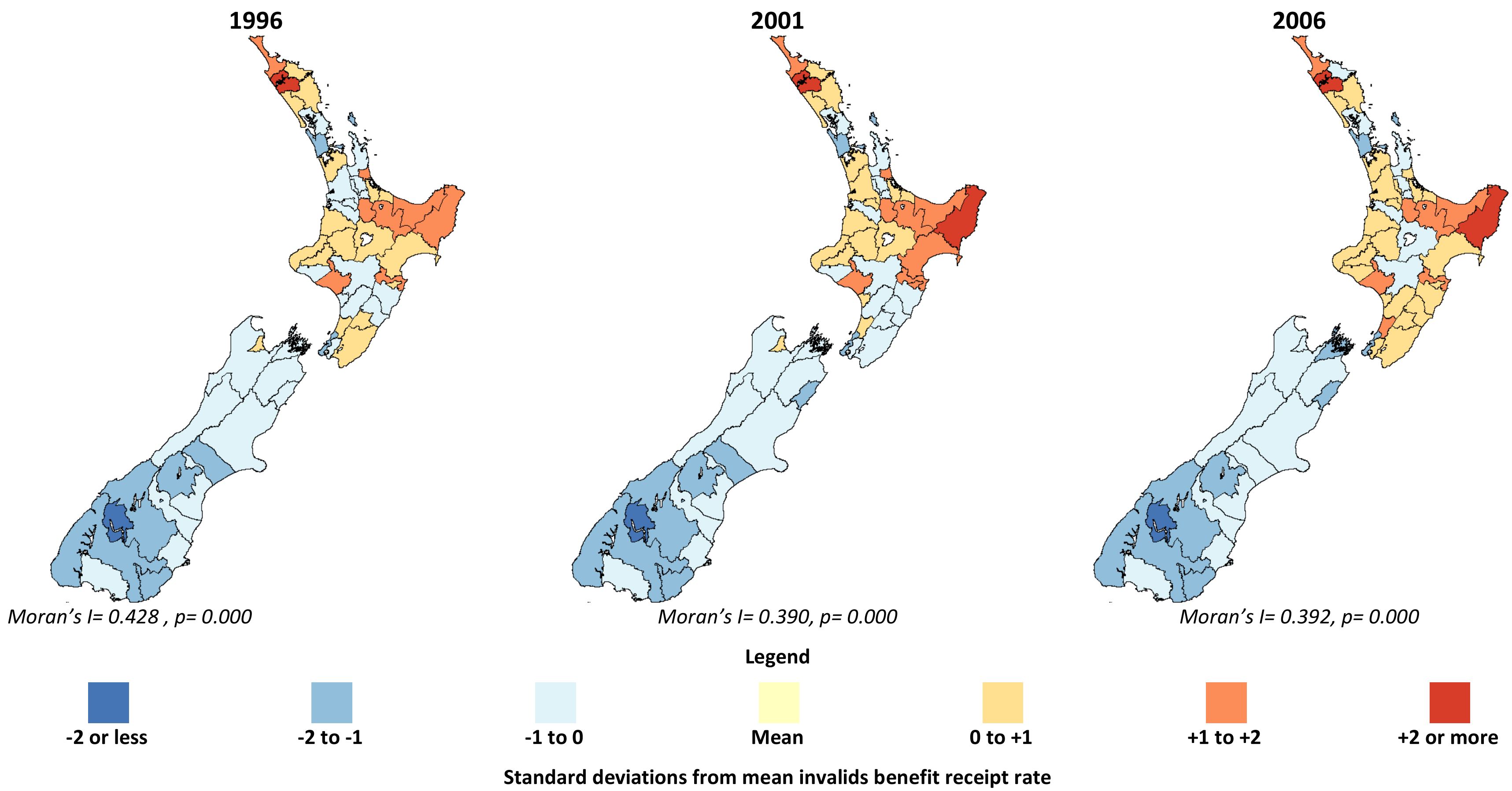
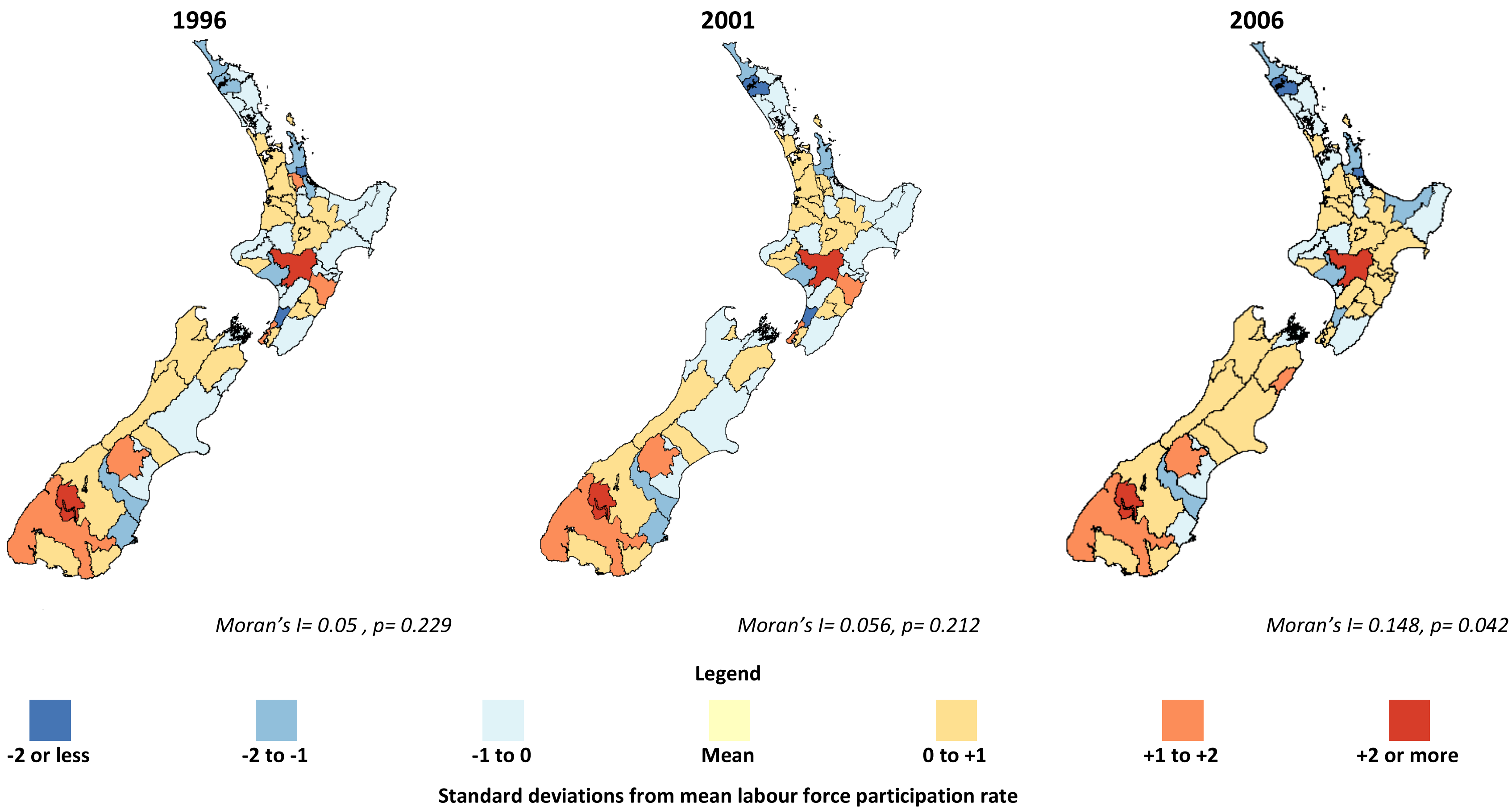


Figure 5.6 Spatial distribution of Labour force participation rate



Taking Figures 5.2-5.5 there is also strong evidence in support of there being spatial dependence in the benefit uptake rates with Moran's *I* statistic being significant for all benefit types and years, with the exception of the invalids benefit rate in 2006, as well as there being clustering apparent through visual inspection of figures 5.2 - 5.5.

From the Moran's *I* statistics shown in Figure 5.6 there is however no evidence of a global spatial pattern in the distribution of the participation rate for the 1996 and 2001 census years and only weak evidence of such a pattern in 2006.[7] That said, in all three periods the LMAs of Queenstown and Taihape standout as having participation rates considerably above the average for New Zealand.

The independent variables used here are chosen not to find the best possible model for any given benefit uptake rate but rather to allow a comparative exploration of the determinants of the interregional and temporal variation in LMA labour force participation and benefit uptake rates on the basis of a consistent set of variables that, in the literature, are seen as significant in the determination of labour market outcomes. These variables are listed in Table 5.2. The motivation for their inclusion is discussed below.

The use of contemporaneous explanatory variables in this context potentially carries the risk of endogeneity, indicating the necessity for the use of an instrumental variable approach. There are many forms of instrumenting that could be employed to address potential endogeneity (see, e.g., Vella & Verbeek, 1999) amongst the explanatory variables we adopted the simplest of these here by taking lags of the potentially endogenous variables, assuming that such lagged variables are uncorrelated with the idiosyncratic error term, so that the parameter estimates may be assumed consistent.

The use of the lagged homeownership variable **(**home-ownership**)** stems from Oswald's work (Oswald, 1996, 1997a, 1997b, 1999) on the relationship between homeownership and unemployment. In the previous chapter of this

[7] See Footnote 9, Chapter 3.

thesis some support for Oswald's conjecture, that an increase in homeownership of 1 percentage point leads to an increase in the unemployment rate of 0.2 percentage points was found in the New Zealand context.[8]

Table 5.3 Variable Definitions for Benefit Uptake Models

Variable	Definition
homeownership	The percentage of private dwellings owned by the occupant in an LMA, lagged 1 census period.
unemployment	The census based percentage of persons unemployed in an LMA, lagged 1 census period.
aged_50_64	Percentage of persons aged 50-64 in an LMA, lagged 1 census period.
solo_parent	The percentage of solo parent families in an LMA, lagged 1 census period.
māori	The percentage of people identifying as Māori in an LMA9, lagged 1 census period.
no_qualification	Percentage of persons 15 years and over reporting no qualifications in an LMA, lagged 1 census period.
service_sector	The percentage of employment in the service sector in an LMA, lagged 1 census period.
net_migration	The net migration rate for an LMA for the preceding census period
1996_dummy	A dummy for the year 1996
2006_dummy	A dummy for the year 2006

The lagged unemployment (unemployment) variable is intended to include the past health of the local labour market, capturing the effects (if any) of hysteresis (Baddeley, Martin, & Tyler, 1998; Pehkonen & Tervo, 1998).

The qualification variable (no_qualification) serves as a proxy for the stock of skill of the LMA's labour force. It is well known that the low skilled have

8 See also Cochrane and Poot (2006) for an earlier and simplified analysis of this issue.

9 The New Zealand Census does not assign individuals a unique ethnicity but aggregates responses to the ethnicity question to each ethnicity an individual specifies, i.e. if a person reports their ethnicity as being Māori and Chinese the counts of both Māori and Chinese ethnicities the counts for both ethnicities are increased by 1. Here the percentage of people identifying as Māori in an LMA is calculated as the 100*the number of those identifying as Māori divided by the usually resident population.

fared poorly in the contemporary labour market with rapidly declining demand for low-skilled workers being typical of many economies (Goux & Maurin, 2000; Machin, 2001; Nickell & Bell, 1995). There are also strong indications of a link between prevailing skills levels and rates of benefit uptake (Black, Daniel, & Sanders, 2002).

Wilson, McLeod, & Sathiyandra (2005) point to the impact of the age profile of the population on rates of uptake of particularly the sickness and invalids benefits in the New Zealand context. They find that around half of the rise in the invalids benefit uptake is explained by population growth, the ageing of the population, and the rise in the age of eligibility for New Zealand Superannuation. A variable (aged_50_64), reflecting our labour market focus, is used to control for this. This is the percentage of the population aged 50 to 64.

The variable solo_parent, the percentage of single parent families, is included as solo parenthood is a prime requirement for receipt of the DPB. There is also evidence of divorce or relationship dissolution leading to ill health (Richards, Hardy, & Wadsworth, 1997). In addition Gruber (2001) points to the role of solo parenthood in the early adoption of deviant behaviours amongst the children of such families that leads to long-run impacts on educational, labour market, and health outcomes. On the other hand, there is also evidence of feedback effects from unemployment on divorce, and hence solo parenthood (see Kraft, 2001). Again, such endogeneity is at least partially controlled by the adopted lag structure.

As with other developed economies, the majority of employment growth in the post 1991 period in New Zealand has been concentrated in the service sector. As an indicator of specialisation in industries that have experienced such growth, service_sector, is included.

The importance of migration in local labour market adjustment is well established[10] and the variable net_migration is included to account for this. With

[10] See Elhorst (2003), for example, for a review of the role of migration in regional unemployment or Choy, et al. (2002) for a discussion of the role of migration in local labour market adjustment in New Zealand.

respect to the sign on the net_migration variable in the models presented here, a positive sign is anticipated in the unemployment benefit equations as unemployment is frequently positively associated with net migration, not because migrants perversely wish to lower their probability of employment and earnings but because of high labour turnover in areas attracting migrants (Poot, 1986a, 1986b). A positive sign of the net migration rate may also be expected in the equations for the participation rate as migrants tend to be in age groups associated with high levels of labour force participation (Department of Labour, 2010, p. 31).

Given the concentration of migrants in high labour force participation prime age groups it is expected that the sign on migration will be negative in the sickness and invalids benefit equations.

It is unclear however what the effect on the level of DPB uptake of migration will be as on the one hand migrants tend to be in age groups in which people tend to have dependent children, thus increasing the pool of potential DPB recipients, but also with higher labour force participation, indicating a lower reliance on benefits other than the unemployment benefit.The net migration rate is calculated using the census survivorship method (Siegel and Swanson, 2004, pp. 505-506). Thus, net migration encompasses here both international and internal migration.

Lastly, māori is the proportion of the usually resident population that identify as Māori. The New Zealand system of ethnic classification allows for an individual to identify with multiple ethnicities hence this construct should not be seen as denoting the proportion of those who see themselves as exclusively Māori. Māori generally have poorer outcomes in the labour market in New Zealand than the Pakeha (European) majority (Chapple & Rea, 1998), although the extent to which the statistical significance of such a variable is a proxy for a number of unspecified determinants that disproportionally affect Māori or whether there is a residual 'ethnic' effect remains debatable (e.g. Gould, 2003).

In addition to the above time period dummies, 2001 being the excluded year, are included to account for aggregate shocks over time (Wooldridge, 2002, pp. 128-129) that affects all LMAs equally and are not captured by the included variables.

5.4 Estimation

Estimation is conducted following two approaches:

Firstly, to explore determinants of the interregional variation in LMA labour force participation and benefit uptake rates, a range of variables was selected to capture various features of the regional labour market. These were discussed in the previous section. As noted earlier, the approach adopted here is not to find the best possible model for any given benefit uptake rate, but to instead consistently apply the same set of reduced form equations to all benefit rates and to compare differences in structure across equations. Actual estimation is carried out using both spatial (pooled spatial lag model) and non spatial (pooled OLS) techniques with robust errors (Huber-White)[11] being used throughout to guard against heteroskedasticity arising from, for instance, the markedly differing populations of the LMA.

Secondly, as we have a system of equations that use the same data to estimate the determinants of regional variation in benefit and participation rates instead of estimating each equation separately it is possible to estimate these equations jointly. This exploits the contemporaneous correlation in the error terms of the equations to gain efficiency in the estimation (Baum, 2006, pp. 236-242). Estimators of this kind are called seemingly unrelated regression (SUR) models after Zellner (Zellner, 1962). It should be noted however that when SUR estimations are conducted using identical specifications of independent variables and these variables contain the same numerical values, there is no gain in efficiency and the estimator is identical to equation by equation OLS estimation (Baum, 2006, p. 237). Here SUR estimation does yield different estimates compared with OLS because, in line with the general paradigm posited in this thesis, spatial spillovers matter and the spatial lag of the dependent variable is

[11] See Baum (2006, pp. 136-138) for a discussion of the Huber-White estimator of the variance of the linear regression estimator.

therefore included on the right hand side. This variable obviously varies equation by equation. The spatial lag for the dependent variable is calculated in accordance with Equation 6.1:

$$Lagy = \rho W y \tag{6.1}$$

Where;

Lagy is a N*1 vector of the spatial lag of the variable y, ρ is the spatial autoregressive coefficient calculated in the corresponding single equation spatial lag model, W is the row-standardised spatial weights matrix used in the single equation spatial lag models while y is a N*1 vector of the values of the dependent variable. N is equal to the number of LMA (58) times the number of time periods (3).

5.5 Results

Detailed results for each estimator and dependent variable are presented in Tables 5.4 to 5.20 while summaries of the results for each estimator and overall are shown in Tables 5.9, 5.15, 5.21 and Table 5.23. Given the number of Tables reporting these results they are presented at the end of the Chapter.

Considering each of the variables in turn; home-ownership, the lagged homeownership variable, is not significant under any estimator for the unemployment, sickness or invalids benefit rates however it does reach significance under all estimators in the case of the labour force participation rate and DPB rate. In the case of the participation rate the parameter estimate on the homeownership variable is around -0.15 across all three estimators, indicating that a 10 percentage point increase in the homeownership rate is associated with a 1.5 percentage point decline in the labour force participation rate. This is a result of similar magnitude to that obtained in the previous chapter, Chapter 4, concerning the Oswald hypothesis. In the preferred model of Chapter 4 (see Table 4.11), the spatial panel lag model, it was found that an increase of 10 percentage points in the level of homeownership was associated with a 1.7 percentage point increase in the unemployment rate. It should be remembered however that the unemployed form part of the labour force hence any increase in unemployment will indirectly impact on labour force participation rate via the discouraged worker effect (Gustavsson & Österholm, 2010) or via market-driven reasons such as those discussed by Juhn, Murphy, & Topel (1991, 2002) and Benati (Benati, 2001). Hence the mechanisms by which homeownership impact on the participation rate are unlikely to be exactly the same as those underpinning Oswald's hypothesised relationship between the unemployment rate and homeownership.

As to why the homeownership variable is not significant in the unemployment benefit rate model, the difference may be due to the fact that the Oswald hypothesis concerns the relationship between homeownership and the unemployment rate, not the relationship between homeownership and unemployment benefit uptake. This distinction would be trivial if there were a simple relation between being unemployed, under the census definition, and being entitled to the unemployment benefit however this is not the case as it is possible to be in receipt of the unemployment benefit while not being counted as unemployed by the census definition (see also, in the New Zealand context, Poot & Brosnan, 1980). More importantly, due to the eligibility criteria for unemployment benefit receipt, many individuals who are unemployed per the census definition of unemployment will not be entitled to the unemployment benefit, due for instance to being in a partnership where their partner is earning sufficient income to completely abate[12] the benefit entitlement (Work and Income New Zealand, 2008, p. 8) or the partner fails to meet the work test imposed by WINZ.[13] As couples, with or without children, are more likely to be home owners (Morrison, 2008, pp. 27-29) than single persons and members of partnerships are less likely to receive the benefit than single persons with otherwise identical characteristics, it would seem reasonable to infer that

[12] Earnings abatement rates are at 70 cents in the dollar on income over $80 per week (jointly) however they are in practice higher as supplemental payments frequently abate from the first dollar of earned income (Work and Income New Zealand, 2008, p. 8).

[13] In 2008 the work tests imposed on the partners of Unemployment benefit beneficiaries by WINZ, the organization responsible for the administration of the benefit system, required that they look for full-time work (30 hours or more per week) if they had no children at home or the youngest child was aged 18 years or over. Where the youngest child was aged 6-17 years the requirement was to look for part-time work (15-29 hours per week) (Work and Income New Zealand, 2008, p. 5).

unemployed homeowners would be underrepresented in the ranks of unemployment beneficiaries attenuating the link hypothesised by Oswald between homeownership and unemployment.

The unemployment variable, included to capture the past health of the local labour market, is significant for all benefit types and the participation rate under all estimators and is of a sign consistent with hysteresis**.** That is to say that past high levels of unemployment in an LMA is associated with scarring in the form of higher benefit rates and lower participation rates in the current period. This is finding is similar to that of Stillman et al. (2010) who found using similar data, though markedly different methodology, that the employment shocks experienced in the structural reform period in New Zealand have had persistent effects, even more than a decade latter.

In terms of the magnitude of the parameter estimate for the unemployment variable, this parameter had the largest or second largest absolute value, excluding the time period dummies and constant, of any of the variables. This was most pronounced in the case of the unemployment and participation models with a 10 percent higher unemployment rate in the past census period being associated with a 5 percentage point higher unemployment benefit rate and a 12 percent point lower participation rate in the current period, using the parameter estimates from the spatial SUR model.[14]

In line with expectations the 'aged_50_64' variable is associated with higher levels of both the sickness and invalids benefit and lower levels of labour market participation under all estimators. In respect of the DPB and unemployment benefit rates, it fails to reach significance, under all estimators. The coeffient is negative in the regressions for the unemployment benefit rate (as would be expected give that the majority of unemployment benefit recipients are young) but is statistically insignificant.

The aged_50_64 variable had the largest parameter size of the modeled variables in the models for the sickness benefit, a 10 percent point higher

[14] Very similar results are obtained using the parameter estimates from the OLS and spatial lag models. Refer to table 5.7.

percentage of those aged 50 to 64 years in the previous census period being associated with a 1.4 percent point higher sickness benefit rate in the current period under the spatial SUR estimator. This variable also had a strong impact, the second largest parameter, in the models of the invalids benefit rate and the participation rate with a 10 percent point higher percentage of those aged 50 to 64 years in a past census period being associated with a 1.3 percent point higher invalids benefit rate and a 10 percent point lower labour force participation rate, again under the spatial SUR estimator[15].

Here we see a strong similarity in the effect of the aged_50_64 variable on invalids and sickness benefit uptake. The impact of this variable provides us with one explanation for the observed spatial divergence (between LMA) in sickness and invalids benefit rates, and the convergence in unemployment and labour force participation rates. The population as a whole is aging however as research by Pool, Baxendine, Cochrane, & Lindop (2005a, 2005b, 2005c) shows, demographically, New Zealand regions are diverging with the consequence that those LMA with rapidly aging populations will also experience higher growth in sickness and invalids benefit uptake.

As noted earlier the vast majority of persons in receipt of the domestic purposes benefit are solo parents hence it is unsurprising to find the percentage of solo parent families' (solo_parent) to be significantly and positively associated with the DPB rate.[16] The solo_parent variable is also significant in all models and under all estimators for the sickness and invalid benefit rates. There are myriad plausible pathways that would account for this relationship. [17] Firstly, a priori the manner in which the social security system functions makes it considerably more likely that an ill solo parent would be in receipt of a sickness or invalids benefit than a partnered person with an identical illness or disability. Secondly, women who are pregnant and unable to work due to the pregnancy who met the income

---

15 Results obtained using the OLS and spatial lag estimators are slightly higher.

16 Under all estimators the solo_parent variable has the largest absolute parameter value in the DPB models. Under the spatial SUR estimator a 10 percent higher percentage of solo parent families in a past census period is associated with a 2 percent higher DPB rate in the current period.

17 See the preceding discussion on the entitlement to unemployment benefit.

criteria would be eligible for the sickness benefit until shortly after birth. Following the birth such persons would quite possibly become entitled to the DPB hence it would be likely that uptake of the sickness and domestic purposes benefit would occur in the same year. Lastly, these administrative considerations aside, there is ample evidence to suggest that the experience of solo parenting is related to negative health comes for the parents themselves, for their children and that these consequences spillover into the adolescence and adulthood of those children (Antecol & Bedard, 2007). Solo_parent is also significant in all models and estimators of the labour force participation rate. The negative coefficient is again to be expected as a large proportion of the solo parent population are in receipt of the DPB and not working. They are thus outside the labour force[18]. Solo parenthood however does not appear to be related to unemployment on the census definition, perhaps surprisingly in light of the potential feedbacks of unemployment on divorce (Kraft, 2001).

The variable māori is negatively and significantly related to the sickness and invalids benefit rates and positively associated with the labour force participation rate. This would seem to be anomalous given the generally worse labour market outcomes experienced by Māori however the effect observed is explicable in terms of the markedly different age structure of the Māori and European populations. As the Māori population is younger on average than the European population, the spatial distribution of the Māori population is very different from that of the non-Māori population and on average Māori account for some 15 percent of the population, the aged_50_64 variable does not adequately capture this demographic effect. The uptake of both sickness and invalids benefits increase with age and the negative coefficients on the māori variable reflect this. A similar, but in sign opposite, effect is observable with the participation rate.

Perhaps surprisingly, given the considerable literature on skills bias in recent technological and organizational change, so called "Skills Biased

[18] In 2006 there were some 194000 single parent families and around 100000 recipients of the DPB, of whom just over 20 percent were in receipt of earnings other than the DPB (Work and Income New Zealand, 2006, p. 1).

Technological Change (SBTC)[19], the qualification variable, no_qualification, did not prove to be significant in the models for the unemployment or sickness benefit nor for the participation rate however it achieved significance under all three estimators for the invalids benefit. The lack of significance of this variable in the unemployment, sickness and participation rate models may of course be due to qualification being a poor proxy for skill in this context (see Farber, Gallie, & Green, 2002) or it could well be that this reflects the growth in low skilled service sector employment. This latter case being consistent with recent more nuanced versions of the SBTC (Autor, Katz, & Kearney, 2006; Autor, Levy, & Murnane, 2002; Goos & Manning, 2007) in which employment growth occurs at either end of the skills spectrum, i.e. at both high and low skills levels, while routine tasks requiring precision[20], occupying intermediate positions in the skills hierarchy – such as craft manual jobs and book keeping (Goos and Manning, 2007, 118) – decline.

Under the pooled lag and spatial SUR estimators' no_qualification proved significant in the DPB rate model with a positive sign. Under the OLS estimator no_qualification was on the border of significance at the 5 percent level, again with a positive sign, and should probably be considered as such. The positive relationship between the DPB uptake rate and skills level is to be expected from the literature which indicates that solo parenthood, which is strongly correlated with DPB receipt, is associated with lower levels of educational attainment (Boden, Fergusson, & Horwood, 2007, p. 151; McLanahan & Percheski, 2008, pp. 262-264).

The service sector employment variable, service_sector, attains significance in the models for the sickness benefit (all estimators) and under the spatial SUR estimator for the unemployment benefit rate. In respective of the sickness benefit rate this would seem intuitively appealing as the ready

---

19 For surveys of the economic models under pinning the SBTC hypothesis see Acemoglu, (2002) or Hornstein, Krusell, & Violante (2005) and on the skills effects of organisational change Piva, Santarelli, & Vivarelli (2005).

20 The logic here is simply that routine tasks requiring precision are amenable to mechanisation while jobs such as fast food workers (low skill) or neurosurgeons (high skill) are not. Goos and Manning (2007) argue that the increase in low skill employment is result of increased demand for such services amongst the high skilled.

availability of service sector jobs would certainly ease the transition from sickness benefit to the labour force. For both the sickness and unemployment benefit there are relatively low, compared to the invalids and domestic purposes benefits, proportions of persons in receipt of benefits for more than a four years.[21].It is however somewhat surprising that, apart from the instance of the spatial SUR estimator that a similar effect is not more readily apparent in the other benefit and participation rate models, though under both OLS and Spatial lag models service_sector is significant at the 10 percent level.

The net migration variable had little impact on any of the benefit rates, only being significant in the spatial SUR model of the unemployment rate and the OLS model for the invalids benefit rate. In both these instances the parameter estimates had small absolute values, particularly in the unemployment benefit rate case, that were unlikely to have large economic significance. Net migration was however significant under all three estimators for the labour force participation rate model though again the effect size was small with a 10 percentage point higher inter-censual net migration being associated with a 0.5 percentage point increase in the participation rate. This confirms the expectation regarding the sign on the net_migration variable discussed above and is in line with the findings of a recent meta analysis by Longhi et al. (2010) that the employment rate consequences of migration are small.

Overall there is relatively strong agreement between the estimators in terms of the variables that are of statistical significance in the determination of the various benefit and labour force participation rate models. In cases where a variable was found to be statistically significant under one estimator there were only 4 out of 31 instances in which it was not also found to be significant under the other estimators. Hence the results appear to be qualitatively robust. In terms of the size of parameter estimates the results produced by the different estimators did not produce a clear cut pattern. However, around 60 percent of

[21] In September of 2006, the available period closest to the 2006 census date, 45 percent of DPB recipients and 75 percent of invalids beneficiaries had been in receipt of some form of benefit for more than 4 years, compared to 30 and 16 percent of sickness and unemployment benefit beneficiaries respectively (Ministry of Social Development, 2006).

the time, amongst variables significant at the 5 percent level, the OLS estimator produced results that were larger than those under the spatial lag model which was in turn larger than those produced under the spatial SUR specification. In the other approximately 40 percent of cases this ordering was reversed.

In terms of which estimator is to be preferred, the OLS estimator is clearly inappropriate given the presence of spatial autocorrelation in the residuals of each of the benefit rate and labour participation rate models run. Inclusion of spatial effects by way of the use of a spatial lag goes someway to addressing this particular issue however it does not address the issue of contemporaneously correlated error terms across the individual equations modeled. Indeed a Breusch-Pagan test of independence of the residual series following the spatial SUR estimation specifically rejects the possibility of independence of the residual series (see Table 5.22). Hence the joint estimation of the models for the various benefit rates and labour force participation will yield more efficient estimates than estimating each independently; confirming the superiority of the spatial SUR estimation over independently the estimates obtained from the independently estimated spatial lag models.[22]

5.6 Conclusion

In this chapter the extent to which the spatial-temporal variation in local labour market outcomes and social security benefit uptake can be linked to compositional effects regarding the workers' human capital and demographic characteristics, the level and composition of labour demand, and the geography of local labour markets has been investigated.

In terms of what matters in the models presented it is readily apparent that past periods of high unemployment have statistically significant and large positive effects on current period benefit rates and a negative effect on the

[22] It should be noted that while SUR will provide more efficient estimates of parameter values it is more susceptible to specification error as an error in the specification of a single equation will propagate through the estimation of the system of equations while if each model is estimated separately the misspecification will be limited to only the model in which the misspecification occurred.

labour force participation rate. The age structure as captured by the aged_50_64 variable has a clear impact on the participation rate (negative) while being associated with higher levels of the sickness and invalids benefit. Both of these results being consistent with the kind of explanatory frameworks advanced by Beatty et al (2000).

In addition the significance of the aged_50_64 points to the role demography is playing in driving the observed spatial divergence (between LMA) in sickness and invalids benefit rates and, more generally in the dichotomisation of the spatial structure of New Zealand's labour market noted in Chapter 3.

Of the other variables included in the models the proportion of solo parents is associated with higher benefit rates for all but the unemployment benefit rate and is negatively associated with the participation rate.

It is not reassuring from a policy perspective that these three factors (past unemployment, age structure and solo parenthood) have large impacts on the benefit and participation rates as none of these factors would seem amenable to simple intervention though the prominent role of past unemployment in all of the models calculated should give cause to consider the long term and enduring costs of negative employment shocks to local labour markets.

There is little that can be done directly about the aging of the population, which has a strong association with the sickness, invalids and participation rates, however the re-engineering of work[23] to accommodate the specific needs of older workers and the rehabilitation of such workers into the work force after illness, along with measures to increase labour force participation, may go some way to ameliorating the adverse labour market consequences of population aging.

Similarly the causes underlying solo parenthood are complex and reflect both changes in societal norms and feedback from growing income inequality and economic change (McLanahan & Percheski, 2008), none of which would seem addressable through simple policy interventions. The adoption of policy

[23] Even in relatively physically demanding occupations such as car manufacturing such reengineering has proved possible – see Berggren (1992) or Shimizu (1995) for example.

aimed at offsetting the lower educational attainment and labour market disadvantage of solo parents would, however, go some way to lowering benefit uptake by this group while heeding Heckman and Masterov's (Heckman & Masterov, 2007) advice to invest in the (young) children of the disadvantaged mitigate some of the longer run costs of solo parenthood.

Table 5.4 OLS results with spatial diagnostic: Unemployment benefit

Number of obs	174					
F(10, 163)	97.220					
Prob > F	0.000					
R-squared	0.851					
Root MSE	1.449					
	Coef.	**Robust Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
home-ownership	0.013	0.036	0.380	0.707	-0.057	0.083
unemployment	0.534	0.101	5.300	0.000	0.335	0.733
aged_50_64	-0.008	0.101	-0.080	0.934	-0.207	0.191
solo_parent	0.068	0.098	0.700	0.486	-0.125	0.261
māori	0.013	0.025	0.510	0.609	-0.037	0.062
no_qualification	-0.006	0.042	-0.140	0.888	-0.089	0.077
service_sector	-0.070	0.042	-1.670	0.097	-0.153	0.013
1996_dummy	0.561	0.505	1.110	0.268	-0.436	1.558
2006_dummy	-4.111	0.670	-6.130	0.000	-5.434	-2.787
net_migration	0.006	0.015	0.410	0.680	-0.023	0.036
constant	4.119	2.379	1.730	0.085	-0.579	8.817
	Statistic	**p-value**				
Moran's I	6.399	0.000				

Table 5.5 OLS results with spatial diagnostic: Sickness benefit

Number of obs	174					
F(10, 163)	31.750					
Prob > F	0.000					
R-squared	0.715					
Root MSE	0.420					
	Coef.	**Robust Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
home-ownership	-0.010	0.009	-1.090	0.276	-0.028	0.008
unemployment	0.143	0.026	5.510	0.000	0.092	0.194
aged_50_64	0.161	0.027	5.870	0.000	0.107	0.215
solo_parent	0.085	0.025	3.410	0.001	0.036	0.134
māori	-0.014	0.006	-2.340	0.021	-0.026	-0.002
no_qualification	0.004	0.011	0.370	0.711	-0.018	0.026
service_sector	-0.027	0.013	-2.060	0.041	-0.053	-0.001
1996_dummy	-0.108	0.134	-0.800	0.423	-0.372	0.157
2006_dummy	-0.017	0.161	-0.100	0.918	-0.334	0.301
net_migration	-0.004	0.004	-1.000	0.320	-0.013	0.004
constant	-0.773	0.724	-1.070	0.287	-2.202	0.656
	Statistic	**p-value**				
Moran's I	2.646	0.008				

Table 5.6 OLS results with spatial diagnostic: Invalids benefit

Number of obs	174					
F(10, 163)	24.620					
Prob > F	0.000					
R-squared	0.668					
Root MSE	0.703					
	Coef.	**Robust Std.Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
home-ownership	-0.004	0.020	-0.190	0.851	-0.043	0.035
unemployment	0.181	0.041	4.420	0.000	0.100	0.262
aged_50_64	0.168	0.056	3.020	0.003	0.058	0.277
solo_parent	0.092	0.034	2.700	0.008	0.025	0.159
māori	-0.061	0.014	-4.320	0.000	-0.089	-0.033
no_qualification	0.092	0.022	4.120	0.000	0.048	0.136
service_sector	0.004	0.016	0.240	0.807	-0.027	0.035
1996_dummy	-1.058	0.233	-4.540	0.000	-1.519	-0.598
2006_dummy	0.692	0.294	2.350	0.020	0.111	1.274
net_migration	-0.016	0.008	-2.000	0.047	-0.032	0.000
constant	-4.896	1.289	-3.800	0.000	-7.440	-2.351
		Statistic	**p-value**			
Moran's I		4.090	0.000			

Table 5.7 OLS results with spatial diagnostic: Domestic purposes benefit

Number of obs	174					
F(10, 163)	158.160					
Prob > F	0.000					
R-squared	0.896					
Root MSE	0.506					
	Coef.	**Robust Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
home-ownership	0.034	0.012	2.700	0.008	0.009	0.058
unemployment	0.095	0.035	2.710	0.008	0.026	0.164
aged_50_64	0.026	0.038	0.680	0.495	-0.049	0.101
solo_parent	0.219	0.028	7.900	0.000	0.165	0.274
māori	0.018	0.008	2.180	0.030	0.002	0.035
no_qualification	0.027	0.014	1.950	0.053	0.000	0.055
service_sector	-0.023	0.013	-1.800	0.074	-0.047	0.002
1996_dummy	-0.059	0.172	-0.340	0.734	-0.398	0.281
2006_dummy	-0.956	0.219	-4.370	0.000	-1.388	-0.523
net_migration	0.001	0.005	0.240	0.812	-0.009	0.011
constant	-3.197	0.900	-3.550	0.001	-4.974	-1.419
	Statistic		**p-value**			
Moran's I	6.435		0.000			

Table 5.8 OLS results with spatial diagnostic: participation rate

Number of obs	174					
F(10, 163)	78.980					
Prob > F	0.000					
R-squared	0.838					
Root MSE	1.909					
	Coef.	**Robust Std. Err.**	**t**	**P>t**	**[95% Conf.Interval]**	
home-ownership	-0.153	0.062	-2.460	0.015	-0.275	-0.030
unemployment	-1.293	0.109	-11.820	0.000	-1.509	-1.077
aged_50_64	-1.076	0.163	-6.580	0.000	-1.398	-0.753
solo_parent	-0.182	0.090	-2.020	0.045	-0.360	-0.004
māori	0.149	0.032	4.610	0.000	0.085	0.213
no_qualification	-0.045	0.053	-0.850	0.395	-0.149	0.059
service_sector	0.035	0.041	0.860	0.390	-0.046	0.117
1996_dummy	2.526	0.762	3.310	0.001	1.021	4.031
2006_dummy	3.555	0.792	4.490	0.000	1.991	5.119
net_migration	0.055	0.022	2.460	0.015	0.011	0.099
constant	103.163	4.062	25.400	0.000	95.141	111.184
	Statistic	**p-value**				
Moran's I	2.677	0.007				

Table 5.9 OLS results with spatial diagnostic: Summary

	UEB		SB		IB		DPB		Participation	
Number of obs	174		174		174		174		174	
F(10, 163)	97.220		31.750		24.620		158.160		78.980	
Prob > F	0.000		0.000		0.000		0.000		0.000	
R-squared	0.851		0.715		0.668		0.896		0.838	
Root MSE	1.449		0.420		0.703		0.506		1.909	
Variable	**Coef.**	**P>t**	**Coef.**	**P>t**	**Coef.**	**P>t**	**Coef.**	**P>t**	**Coef.**	**P>t**
homeownership	0.013	0.707	-0.010	0.276	-0.004	0.851	0.034	0.008	-0.153	0.015
unemployment	0.534	0.000	0.143	0.000	0.181	0.000	0.095	0.008	-1.293	0.000
aged_50_64	-0.008	0.934	0.161	0.000	0.168	0.003	0.026	0.495	-1.076	0.000
solo_parent	0.068	0.486	0.085	0.001	0.092	0.008	0.219	0.000	-0.182	0.045
māori	0.013	0.609	-0.014	0.021	-0.061	0.000	0.018	0.030	0.149	0.000
no_qualification	-0.006	0.888	0.004	0.711	0.092	0.000	0.027	0.053	-0.045	0.395
service_sector	-0.070	0.097	-0.027	0.041	0.004	0.807	-0.023	0.074	0.035	0.390
1996_dummy	0.561	0.268	-0.108	0.423	-1.058	0.000	-0.059	0.734	2.526	0.001
2006_dummy	-4.111	0.000	-0.017	0.918	0.692	0.020	-0.956	0.000	3.555	0.000
net_migration	0.006	0.680	-0.004	0.320	-0.016	0.047	0.001	0.812	0.055	0.015
constant	4.119	0.085	-0.773	0.287	-4.896	0.000	-3.197	0.001	103.163	0.000
Moran's I	6.399	0.000	2.646	0.008	4.090	0.000	6.435	0.000	2.677	0.007

Table 5.10 Spatial lag model: Unemployment benefit

Number of obs	174					
Variance ratio	0.854					
Squared corr.	0.857					
Sigma	1.370					
Log likelihood	-303.093					
	Coef.	**Robust Std. Err.**	**z**	**P>z**	**[95% Conf.Interval]**	
home-ownership	0.003	0.035	0.070	0.942	-0.065	0.070
unemployment	0.526	0.094	5.620	0.000	0.343	0.709
aged_50_64	-0.019	0.096	-0.200	0.840	-0.207	0.169
solo_parent	0.079	0.093	0.850	0.394	-0.103	0.261
māori	-0.001	0.025	-0.050	0.964	-0.049	0.047
no_qualification	0.007	0.040	0.160	0.870	-0.072	0.085
service_sector	-0.067	0.040	-1.650	0.099	-0.146	0.012
1996_dummy	0.186	0.506	0.370	0.713	-0.805	1.177
2006_dummy	-3.125	0.721	-4.340	0.000	-4.538	-1.713
net_migration	0.007	0.014	0.530	0.599	-0.020	0.035
constant	2.937	2.361	1.240	0.213	-1.689	7.564
rho	0.205	0.073	2.800	0.005	0.062	0.349
Wald test of rho=0:					chi2(1) =	7.862 (0.005)
Lagrange multiplier test of rho=0:					chi2(1) =	4.795 (0.029)
Acceptable range for rho:						-1.229 < rho < 1.000

Table 5.11 Spatial lag model: Sickness benefit

Number of obs	174					
Variance ratio	0.720					
Squared corr.	0.723					
Sigma	0.400					
Log likelihood	-88.566					
	Coef.	**Robust Std. Err.**	**z**	**P>z**	**[95% Conf. Interval]**	
home-ownership	-0.012	0.009	-1.340	0.181	-0.029	0.006
unemployment	0.141	0.025	5.520	0.000	0.091	0.191
aged_50_64	0.151	0.026	5.720	0.000	0.099	0.203
solo_parent	0.084	0.024	3.570	0.000	0.038	0.130
māori	-0.017	0.006	-2.710	0.007	-0.029	-0.005
no_qualification	0.009	0.011	0.820	0.410	-0.012	0.029
service_sector	-0.026	0.012	-2.070	0.039	-0.050	-0.001
1996_dummy	-0.122	0.129	-0.950	0.343	-0.376	0.131
2006_dummy	0.000	0.151	0.000	0.998	-0.295	0.296
net_migration	-0.004	0.004	-0.920	0.360	-0.012	0.004
constant	-1.015	0.690	-1.470	0.141	-2.368	0.338
rho	0.148	0.100	1.480	0.138	-0.048	0.345
Wald test of rho=0:					chi2(1) =	2.199 (0.138)
Lagrange multiplier test of rho=0:					chi2(1) =	3.869 (0.049)
Acceptable range for rho:						-1.229 < rho < 1.000

Table 5.12 Spatial lag model: Invalids benefit

Number of obs	174					
Variance ratio	0.675					
Squared corr.	0.686					
Sigma	0.660					
Log likelihood	-176.526					
	Coef.	**Robust Std. Err.**	**z**	**P>z**	**[95% Conf. Interval]**	
home-ownership	-0.005	0.019	-0.250	0.805	-0.042	0.032
unemployment	0.175	0.040	4.410	0.000	0.097	0.253
aged_50_64	0.147	0.055	2.690	0.007	0.040	0.254
solo_parent	0.095	0.031	3.070	0.002	0.034	0.156
māori	-0.062	0.013	-4.650	0.000	-0.089	-0.036
no_qualification	0.098	0.021	4.720	0.000	0.057	0.139
service_sector	0.007	0.014	0.520	0.603	-0.021	0.035
1996_dummy	-0.742	0.237	-3.130	0.002	-1.206	-0.278
2006_dummy	0.746	0.267	2.790	0.005	0.222	1.270
net_migration	-0.014	0.008	-1.810	0.071	-0.029	0.001
constant	-5.760	1.250	-4.610	0.000	-8.210	-3.309
rho	0.272	0.112	2.430	0.015	0.052	0.491
Wald test of rho=0:					chi2(1) = 5.885 (0.015)	
Lagrange multiplier test of rho=0:					chi2(1) = 5.032(0.025)	
Acceptable range for rho:					-1.229 < rho < 1.000	

Table 5.13 Spatial lag model: Domestic purposes benefit

Number of obs	174					
Variance ratio	0.908					
Squared corr.	0.911					
Sigma	0.45					
Log likelihood	-110.450					
	Coef.	**Robust Std. Err.**	**z**	**P>z**	**[95% Conf.Interval]**	
home-ownership	0.033	0.011	3.050	0.002	0.012	0.054
unemployment	0.101	0.029	3.530	0.000	0.045	0.157
aged_50_64	0.003	0.033	0.100	0.918	-0.060	0.067
solo_parent	0.205	0.025	8.080	0.000	0.155	0.255
māori	0.006	0.008	0.840	0.401	-0.009	0.021
no_qualification	0.037	0.013	2.840	0.005	0.012	0.063
service_sector	-0.018	0.012	-1.490	0.137	-0.041	0.006
1996_dummy	-0.066	0.142	-0.460	0.644	-0.344	0.213
2006_dummy	-0.552	0.209	-2.640	0.008	-0.962	-0.143
net_migration	0.003	0.005	0.610	0.539	-0.006	0.012
constant	-4.168	0.852	-4.890	0.000	-5.837	-2.498
rho	0.250	0.052	4.770	0.000	0.147	0.353
Wald test of rho=0:					chi2(1) = 22.756 (0.000)	
Lagrange multiplier test of rho=0:					chi2(1) = 25.503(0.000)	
Acceptable range for rho:					-1.229 < rho < 1.000	

Table 5.14 Spatial lag model: Participation

Number of obs	174					
Variance ratio	0.839					
Squared corr.	0.841					
Sigma	1.830					
Log likelihood	-352.389					
	Coef.	**Robust Std. Err.**	**z**	**P>z**	**[95% Conf. Interval]**	
home-ownership	-0.154	0.060	-2.570	0.010	-0.271	-0.036
unemployment	-1.253	0.109	-11.450	0.000	-1.468	-1.039
aged_50_64	-1.034	0.159	-6.520	0.000	-1.345	-0.723
solo_parent	-0.191	0.088	-2.180	0.029	-0.363	-0.019
māori	0.155	0.032	4.820	0.000	0.092	0.218
no_qualification	-0.056	0.052	-1.070	0.287	-0.159	0.047
service_sector	0.030	0.041	0.730	0.467	-0.050	0.109
1996_dummy	2.513	0.747	3.360	0.001	1.048	3.978
2006_dummy	3.122	0.830	3.760	0.000	1.495	4.749
net_migration	0.054	0.022	2.470	0.013	0.011	0.096
constant	94.641	6.746	14.030	0.000	81.419	107.862
rho	0.127	0.084	1.510	0.130	-0.037	0.291
Wald test of rho=0:					chi2(1) =	2.290 (0.130)
Lagrange multiplier test of rho=0:					chi2(1) =	2.156 (0.142)
Acceptable range for rho:						-1.229 < rho < 1.000

Table 5.15 Spatial lag model: Summary

	UEB	SB	IB	DPB	PART
Number of obs	174	174	174	174	174
Variance ratio	0.854	0.720	0.675	0.908	0.839
Squared corr.	0.857	0.723	0.686	0.911	0.841
Sigma	1.370	0.400	0.660	0.45	1.830
Log likelihood	-303.093	-88.566	-176.526	-110.450	-352.389

	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
home-ownership	0.003	0.942	-0.012	0.181	-0.005	0.805	0.033	0.002	-0.154	0.010
unemployment	0.526	0.000	0.141	0.000	0.175	0.000	0.101	0.000	-1.253	0.000
aged_50_64	-0.019	0.840	0.151	0.000	0.147	0.007	0.003	0.918	-1.034	0.000
solo_parent	0.079	0.394	0.084	0.000	0.095	0.002	0.205	0.000	-0.191	0.029
māori	-0.001	0.964	-0.017	0.007	-0.062	0.000	0.006	0.401	0.155	0.000
no_qualification	0.007	0.870	0.009	0.410	0.098	0.000	0.037	0.005	-0.056	0.287
service_sector	-0.067	0.099	-0.026	0.039	0.007	0.603	-0.018	0.137	0.030	0.467
1996_dummy	0.186	0.713	-0.122	0.343	-0.742	0.002	-0.066	0.644	2.513	0.001
2006_dummy	-3.125	0.000	0.000	0.998	0.746	0.005	-0.552	0.008	3.122	0.000
net_migration	0.007	0.599	-0.004	0.360	-0.014	0.071	0.003	0.539	0.054	0.013
constant	2.937	0.213	-1.015	0.141	-5.760	0.000	-4.168	0.000	94.641	0.000
rho	0.205	0.005	0.148	0.138	0.272	0.015	0.250	0.000	0.127	0.130

Table 5.16 Spatial lag seemingly unrelated regression: Unemployment benefit

Obs	174					
Parms	11					
RMSE	1.372					
R-sq	0.857					
chi2	1048.400					
P	0.000					
	Coef.	**Std.Err.**	**z**	**P>z**	**[95% Conf.Interval]**	
wpuebrho4	1.673	0.497	3.370	0.001	0.700	2.647
home-ownership	-0.005	0.035	-0.140	0.891	-0.073	0.064
unemployment	0.521	0.085	6.130	0.000	0.354	0.687
aged_50_64	-0.027	0.102	-0.260	0.793	-0.227	0.173
solo_parent	0.086	0.073	1.190	0.235	-0.056	0.229
māori	-0.011	0.024	-0.440	0.661	-0.057	0.036
no_qualification	0.015	0.038	0.400	0.692	-0.059	0.089
service_sector	-0.064	0.031	-2.050	0.040	-0.126	-0.003
1996_dummy	-0.067	0.537	-0.120	0.901	-1.120	0.986
2006_dummy	-2.462	0.741	-3.320	0.001	-3.914	-1.010
net_migration	0.008	0.014	0.590	0.557	-0.020	0.036
constant	2.142	2.640	0.810	0.417	-3.033	7.317

Table 5.17 Spatial lag seemingly unrelated regression: Sickness benefit

Obs	174					
Parms	11					
RMSE	1.372					
R-sq	0.857					
chi2	1048.400					
P	0.000					
	Coef.	**Std.Err.**	**z**	**P>z**	**[95% Conf.Interval]**	
wpsbrho4	2.139	0.522	4.100	0.000	1.115	3.162
home-ownership	-0.014	0.010	-1.360	0.175	-0.034	0.006
unemployment	0.138	0.025	5.530	0.000	0.089	0.187
aged_50_64	0.140	0.030	4.610	0.000	0.081	0.200
solo_parent	0.083	0.021	3.880	0.000	0.041	0.124
māori	-0.021	0.007	-2.970	0.003	-0.034	-0.007
no_qualification	0.014	0.011	1.240	0.216	-0.008	0.036
service_sector	-0.024	0.009	-2.600	0.009	-0.042	-0.006
1996_dummy	-0.139	0.148	-0.940	0.347	-0.430	0.151
2006_dummy	0.020	0.164	0.120	0.905	-0.302	0.341
net_migration	-0.003	0.004	-0.790	0.431	-0.012	0.005
constant	-1.291	0.767	-1.680	0.093	-2.795	0.214

Table 5.18 Spatial lag seemingly unrelated regression: Invalids benefit

Obs	174					
Parms	11					
RMSE	0.656					
R-sq	0.692					
chi2	397.200					
P	0.000					
	Coef.	**Std. Err.**	**z**	**P>z**	**[95% Conf.Interval]**	
wpibrho4	1.898	0.419	4.530	0.000	1.076	2.720
home-ownership	-0.006	0.017	-0.370	0.710	-0.039	0.026
unemployment	0.166	0.041	4.070	0.000	0.086	0.245
aged_50_64	0.131	0.049	2.650	0.008	0.034	0.228
solo_parent	0.101	0.035	2.920	0.003	0.033	0.169
māori	-0.065	0.011	-5.880	0.000	-0.086	-0.043
no_qualification	0.104	0.018	5.780	0.000	0.069	0.139
service_sector	0.011	0.015	0.710	0.479	-0.019	0.040
1996_dummy	-0.450	0.276	-1.630	0.103	-0.991	0.091
2006_dummy	0.786	0.267	2.940	0.003	0.263	1.309
net_migration	-0.012	0.007	-1.820	0.068	-0.026	0.001
constant	-6.535	1.283	-5.090	0.000	-9.049	-4.020

Table 5.19 Spatial lag seemingly unrelated regression: Domestic purposes benefit

Obs	174
Parms	11
RMSE	0.455
R-sq	0.910
chi2	1785.450
P	0.000

	Coef.	**Std. Err.**	**z**	**P>z**	**[95% Conf.Interval]**	
wpdpbrho4	1.392	0.186	7.490	0.000	1.028	1.756
home-ownership	0.032	0.011	2.810	0.005	0.010	0.055
unemployment	0.103	0.028	3.670	0.000	0.048	0.159
aged_50_64	-0.006	0.034	-0.160	0.871	-0.072	0.061
solo_parent	0.199	0.024	8.250	0.000	0.152	0.247
māori	0.002	0.008	0.220	0.824	-0.014	0.017
no_qualification	0.041	0.012	3.300	0.001	0.017	0.066
service_sector	-0.016	0.010	-1.530	0.127	-0.036	0.004
1996_dummy	-0.068	0.167	-0.410	0.683	-0.396	0.260
2006_dummy	-0.394	0.199	-1.980	0.048	-0.785	-0.004
net_migration	0.004	0.005	0.770	0.442	-0.006	0.013
constant	-4.548	0.873	-5.210	0.000	-6.260	-2.837

Table5.20 Spatial lag seemingly unrelated regression: Participation

Obs	174
Parms	11
RMSE	1.829
R-sq	0.841
chi2	920.900
P	0.000

	Coef.	**Std. Err.**	**z**	**P>z**	**[95% Conf.Interval]**	
wppartrho4	1.479	0.630	2.350	0.019	0.244	2.714
home-ownership	-0.154	0.046	-3.340	0.001	-0.244	-0.064
unemployment	-1.234	0.116	-10.650	0.000	-1.461	-1.007
aged_50_64	-1.014	0.138	-7.320	0.000	-1.286	-0.743
solo_parent	-0.196	0.097	-2.020	0.043	-0.385	-0.006
māori	0.157	0.031	5.110	0.000	0.097	0.217
no_qualification	-0.061	0.050	-1.230	0.221	-0.159	0.037
service_sector	0.027	0.042	0.640	0.523	-0.055	0.109
1996_dummy	2.507	0.672	3.730	0.000	1.190	3.824
2006_dummy	2.914	0.791	3.690	0.000	1.364	4.464
net_migration	0.053	0.019	2.780	0.005	0.016	0.090
constant	90.558	6.373	14.210	0.000	78.068	103.048

Table 5.21 Spatial lag seemingly unrelated regression: Summary

	Unemployment benefit		Sickness benefit		Invalids benefit		DPB		Participation	
Obs	174		174		174		174		174	
Parms	11.000		11.000		11.000		11.000		11.000	
RMSE	1.372		0.403		0.656		0.455		1.829	
R-sq	0.857		0.720		0.692		0.910		0.841	
chi2	1048.400		461.590		397.200		1785.450		920.900	
P	0.000		0.000		0.000		0.000		0.000	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
home-ownership	-0.005	0.891	-0.014	0.175	-0.006	0.710	0.032	0.005	-0.154	0.001
unemployment	0.521	0.000	0.138	0.000	0.166	0.000	0.103	0.000	-1.234	0.000
aged_50_64	-0.027	0.793	0.140	0.000	0.131	0.008	-0.006	0.871	-1.014	0.000
solo_parent	0.086	0.235	0.083	0.000	0.101	0.003	0.199	0.000	-0.196	0.043
māori	-0.011	0.661	-0.021	0.003	-0.065	0.000	0.002	0.824	0.157	0.000
no_qualification	0.015	0.692	0.014	0.216	0.104	0.000	0.041	0.001	-0.061	0.221
service_sector	-0.064	0.040	-0.024	0.009	0.011	0.479	-0.016	0.127	0.027	0.523
1996_dummy	-0.067	0.901	-0.139	0.347	-0.450	0.103	-0.068	0.683	2.507	0.000
2006_dummy	-2.462	0.001	0.020	0.905	0.786	0.003	-0.394	0.048	2.914	0.000
net_migration	0.008	0.557	-0.003	0.431	-0.012	0.068	0.004	0.442	0.053	0.005
constant	2.142	0.417	-1.291	0.093	-6.535	0.000	-4.548	0.000	90.558	0.000
Lag	1.673	0.001	2.139	0.000	1.898	0.000	1.392	0.000	1.479	0.019

Table 5.22 Correlation matrix of residuals

	Benefit type				
	Unemployment	**Sickness**	**Invalids**	**Domestic purposes**	**Participation**
Unemployment	1				
Sickness	0.226	1			
Invalids	0.205	0.496	1		
Domestic purposes	0.258	0.378	0.366	1	
Participation	-0.015	-0.361	-0.4316	-0.3122	1

Breusch-Pagan test of independence: chi2(10) = 190.703, Pr=0.000

Table 5.23 Comparison of results

	UEB			SB			IB			DPB			PART		
	OLS	LAG	SUR	OLS	LAG	SUR	OLS	LAG	SUR	OLS	LAG	SUR	OLS	LAG	SUR
home-ownership	0.013	0.003	-0.005	-0.01	-0.012	-0.014	-0.004	-0.005	-0.006	0.034	0.033	0.032	-0.153	-0.154	-0.154
unemployment	0.534	0.526	0.521	0.143	0.141	0.138	0.181	0.175	0.166	0.095	0.101	0.103	-1.293	-1.253	-1.234
aged_50_64	-0.008	-0.019	-0.027	0.161	0.151	0.140	0.168	0.147	0.131	0.026	0.003	-0.006	-1.076	-1.034	-1.014
solo_parent	0.068	0.079	0.086	0.085	0.084	0.083	0.092	0.095	0.101	0.219	0.205	0.199	-0.182	-0.191	-0.196
māori	0.013	-0.001	-0.011	-0.014	-0.017	-0.021	-0.061	-0.062	-0.065	0.018	0.006	0.002	0.149	0.155	0.157
no_qualification	-0.006	0.007	0.015	0.004	0.009	0.014	0.092	0.098	0.104	0.027	0.037	0.041	-0.045	-0.056	-0.061
service_sector	-0.070	-0.067	-0.064	-0.027	-0.026	-0.024	0.004	0.007	0.011	-0.023	-0.018	-0.016	0.035	0.030	0.027
1996_dummy	0.561	0.186	-0.067	-0.108	-0.122	-0.139	-1.058	-0.742	-0.45	-0.059	-0.066	-0.068	2.526	2.513	2.507
2006_dummy	-4.111	-3.125	-2.462	-0.017	0.000	0.02	0.692	0.746	0.786	-0.956	-0.552	-0.394	3.555	3.122	2.914
net_migration	0.006	0.007	0.008	-0.004	-0.004	-0.003	-0.016	-0.014	-0.012	0.001	0.003	0.004	0.055	0.054	0.053
constant	4.119	2.937	2.142	-0.773	-1.015	-1.291	-4.896	-5.76	-6.535	-3.197	-4.168	-4.548	103.163	94.641	90.558

* Shading indicates significance

Chapter 6

THE SPATIAL IMPACT OF LOCAL INFRASTRUCTURAL INVESTMENT IN NEW ZEALAND[1]

6.1 Introduction

Public infrastructural investment has been widely used as a tool for regional economic development, motivated by the view that such infrastructure is an intermediate public good that plays an active role in the production process. It is expected that increasing the stock of public infrastructure in a region will improve the productivity of existing firms and encourage new firms to locate to the region. Consequently, regional output and employment will grow (Lall, 2007). Endogenous growth theory (e.g. Aghion & Howitt, 2009) suggests that it is even possible that the region's long-run growth rate will increase. Meta-analyses of the empirical research does indeed show that public expenditure on infrastructure benefits economic growth (Bom & Ligthart, 2009; Nijkamp & Poot, 2004). This is the case at both the national and regional levels.

Given the magnitude of these investments and the policy emphasis on them as tools for regional development, the role of infrastructure in economic growth has been the subject of considerable research in the fields of public policy, economics, and planning, dating back to Nurske (1953) and Hirschman (1958). The past several decades have seen an intensification of this interest with numerous studies taking their lead from the work of Aschauer (1989) and Biehl (1986) in which infrastructure enters as an input in an aggregate production function.

The earlier studies in this tradition found a strong productive effect of public infrastructure. For example, Aschauer (1989), Reich (1991) and Deno (1988) all found that the return to private sector economic performance from

[1] An earlier version of this chapter has appeared as Cochrane, Grimes, McCann, & Poot (2010).

public investment was greater than from private investment. However, more recent research has raised serious concerns around the robustness of these empirical results (see Sturm, Kuper, & De Haan, 1998 for an overview of this literature). In terms of the specification of regression models that explain the contribution of public infrastructure to regional output, it has been found that, when regional and temporal fixed effects are introduced, the effects of public sector investment on private sector productivity and output are either markedly reduced or disappear completely (Garcia-Mila & McGuire, 1992; Holtz-Eakin, 1994; Hulten & Schwab, 1991). Moreover, when the spatial context in which public infrastructural investment occurs is taken into account, the magnitude and significance of the estimated effect of that investment decreases as well (Kelejian & Robinson, 1997).

A number of possible avenues exist by which public investment at one location may influence productivity and output at neighbouring locations. For instance:

- Public infrastructural investment in one region may induce mobile production factors to move to that region to avail themselves of the improved infrastructural endowments. This mechanism suggests that the output of a region would depend positively on its stock of infrastructure and negatively on the stock of infrastructure in the surrounding regions.
- Conversely, public infrastructure – especially that related to transportation – may have a positive impact not only in the region where it is located but also on neighbouring regions due to the network characteristic of some infrastructure, in which any piece is subordinate to the entire network. For example, the building or expansion of a port or airport in one region may allow producers in neighbouring regions greater access to markets.
- In addition, the analysis of the effects of public infrastructural investment is usually carried out using data aggregated to administrative boundaries. These boundaries frequently poorly reflect functional economic areas or the networks that connect them. Linkages forward and backward are then

not appropriately measured in the data and statistical spillover effects result from this measurement problem.

One approach to measuring the spatially varying impacts of infrastructure is the spatial equilibrium approach suggested by Haughwout (2002), which has been used to assess the impact of the Auckland northern motorway extension (see Grimes & Liang, 2010). This approach measures changes in land values at a highly disaggregated level, a mesh block.[2]

The approach that is adopted in the present chapter complements this earlier research and considers the economic impact at a greater spatial level that is also of policy significance, namely that of the Labour Market Area (LMA), the spatial unit used throughout this thesis. This chapter is therefore in the tradition of the macro-level impact studies cited above, but with the innovations of, firstly, using spatial econometrics to measure interregional spillover effects and, secondly, of identifying the drivers of local public investment.

The chapter is structured as follows: section 6.2 covers the theoretical framework, the specification of the model and the methodology used to perform the estimation. Section 6.3 discusses the data used in this chapter. Section 6.4 reports the results of the standard 3 stage least squares (3SLS) procedure to estimate the parameters of the model and then compares these results with those of a recently developed spatial 3SLS procedure. Section 6.5 is by way of conclusion.

6.2 Model Specification and Methodology

The approach adopted here is to embed the impact of local infrastructure investment in a model of spatial equilibrium such as developed by Roback (1982) and Haughwout (2002). Spatial variation in unemployment rates and labour force participation remain in the background. A simple extension of the Roback (1982)

[2] A mesh block is the smallest geographic unit for which statistical data is collected and processed by Statistics New Zealand. In urban areas it is about the size of a city block.

model suffices to motivate the empirical relationships that can be anticipated.[3] In the Roback model, capital and workers are perfectly mobile. However, land availability and amenities are location specific. Following an exogenous shock, workers will migrate between regions until their utility is the same everywhere. Similarly, capital is moved across regions until the rate of return is the same everywhere. In the absence of differences in amenities across regions, wages and rents would also be equal everywhere but, as Roback (1982) shows, different levels of amenities across regions will lead to spatial differences in wages and rents. Amenities may be fixed and natural, such as related to the climate, or varying such as positive or negative externalities associated with population density, or the amenities provided by local government.

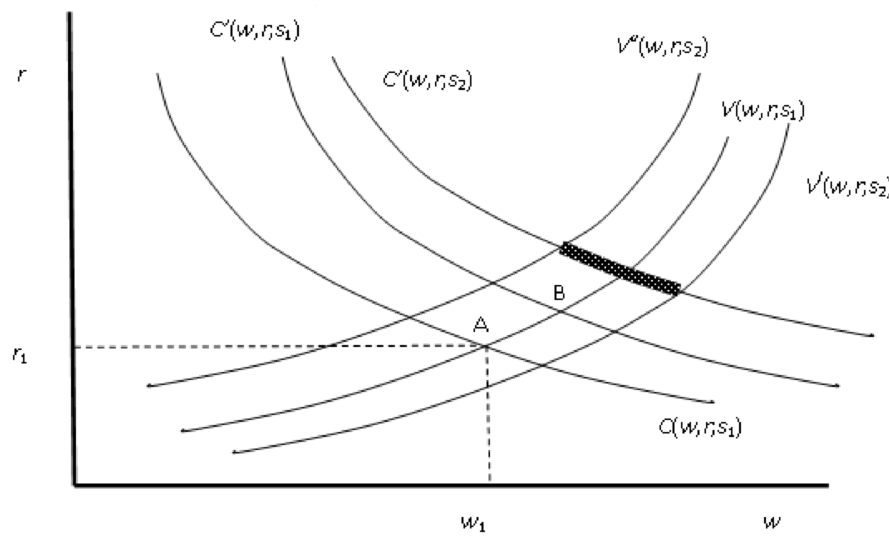
In this chapter, local government-provided infrastructure is interpreted as productive amenities. However, the level of local infrastructure is assumed endogenous. It is easy to show with the Roback model that an exogenous increase in productive amenities leads to higher rents, but has an ambiguous effect on wages. What would drive endogenous infrastructure investment? The simplest explanation is that most publicly provided services and infrastructure are congestible. Consequently, an increase in population leads to a lower quality of public services and greater congestion, and possibly outward migration of residents, unless some infrastructure investment is undertaken. With endogenous infrastructure and local authorities being the third set of behavioural agents in the model, a third equilibrium condition (besides equal utility and equal unit production costs across space) must be imposed. A plausible condition is a balanced budget (over-time) for local government spending, with local infrastructural and other outlays funded by local taxes, usually in the form of a property tax.

If local infrastructure investment is endogenous and productive, wages are expected to increase in response to an increase in infrastructure. This is illustrated in Figure 6.1 for the impacts of endogenous local authority spending.

[3] See Moretti (2010) for a recent model of spatial equilibrium with heterogeneous labour and agglomeration.

Consider a particular region in which the initial equilibrium land rent is r_1 and the wage is w_1 (point A). Following a positive productivity shock, the cost equalisation curve $C(w,r;s_1)$ will shift to the right, to $C'(w,r;s_1)$. Consequently, firms in the region will offer higher wages and rents will increase (point B). However, with endogenous public infrastructure spending this is not the new equilibrium.

Figure 6.1 The Roback model with endogenous local authority spending



The positive productivity shock leads to greater employment, which requires inward migration. To avoid a decline in the quality of public services, the local government responds with increasing public amenities from s_1 to s_2. This shifts the cost equalization curve from $C'(w,r;s_1)$ to $C'(w,r;s_2)$. At the same time, there are two influences on the curve $V(w,r;s_1)$ that represents wage/rent combinations with spatially equalized utility. The first is that the additional public spending is likely to have spillover benefits for consumers (e.g., road infrastructure lowers travel times). This leads to a shift of V upwards. On the other hand, the local tax that needs to be raised lowers real disposable income, which shifts V to the right. The combined effect will be that the shift in V will be rather small, say between V^u and V^l. The new equilibrium is somewhere along the bold segment in Figure 6.1.

The outcome as displayed in Figure 6.1 leads to the conclusion that a positive productivity shock is expected to raise land rent in spatial equilibrium, increases the population of the region through net inward migration, increases the level of public infrastructure investment, and increases wages. If the greater population subsequently enhances productivity growth further through agglomeration advantages (with the congestion externalities being partly offset by additional local government spending) a positive feedback loop has been created of self-reinforcing growth associated with inward migration.[4]

The simple endogenous processes described above suggest a growth model of four equations: one each for growth in public infrastructure capital, change in real income, population change, and lastly change in the real value of land. Each equation is estimated using data for 58 LMAs across two time periods (1996-2001 and 2001-2006). Ideally a longer panel would have been desirable however this was not possible for two reasons. Firstly there appears to be no data collected in a consistent manner prior to the mid-1990s and secondly the local government reforms of 1989/1990 radically altered the geography of local governance in New Zealand (McKinlay, 1998) precluding backdating to earlier periods.

The first equation, for growth in public infrastructure capital (Δ_Infrastructure), is estimated as a function of a period dummy controlling for national business cycle effects (Period_dummy) and variables for the percentage change in real median income (Δ_Income), the percentage change in the usually resident population (Δ_Population), initial homeownership (%_Homeownership_1996), the interaction of the period dummy with initial homeownership (Period*Homeown) and the percentage change in estimated real land value (Δ_Landvalue).

The real income growth variable (Δ_Income) is included as an explanatory variable since the growth in public infrastructure capital is anticipated to be

4 A recent meta-analysis suggests that an increase in the rate of net internal migration by one percentage point, raises the rate of real income growth by 0.1 percentage points. This is consistent with the suggested self-reinforcing growth (Ozgen, Nijkamp, & Poot, 2010).

positively related to real income growth. This reflects investment being a function of the change in the level of output (i.e. the accelerator principle), with real income growth proxying for real regional GDP growth.[5]

Population change (Δ_Population) plays a crucial role in the determination of public infrastructure investment as both local and central government use this easily measurable variable as the basis for both funding and planning.

Roskruge, Grimes, McCann, & Poot (2010) found homeowners tend to be more critical of local authorities than renters, potentially demanding higher provision of services, thus driving local authorities to invest more heavily in public infrastructure. The homeownership variable (%_Homeownership_1996) is used to capture this effect with the value from the start of the period under consideration (1996) being used to avoid problems with endogeneity. As with the other time-interacted variables in the system of equations, the interaction of the homeownership variable with the period dummy allows the coefficient on this variable (Period*Homeown) to vary between periods.

The change in real land value variable (Δ_Landvalue) is of particular significance in the New Zealand context as nearly 60 percent of local services are funded from property taxes (McLuskey, Aitken, Grimes, Kerr , & Timmins, 2006).

The equation for change in real income per capita explains economic growth in terms of the growth in public infrastructure capital (Δ_Infrastructure), the percentage change in usually resident population (Δ_Population), the natural logarithm of median income at the beginning of the period (log_Income_1996), the interaction of the period dummy and the income variable (Period*Income), the local unemployment rate (%_Unemployed_1996), the interaction of the local unemployment rate and the period dummy (Period*Unemployed) and a period effect (Period_dummy).

Growth in public infrastructure capital (Δ_Infrastructure) is expected to induce real per capita income growth through both Keynesian demand effects

---

[5] Official estimates of sub national GDP are not available for New Zealand.

and neoclassical productivity effects, while the inclusion of the percentage change in usually resident population (Δ_Population) is supported by the meta analysis of Ozgen et al. (2010) who found that population growth was positively related to real income growth when population growth is due to net inward migration.

We expect a negative sign on the parameter estimate of the log of real income at the beginning of the period (log_Income_1996) (beta convergence) as the standard neoclassical growth model posits that income growth is inversely related to the initial level of income (Barro & Sala-i-Martin, 1992).

Assuming an Okun's law like relationship between unemployment and real income growth (Lee, 2000), real income growth will be reduced as unemployment rises. We therefore expect a negative sign on the local unemployment rate (%_Unemployed_1996) parameter.

The variables growth in public infrastructure capital (Δ_Infrastructure), change in overseas born population (Δ_Overseas_Born), [6] industry mix (Industry_Mix), the natural logarithm of the median real income (log_Income_1996), the interaction of the period dummy and the income variable (Period*Income), the percentage unemployed (%_Unemployed_1996), the interaction of the local unemployment rate and the period dummy (Period*Unemployed), and the period dummy (Period_dummy) enter into the equation for population growth (Δ_Population).

It is anticipated that investment in public infrastructure capital (Δ_Infrastructure) will have a positive relationship with population growth as such investment may make an area relatively more attractive to reside in, inducing in-migration.

Population growth through net migration has long been associated with prevailing labour market conditions, with real income levels (log_Income_1996) and employment opportunities (Industry_Mix) being positively related to these flows (see Boyle, Halfacree, & Robinson, 1998; Greenwood, 1997; Molho, 1986;

[6] International migration is proxied here by the five-yearly change in the percentage of overseas born persons in an LMA.

Poot, 1986b). Unemployment is also frequently positively associated with net migration, not because migrants perversely wish to lower their probability of employment and earnings but because of high labour turnover in such areas attracting migrants (Poot, 1986b). This was also already noted in the previous chapter.

The equation for the percentage change in real land value consists of the variables for growth in public infrastructure capital (Δ_Infrastructure), the natural log of the estimated real land value at the beginning of the period (log_landvalue_1996), the interaction of the land value and the period dummy (period*landvalue), percentage change in usually resident population (Δ_Population), and the period dummy (period_dummy).

Real land values are hypothesised to increase with investment in public infrastructure; hence a positive sign is expected on the parameter for growth in public infrastructure capital (Δ_Infrastructure) due to positive externalities stemming from such investments. For instance, accessibility of areas may improve with investment in roading, leading to more demand for land in those areas and hence higher real land values.

Spatial differences in amenities will lead to persistent spatial differences in the value of land. However, on the long-run growth path there may be neoclassical convergence, in which case a negative sign on the parameter estimate for the natural log of estimated real land value (log_landvalue_1996) can be expected. Lastly, increases in population (Δ_Population) will lead to increased demand for land for residential purposes.

In a recent article, Wu and Gopinath (2008) examine the causes of spatial disparities in economic development in the United States using a two-step procedure based on the general approach of Kelejian and Prucha (2004). Firstly, a system of simultaneous equations, being structural equations of demand and supply in the labour and housing markets, is estimated using a 3SLS estimator, thus correcting for endogeneity and contemporaneous correlation. In the second step of the procedure the residuals from the 3SLS estimation were tested for spatial auto-correlation. If spatial auto-correlation is identified in an equation, the 3SLS residuals are used to estimate the spatial correlation parameter (ρ) by means of the generalised moment estimator suggested by Kelejian and Prucha (1999). The data are then transformed using the matrix (I-ρW) where I is an NxN identity matrix, N being the number of observations, and W a spatial weights matrix. Using the transformed data, each equation is then re-estimated using the ordinary least squares estimator (OLS).

In this chapter a similar problem is faced: the estimation of a system of equations representing the growth path of regional economies in the presence of spatial auto-correlation. However, here a somewhat different approach is adopted from that of Wu and Gopinath (2008). Initially the four-equation growth model (one equation each for growth in public infrastructure capital, change in real income, population change and change in the real value of land) is estimated using standard 3SLS.[7] In performing this estimation an issue arises from the endogenous determination of two explanatory variables, homeownership and unemployment. One avenue for dealing with this issue is to use beginning of period values (i.e. 1996 values for the 1996-2001 period and 2001 values for the 2001-2006 period). However, while this might be satisfactory for the first period (1996-2001) it is not for the second as the values for 2001 would be endogenously determined with the 1996-2001 change variables. Instead, for both time periods, homeownership and unemployment are entered as their 1996 values and as their 1996 value interacted with the time period dummy.[8]

The residuals of each of the estimated equations are then inspected for the presence of spatial autocorrelation. Where the residuals of a particular equation show a significant level of spatial autocorrelation, the spatial lag of the dependent variable is created. Next, the 3SLS system was re-estimated with the inclusion of the spatially lagged variables in the relevant equations. The inclusion of the spatially lagged dependent variables in the 3SLS system can be seen as

---

[7] All estimations were carried out in Stata 11 using either the reg3 command (3SLS), the spatreg command (invoking the spatial procedures provided by Maurizio Pisati) or the splagvar commands of P. Wilner Jeanty.

[8] We also follow this procedure for the inclusion of income and land value in equations that test for regional convergence.

analogous to the use of the Spatial Autoregressive (SAR) model in the single equation context (see LeSage & Pace, 2009, pp. 32-33).

The observations in all models were weighted by the LMAs' usually resident population for the beginning of the period in question. Given that many of the variables represent average outcomes for individuals and households within LMAs, such as the percentage of labour force that is unemployed, a control for heteroscedasticity was introduced by means of analytical weights that were equal to the population size of each LMA. [9]

6.3 Data and descriptives

The data used in this chapter are drawn from a number of sources covering the two periods 1996-2001 and 2001-2006:

- The quinquennial New Zealand Census of Population and Dwellings;
- Motu's Quotable Value New Zealand (QVNZ) sales and valuation database;
- Motu's Regional and Local Authorities Finance database;
- Statistical profiles of individual councils available from the Department of Internal Affairs at http://www.localcouncils.govt.nz/lgip.nsf.

As throughout this thesis, the data were aggregated and adjusted to coincide with LMA (as discussed in chapter 2) boundaries.

Turning to the derivation of the main dependent variables: Total additions to public fixed capital in the LMA were estimated on the basis of reported Territorial Authority (TA) and Regional Council (RC) additions to infrastructure capital, apportioned to their constituent CAU on the basis of population, then re-aggregated to the LMA boundaries. It should be noted that estimates of fixed capital stocks of public infrastructure are unfortunately not

[9] Analytical weights can be used with most Stata regression commands, but not with spatreg.

available in New Zealand. Hence there is only information on additions to stocks of infrastructure capital rather than the stocks themselves.[10].

Growth in infrastructural capital was assumed to be proportional to the investment ratio (I/Y*100). This ratio was calculated by dividing the sum of total additions to fixed capital (I) in the LMA by Territorial Authorities (TA) and Regional Councils (RC) by LMA aggregate income (Y). The latter was proxied by the mean personal income in the LMA multiplied by the usually resident population aged 15 years and over.

Figure 6.2 and Figure 6.3 show the spatial distribution of growth in infrastructural capital for the 1996-2001 and 2001-2006 periods, respectively. The Moran's *I* statistics for both periods are positive and significant (I=0.156, p<.05), indicating the clustering of similar values of infrastructural growth. For the 1996-2001 period, infrastructural capital growth rates range from about 1.5 percent (Hutt Valley) to 28 percent (Queenstown) while for the 2001-2006 period the range is similar, ranging from 1.7 percent (Hutt Valley) to 28 percent (Queenstown) with growth rates in the two periods being strongly correlated (r=.65, p <.01).

The percentage change in real median income (NZ$2006) was calculated from the census meshblock database for the 1996, 2001 and 2006 censuses. For the first period, 1996-2001, percentage change in real median income ranged from a decline of around 1 percent in Bulls to an increase of approximately 17 percent in Kaikohe while in the second period the percentage change in real median income ranged from just under 1 percent in Tokoroa to nearly 25 percent in Alexandra. Interestingly, the correlation in growth in median income between the two periods was insignificant. The Moran's *I* for the period was significant and positive (I=.168, p<.05); however for the second period *I* was not significant (I=.079, p>.1) indicating that in the latter period growth in real median income

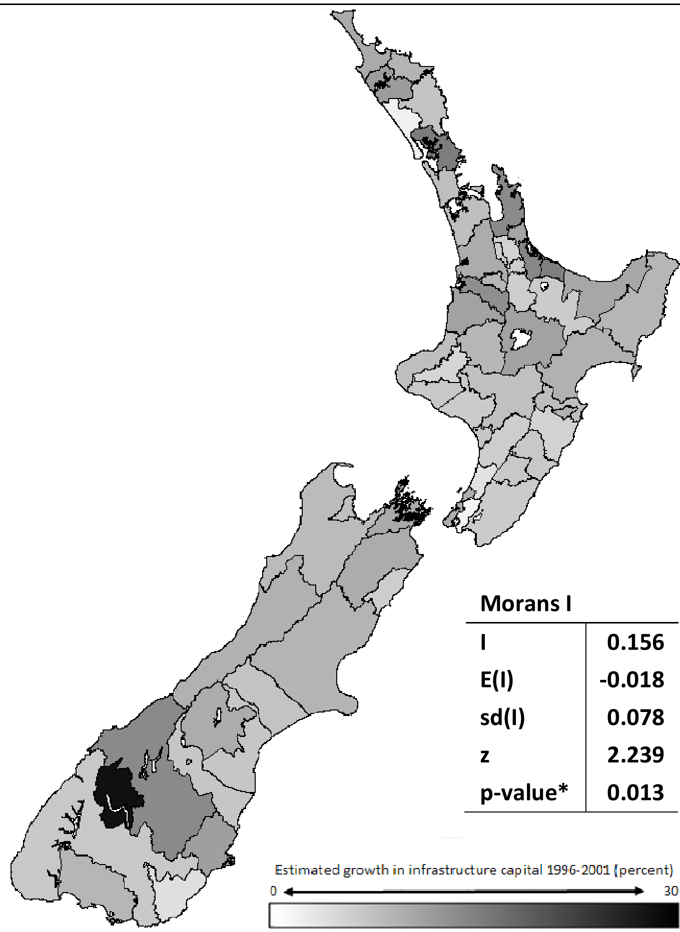
[10] The availability of data on local governance in New Zealand is limited to what is reported by the various authorities and councils themselves – which does not appear to be available in a format that is consistent between these bodies – or via the "Quarterly Local Authority Survey" which is highly aggregated and limited in coverage with some activities, such as those of Local Authority Trading Enterprises, being excluded (Statistics New Zealand, 2010).

was geographically relatively uniformly distributed. Figures 6.4 and 6.5 show the spatial distribution of the percentage change in real median income for the two periods.

The percentage intercensal change in usually resident population was again calculated on the basis of census counts aggregated to LMA boundaries. The spatial distribution of the percentage inter census changes in usually resident population are shown in Figures 6.6 and 6.7 for the 1996-2001 and 2001-2006 periods respectively. The Moran's *I* for both periods were significant and positive (1996-2001, $I=.212$, $p<.01$; 2001-2006, $I=.253$, $p<.001$). For the first period, population growth varied between a decline of nearly 14 percent in Taihape and an increase of 16 percent in Tauranga with over half (35) of the LMAs experiencing population declines. In the second period, population growth ranged between a decline of 5 percent in Eketahuna and an increase of nearly 30 percent in Queenstown with only a quarter of LMAs experiencing population declines. Population growth between the two periods was highly correlated ($r=.798$, $p<.05$).

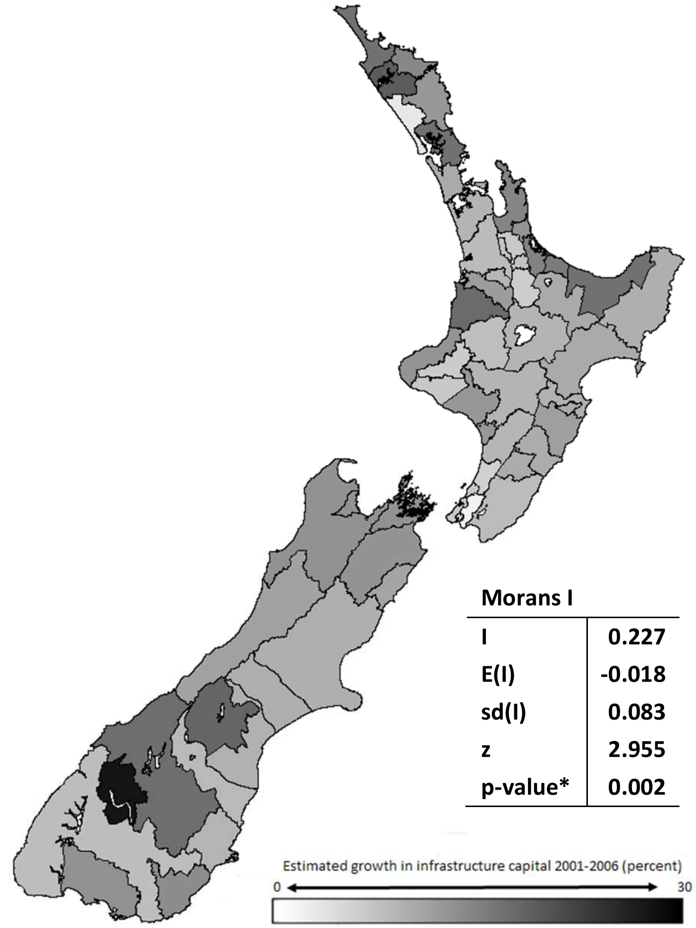
To obtain the percentage change in estimated real land value, the land values were estimated by multiplying the CAU level mean sales price by the ratio of land valuation to capital valuation for each census year. The CAU estimates were then aggregated to LMA level, weighted by the number of dwellings in each CAU and converted to NZ$2006 dollars. The percentage change for the intercensal period was then calculated. In the first period, the percentage change in land values ranged from a decline of nearly 50 percent in Waipukurau to an increase of close to a 100 percent in Eketahuna. There was a moderate negative correlation between the percentage change in estimated real land value in the first and second periods ($r=-.416$, $p<.05$). In the second period the largest, and only, decline was that of Eketahuna (-14 percent) while in the MacKenzie LMA real land values increased by nearly 380 percent. Figures 6.8 and 6.9 show the spatial distribution of percentage change in estimated real land value. The Moran's *I* for both periods is significant and positive (1996-2001, $I=.200$, $p<.01$; 2001-2006, $I=.129$, $p<.05$) though *I* is considerably smaller in the second period.

Figure 6.2 Estimated growth in infrastructure capital 1996-2001



Morans I	
I	0.156
E(I)	-0.018
sd(I)	0.078
z	2.239
p-value*	0.013

Figure 6.3 Estimated growth in infrastructure capital 2001-2006



Morans I	
I	0.227
E(I)	-0.018
sd(I)	0.083
z	2.955
p-value*	0.002

Figure 6.4 Change in real median income 1996-2001 (percent)

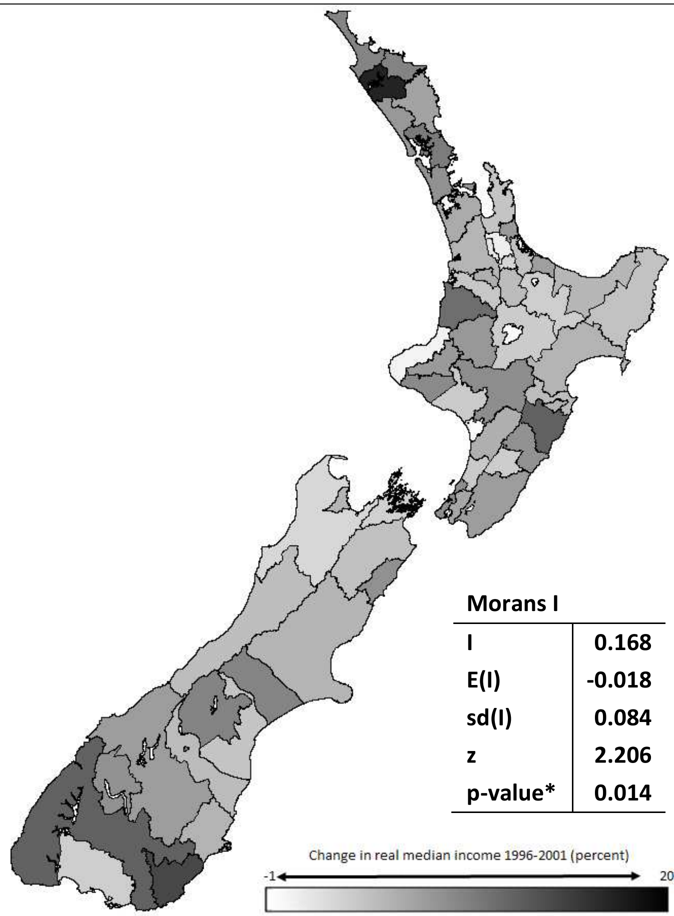


Figure 6.5 Change in real median income 2001-2006 (percent)

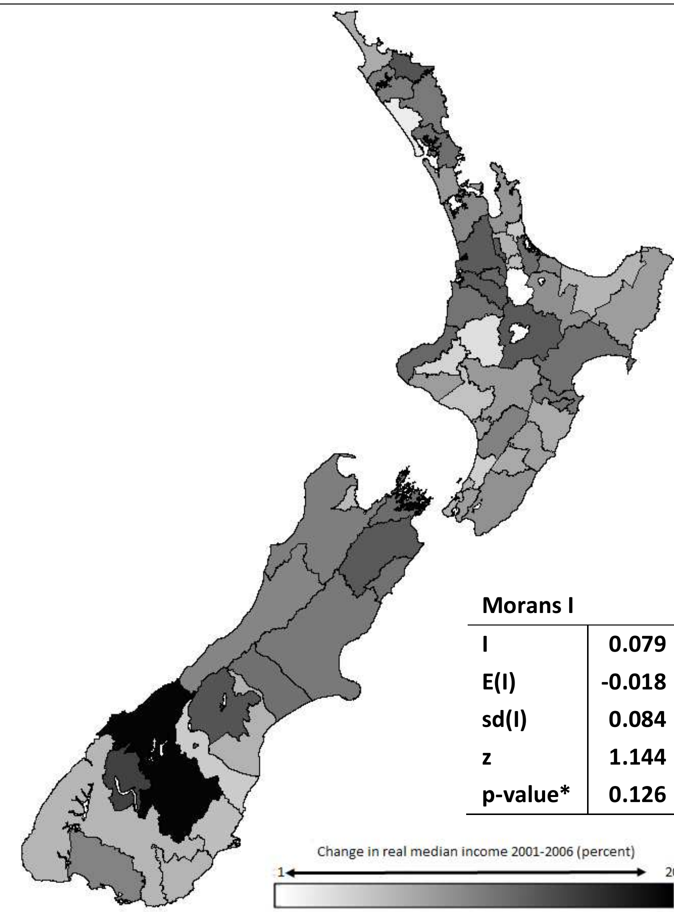
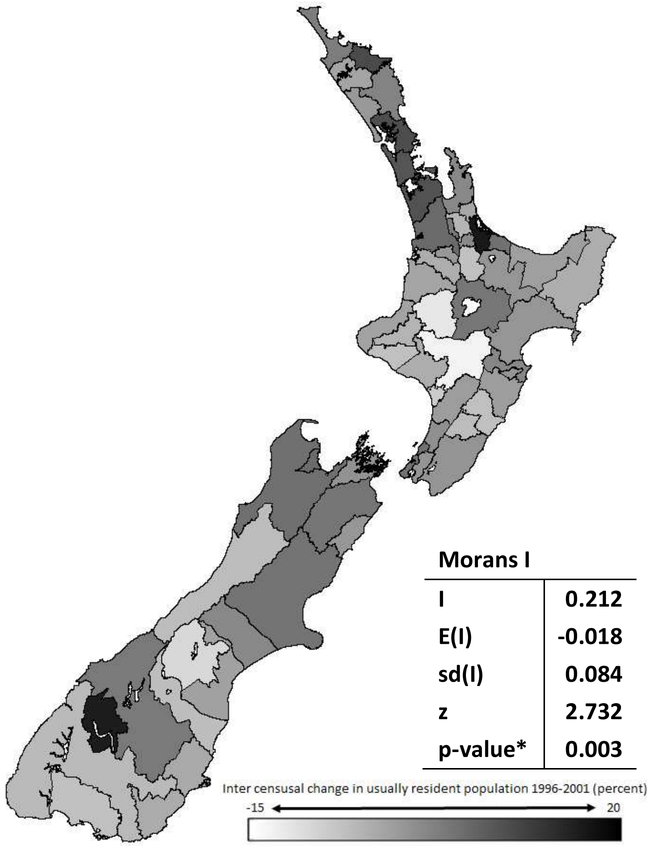
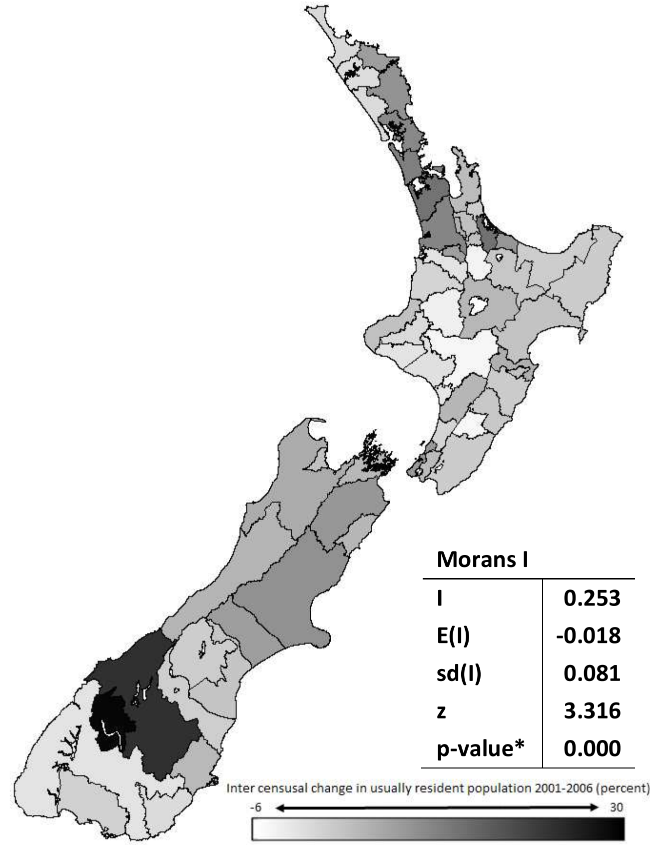


Figure 6.6 **Inter censusal change in usually resident population 1996-2001 (percent)**



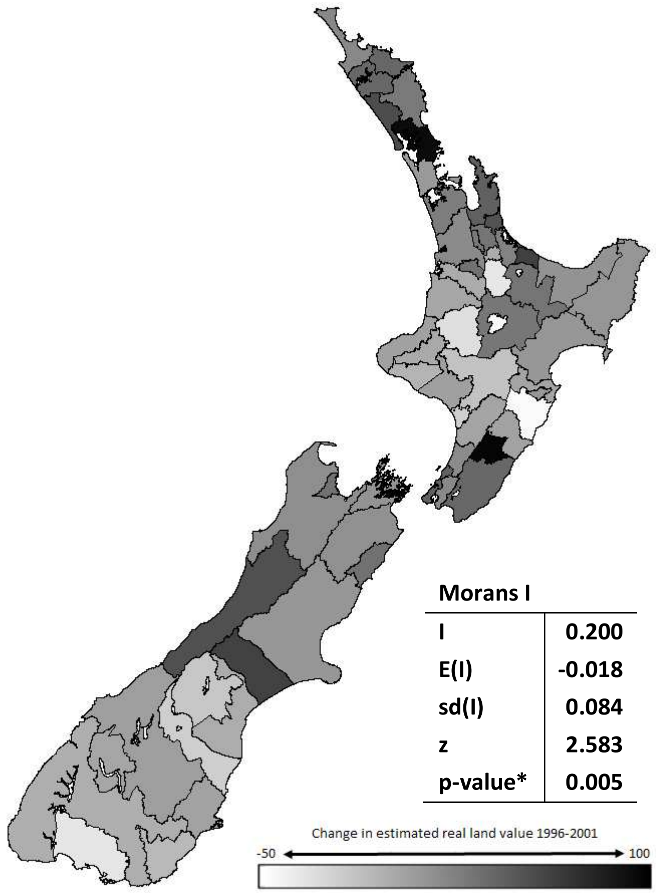
Morans I	
I	**0.212**
E(I)	**-0.018**
sd(I)	**0.084**
z	**2.732**
p-value*	**0.003**

Figure 6.7 **Inter censusal change in usually resident population 2001-2006 (percent)**



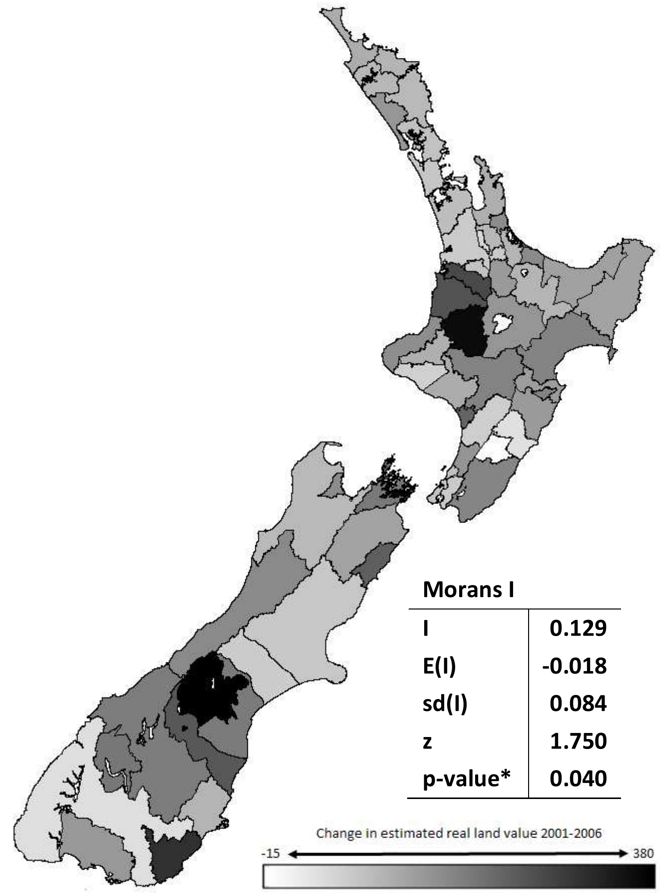
Morans I	
I	**0.253**
E(I)	**-0.018**
sd(I)	**0.081**
z	**3.316**
p-value*	**0.000**

Figure 6.8 Change in estimated real land value 1996-2001



Morans I	
I	0.200
E(I)	-0.018
sd(I)	0.084
z	2.583
p-value*	0.005

Figure 6.9 Change in estimated real land value 2001-2006



Morans I	
I	0.129
E(I)	-0.018
sd(I)	0.084
z	1.750
p-value*	0.040

The industry mix variable is the industry mix effect calculated by the classical shift share technique (Cochrane & Poot, 2008) and captures the effect of the industrial structure of the LMA on LMA level employment, as already elaborated extensively in Chapter 3. Definitions for all variables used in this analysis can be seen in Table 6.1 with their accompanying descriptive statistics shown in Table 6.2.

Table 6.1 Variable Definitions

	Variable	Definition
Endogenous	Δ_Income	Change in real median income (percent)
	Δ_Infrastructure	Estimated growth in infrastructure capital (see following slide)
	Δ_Landvalue	Change in estimated real land value (percent)
	Δ_Population	Percentage change in usually resident population over the inter census period
Exogenous	%_Homeownership _1996	Percent Home ownership
	%_Unemployed_1996	Percentage of labour force that is unemployed in 1996
	Industry_Mix	Industry mix effect
	log_Income_1996	Natural logarithm of real median income $2006
	log_Landvalue_1996	Natural log of estimated real land value $2006 (see following slide)
	Period*Homeown	Interaction of %_Homeownership and the period dummy
	Period*Income	Interaction of log_Income_1996 and the period dummy
	Period*Landvalue	Interaction of log_Landvalue_1996 and the period dummy
	Period*Unemployed	Interaction of %_Unemployed_1996 and the period dummy
	Period_dummy	0=1996-2001, 1=2001-2006
	Δ_Overseas_Born	Change in overseas born population (percent)
Instruments	%_Degree_Plus	Percentage with Bachelors degree or better
	%_Māori	Percentage Māori
	%_Professionals	Percentage in professional occupations
	%_Smokers_1996	Percentage smokers 1996
	Dependency_Ratio	Demographic dependency ratio ((0-14 plus 65+) / (15-64))
	Km_to_Auckland	Distance to Auckland (Km)
	Period*Population_Density	Interaction of Population_density and the period dummy
	Population_density	LMA population density (population per km2)
	Rainfall	Rainfall (ml) largest urban area in LMA (20 yr average)
	Δ_Income	Change in real median income (percent)
	Δ_Infrastructure	Estimated growth in infrastructure capital (see following slide)
	Δ_Population	Percentage change in usually resident population over the inter census period
	Δ_Landvalue	Change in estimated real land value (percent)

In this chapter, as elsewhere in the thesis, the spatial weights matrix used in the estimation is constructed on the basis of the reciprocal of the squared travel time between the major urban centres of each LMA. The matrix takes a block diagonal form. Effectively, LMAs in one time period form an interacting block with no neighbours in another time period. Alternatively this can be interpreted as there being an infinite distance between any LMAs in a specific time period and all other LMAs at other points in time. Before carrying out the spatial regressions, the weights matrix has been row standardized.

Table 6.2 Descriptive statistics by period (population weighted)*

		Period beginning 1996				Period beginning 2001			
	Variable	mean	sd	min	max	mean	sd	min	max
Endogenous	Δ_Income	5.85	2.29	-0.71	16.94	11.59	3.02	0.75	24.52
	Δ_Infrastructure	8.21	2.59	1.45	28.05	9.69	3.01	1.70	27.54
	Δ_Landvalue	15.64	18.51	-47.61	96.32	95.91	43.11	-13.97	376.07
	Δ_Population	3.29	5.43	-13.52	16.44	7.78	5.21	-5.2	28.99
Exogenous	%_Homeownership _1996	70.54	3.33	51.97	79.24	70.51	3.28	51.97	79.24
	%_Unemployed_1996	7.81	1.89	2.37	18.87	7.80	1.86	2.37	18.87
	Industry_Mix	-0.06	1.84	-5.71	3.42	-0.07	2.52	-7.82	3.62
	log_Income_1996	9.94	0.11	9.47	10.15	9.94	0.11	9.47	10.15
	log_Landvalue_1996	11.03	0.68	8.89	12.00	11.06	0.67	8.89	12.00
	Δ_Overseas_Born	12.39	9.46	-10.9	38.73	24.53	9.39	-2.37	69.34
Instruments	%_Degree_Plus	9.44	4.79	3.21	21.46	11.59	5.3	3.83	23.8
	%_Māori	13.64	7.99	4.51	52.59	13.41	8.13	4.39	55.42
	%_Professionals	22.44	5.34	9.77	33.87	24.74	5.96	10.49	36.65
	%_Smokers_1996	23.83	3.12	20.5	37.05	23.75	3.08	20.5	37.05
	Dependency_Ratio	53.35	6.29	34.21	69.84	53.52	6.76	35.48	71.12
	Km_to_Auckland	474.13	482.5	0.00	1638	461.05	479.06	0.00	1638
	Population_density	63.09	85.23	0.45	321.25	64.33	85.49	0.45	321.25
	Rainfall	1123.02	293.89	360.00	2430.00	1124.78	289.7	360.00	2430.00

*Weighted by LMA usually resident population at commencement of period

6.4 Results

The results of the non-spatial 3SLS system are presented in Table 6.3.[11] Two variables attain significance at the 5 percent level (with positive coefficients) in the growth in public infrastructure capital (Δ _Infrastructure) equation. The

[11] In Tables 6.3, 6.5 and 6.7 rather than reporting the interaction terms directly, the parameter on the variable of interest in the latter period is reported. For instance in the equation for the percentage change in real land value, rather than reporting the parameter on the interaction term for land value and the period dummy (period*landvalue), what is reported is the parameter on land value in the 2001-2006 period. This is simply obtained by adding the parameter estimate obtained for the first period to that of the interacted term. The motivation for this was to assist in interpretation of the results.

variable for percentage change in median income (Δ_Income) is significant, which suggests that growth in real income in a region leads to an increase in investment in public capital. Secondly, the percentage change in estimated real land value (Δ_Landvalue) is also significant, in line with the expected importance of land taxes (rates) in funding local infrastructural investment. The other variables are all statistically insignificant though of the expected sign. It would seem that the spatial distribution of investment in public infrastructure is rather haphazard in New Zealand, possibly more determined by funding availability and political factors rather than conventional economic drivers.

In the change in real income (Δ_Income) equation the population change variable (Δ_Population) and the growth in public infrastructure capital (Δ_Infrastructure) variable are significant and positive. Infrastructure growth increases productivity and, consequently, real income, as the work of Aschauer (1989) and others suggested. Moreover, population growth also provides a boost to real income growth, which is consistent with the recent meta-analysis of Ozgen et al. (2010)

Regional population growth is positively affected by investment in public infrastructure (Δ_Infrastructure), international migration (Δ_Overseas_Born), a favourable mix of industries (Industry_Mix), and income in the latter period. In addition, unemployment in the second period is associated with high levels of population growth, perhaps due to greater labour market churn in such areas. The period dummy is negative even though population growth in the latter period was more than in the earlier one (see Table 6.2). However, as the equation includes a term to capture the effects of international migration (Δ_Overseas_Born), this may reflect the fact that natural increase in the population of New Zealand was relatively lower in the second period with overall population growth being driven by international migration.

Lastly, the variable for investment in public infrastructure (Δ_Infrastructure) attains significance for the change in real value of land (Δ_Landvalue), as does the lagged log of real land value in the second period and the period dummy itself.

Table 6.3 Non-Spatial 3SLS Model Results

Equation	Obs	Parms	RMSE	R-sq	chi2	P
Estimated growth in	116	6	2.81	0.051	52.44	.000
Change in real median	116	7	2.75	0.506	214.17	.000
Inter census change in	116	8	2.14	0.861	800.87	.000
Change in estimated	116	5	26.839	0.734	317.51	.000
Estimated growth in infrastructure capital						
	Coef.	**Std.Err.**	**z**	**P>z**	**[95% Conf.Interval]**	
Δ_Income	0.628	0.125	5.010	0.000	0.383	0.873
Δ_Population	0.037	0.057	0.640	0.519	-0.075	0.149
%_1996	0.078	0.091	0.850	0.394	-0.101	0.256
%_1996	0.028	0.156	0.179	0.858	-0.278	0.333
Δ_Landvalue	0.026	0.011	2.290	0.022	0.004	0.048
Period_dummy	-0.807	8.914	-0.090	0.928	-18.278	16.664
Constant	-1.469	6.585	-0.220	0.823	-14.375	11.437
Change in real median income						
Δ_Infrastructure	0.610	0.162	3.760	0.000	0.292	0.928
Δ_Population	0.137	0.064	2.130	0.033	0.012	0.262
log_Income_1996,	2.031	3.593	0.570	0.572	-5.011	9.073
log_Income_2001,	-3.500	5.645	-0.620	0.535	-14.564	7.564
%_Unemployed_1996,	0.004	0.176	0.020	0.981	-0.341	0.349
%_Unemployed_1996,	-0.196	0.300	-0.653	0.516	-0.784	0.392
Period_dummy	60.755	44.197	1.370	0.169	-25.870	147.380
Constant	-19.830	36.955	-0.540	0.592	-92.260	52.600
Inter census change in usually resident population						
Δ_Infrastructure	0.519	0.139	3.730	0.000	0.247	0.791
Δ_Overseas_Born	0.414	0.027	15.560	0.000	0.361	0.467
Industry_Mix	0.474	0.130	3.660	0.000	0.219	0.729
log_Income_1996,	5.284	3.421	1.540	0.122	-1.421	11.989
log_Income_1996,	18.403	5.247	3.508	0.000	8.120	28.686
%_Unemployed_1996,	0.224	0.164	1.370	0.170	-0.097	0.545
%_Unemployed_1996,	0.852	0.280	3.042	0.002	0.303	1.401
Period_dummy	-136.599	40.415	-3.380	0.001	-215.811	-57.387
Constant	-60.335	34.971	-1.730	0.084	-128.877	8.207
Change in estimated real land value						
Δ_Infrastructure	4.140	1.386	2.990	0.003	1.423	6.857
Log_Landvalue_1996,	1.024	8.161	0.130	0.900	-14.971	17.019
Log_Landvalue_1996,	-34.788	10.976	-3.169	0.002	-56.301	-13.275
Δ_Population	-0.020	1.001	-0.020	0.984	-1.982	1.942
Period_dummy	470.428	81.592	5.770	0.000	310.511	630.345
Constant	-29.593	90.221	-0.330	0.743	-206.423	147.237

Endogenous variables: Δ_Infrastructure, Δ_Income, Δ_Population, Δ_Landvalue

Exogenous variables: %_Homeownership _1996, Period*Homeown, Period_dummy, lag_log_Income_1996, log_Income_1996, Period*Income, %_Unemployed_1996 , Period*Unemployed, Industry mix effect, lag_log_Landvalue_1996, log_Landvalue_1996, Period*Landvalue, %_Māori Rainfall, %_Professionals, %_Degree_Plus, %_Smokers_1996, Km_to_Auckland, Population_density, Period*Population_Density, Dependency_Ratio, Δ_Overseas_Born

Table 6.4 Moran's *I* statistics for the residuals from the non-spatial 3SLS

Variables	I	E(I)	sd(I)	z	p-value
Estimated growth in infrastructure capital	0.107	-0.009	0.060	1.921	0.027
Change in real median income	0.093	-0.009	0.061	1.663	0.048
Inter census change in usually resident population	0.061	-0.009	0.061	1.140	0.127
Change in estimated real land value	0.107	-0.009	0.060	1.908	0.028

Table 6.4 shows the Moran's *I* statistics for the residuals from the non-spatial 3SLS. Except for the inter census change in usually resident population, Moran's *I* for the residuals of the non-spatial 3SLS estimation are positive and significant at the 5 percent level indicating that spatial auto correlation is a problem in these instances.[12] Accordingly, the 3SLS system is re-estimated including spatial lags on the dependent variables in the growth in public infrastructure capital (Δ_Infrastructure), change in real income (Δ_Income) and change in real value of land (Δ_Landvalue) equations.[13]

The results of the spatial 3SLS model are shown in Table 6.5 along with the Moran's *I* statistics for the residuals (Table 6.6), while Table 6.7 compares the results of the non-spatial and spatial 3SLS.

In the public infrastructure capital (Δ_Infrastructure) equation, the percentage change in median income (Δ_Income) variable remains significant and positive, though of a somewhat smaller magnitude. The estimated real land value (Δ_Landvalue) variable is still positive, but no longer significant. In addition, the spatial lag of the growth in public infrastructure capital (Δ_Infrastructure) is significant and positive indicating that growth in infrastructure spending in one region spending spills over into surrounding areas.

[12] Cliff and Ord (1981, pp. 200-206) and (2005, pp. 314-315)(2005, p. 314-315) discuss the problem of assessing spatial auto correlation in regression residuals using Moran's *I.*

[13] Though not reported here when the system of equations was run with the inclusion of a spatial lag on the dependent variable in the Inter census change in usually resident population equationas well as the public infrastructure capital (Δ_Infrastructure), change in real income (Δ_Income) and change in real value of land (Δ_Landvalue) equations the parameter estimates obtain were very similar to those obtained in this estimation.

Table 6.5 Spatial 3SLS Model Results

Equation	Obs	Parms	RMSE	R-sq	chi2	P
Estimated growth in infrastructure	116	7	2.570	0.205	54.42	.000
Change in real median income	116	8	2.547	0.577	210.24	.000
Inter census change in usually	116	8	2.131	0.862	807.85	.000
Change in estimated real land value	116	6	26.772	0.735	312.51	.000

Estimated growth in infrastructure capital	Coef.	Std.Err.	z	P>z	[95% Conf.Interval]	
Lag_Δ_Infrastructure	0.415	0.128	3.250	0.001	0.164	0.666
Δ_Income	0.490	0.125	3.920	0.000	0.245	0.735
Δ_Population	0.016	0.057	0.280	0.781	-0.096	0.128
%_1996 Homeownership, 1996-	0.024	0.094	0.250	0.800	-0.160	0.208
%_1996 Homeownership, 2001-	-0.005	0.161	-0.031	0.975	-0.321	0.311
Δ_Landvalue	0.016	0.011	1.420	0.154	-0.006	0.038
Period_dummy	-1.540	9.125	-0.170	0.866	-19.425	16.345
Constant	0.065	6.703	0.010	0.992	-13.073	13.203
Change in real median income						
Lag_Δ_Income	0.076	0.141	0.540	0.590	-0.200	0.352
Δ_Infrastructure	0.430	0.163	2.630	0.009	0.111	0.749
Δ_Population	0.157	0.064	2.440	0.015	0.032	0.282
log_Income_1996,1996-01 coeff	2.504	3.697	0.680	0.498	-4.742	9.750
log_Income_2001, 2001-06 coeff	-4.867	5.790	-0.841	0.400	-16.215	6.481
%_Unemployed_1996, 1996-01	-0.019	0.182	-0.110	0.915	-0.376	0.338
%_Unemployed_1996, 2001-06	-0.224	0.312	-0.717	0.473	-0.836	0.388
Period_dummy	78.865	45.205	1.740	0.081	-9.735	167.465
Constant	-23.388	37.995	-0.620	0.538	-97.857	51.081
Inter censusal change in usually resident population						
Δ_Infrastructure	0.515	0.134	3.850	0.000	0.252	0.778
Δ_Overseas_Born	0.412	0.026	15.700	0.000	0.361	0.463
Industry_Mix	0.490	0.129	3.790	0.000	0.237	0.743
log_Income_1996,1996-01 coeff	5.440	3.390	1.600	0.109	-1.204	12.084
log_Income_1996, 2001-06 coeff	18.411	5.215	3.530	0.000	8.190	28.632
%_Unemployed_1996, 1996-01	0.217	0.163	1.330	0.183	-0.102	0.536
%_Unemployed_1996, 2001-06	0.846	0.279	3.036	0.002	0.300	1.392
Period_dummy	-135.114	40.273	-3.350	0.001	-214.048	-56.180
Constant	-61.764	34.639	-1.780	0.075	-129.655	6.127
Change in estimated real land value						
Lag_Δ_Landvalue	0.064	0.115	0.550	0.579	-0.161	0.289
Δ_Infrastructure	2.179	1.418	1.540	0.125	-0.600	4.958
Log_Landvalue_1996, 1996-01 coeff	-0.498	8.502	-0.060	0.953	-17.162	16.166
Log_Landvalue_1996, 2001-06 coeff	-37.416	11.991	-3.120	0.002	-60.918	-13.914
Δ_Population	0.426	1.020	0.677	0.677	-1.573	2.425
Period_dummy	477.405	99.404	4.803	0.000	282.577	672.233
Constant	0.539	93.937	0.995	0.995	-183.574	184.652

Exogenous variables: lag_infrastructure, %_Homeownership _1996, Period*Homeown, Period_dummy, lag_log_Income_1996, log_Income_1996, Period*Income , %_Unemployed_1996 Period*Unemployed, Industry mix effect, lag_log_Landvalue_1996, log_Landvalue_1996, Period*Landvalue , %_Māori, Rainfall, %_Professionals, %_Degree_Plus, %_Smokers_1996, Km_to_Auckland, Population_density, Period*Population_Density, Dependency_Ratio, Δ_Overseas_Born

Table 6.6 Moran's *I* statistics for the residuals from the spatial 3SLS

Variables	I	E(I)	sd(I)	z	p-value
Estimated growth in infrastructure capital	0.012	-0.009	0.06	0.337	0.368
Change in real median income	0.070	-0.009	0.061	1.288	0.099
Inter census change in usually resident population	0.061	-0.009	0.061	1.136	0.128
Change in estimated real land value	0.083	-0.009	0.06	1.519	0.064

For the real income (Δ_Income) equation, the population change variable (Δ_Population) and the growth in public infrastructure capital (Δ_Infrastructure) variable remain significant and positive although the estimated parameter values are between a third and a quarter lower than in the non-spatial 3SLS.

Turning to the regional population growth equation from the spatial 3SLS model, we find that the parameter estimates for public infrastructure (Δ_Infrastructure), international migration (Δ_Overseas_Born), industry mix (Industry_Mix), and the log income term for the latter period all remain significant, positive and of similar magnitude to those obtained in the non-spatial 3SLS. The period dummy (Period_dummy) also remains significant, of a similar magnitude and retains a negative sign.

In the final equation of the system, for the change in real value of land (Δ_Landvalue), the lagged log of real land value in the second period and the period dummy remain significant and of similar magnitude to the estimates obtained in the non-spatial 3SLS while the variable for investment in public infrastructure (Δ_Infrastructure) remains positive but ceases to be significant at 5% (p=0.125).

Table 6.6 reports Moran's *I* statistics for the residuals of the spatial 3SLS estimation. This indicates that the inclusion of the spatial lags in the growth in public infrastructure capital (Δ_Infrastructure), change in real income (Δ_Income) and change in real value of land (Δ_Landvalue) equations has reduced the impact of spatial auto correlation with none of the Moran's *I* for the 3SLS equations being significant. This confirms that spatial 3SLS is the correct econometric procedure for the model.

Table 6.7 Comparison of Non-Spatial and Spatial 3SLS Model Results

	Non Spatial 3SLS		Spatial 3SLS	
Equation	**R-sq**	**P**	**R-sq**	**P**
Estimated growth in infrastructure capital	0.051	0.000	0.205	0.000
Change in real median income	0.506	0.000	0.577	0.000
Inter census change in usually resident population	0.861	0.000	0.862	0.000
Change in estimated real land value	0.734	0.000	0.735	0.000
Estimated growth in infrastructure capital				
	Coef.	**P>z**	**Coef.**	**P>z**
Lag_Δ_Infrastructure			0.415	0.001
Δ_Income	0.628	0.000	0.490	0.000
Δ_Population	0.037	0.519	0.016	0.781
%_1996 Homeownership 1996-01 coefficient	0.078	0.394	0.024	0.800
%_1996 Homeownership 2001-06	0.028	0.858	-0.005	0.975
Δ_Landvalue	0.026	0.022	0.016	0.154
Period_dummy	-0.807	0.928	-1.540	0.866
Constant	-1.469	0.823	0.065	0.992
Change in real median income				
Lag_Δ_Income			0.076	0.590
Δ_Infrastructure	0.610	0.000	0.430	0.009
Δ_Population	0.137	0.033	0.157	0.015
log_Income_1996 – 1996-01 coeff	2.031	0.572	2.504	0.498
log_Income_2001 – 2001-06 coeff	-3.500	0.535	-4.867	0.400
%_Unemployed_1996 – 1996-01 coeff	0.004	0.981	-0.019	0.915
%_Unemployed_1996 2001-06 coeff	-0.196	0.516	-0.224	0.473
Period_dummy	60.755	0.169	78.865	0.081
Constant	-19.830	0.592	-23.388	0.538
Inter census change in usually resident population				
Δ_Infrastructure	0.519	0.000	0.515	0.000
Δ_Overseas_Born	0.414	0.000	0.412	0.000
Industry_Mix	0.474	0.000	0.490	0.000
log_Income_1996 – 1996-01 coeff	5.284	0.122	5.440	0.109
log_Income_2001 – 2001-06 coeff	18.403	0.000	18.411	0.000
%_Unemployed_1996 – 1996-01 coeff	0.224	0.170	0.217	0.183
%_Unemployed_1996 2001-06 coeff	0.852	0.002	0.846	0.002
Period_dummy	-136.599	0.001	-135.114	0.001
Constant	-60.335	0.084	-61.764	0.075
Change in estimated real land value				
Lag_Δ_Landvalue			0.064	0.579
Δ_Infrastructure	4.140	0.003	2.179	0.125
Log_Landvalue_1996, 1996-01 coeff	1.024	0.900	-0.498	0.953
Log_Landvalue_1996, 2001-06 coeff	-34.788	0.002	-37.416	0.002
Δ_Population	-0.020	0.984	0.426	0.677
Period_dummy	470.428	0.000	477.405	0.000
Constant	-29.593	0.743	0.539	0.995

6.5 Conclusions

This chapter developed and estimated a model of the impact of local authority infrastructure spending in New Zealand using spatial econometric modelling techniques. Both the spatial and non-spatial 3SLS estimators told a similar story, indicating that the spatial distribution of investment in public infrastructure may be rather haphazard in New Zealand, possibly more determined by funding availability and political factors rather than conventional economic drivers. There is significant spatial dependence in infrastructure with clear evidence that growth in infrastructural spending in an area spills over into surrounding regions.

The results support the presence of self-reinforcing growth processes: real income growth is positively affected by both infrastructure growth and population growth, while real income growth itself contributes to growth in infrastructure spending. The equation for population growth is consistent with theories of migration. Finally, there is some weaker evidence that increased infrastructure investment is reflected positively in land values. These findings are all in accordance with to the extension of Roback's spatial equilibrium model discussed in Section 6.2, confirming that positive two-way interactions exist between infrastructure investment and regional economic outcomes.

Chapter 7

SUMMARY AND CONCLUSIONS

7.1 Summary

As discussed in the introductory chapter (Chapter 1) the primary focus of this thesis has been on how local labour markets respond to local or external shocks, taking spatial dependencies into account. Of course, an exhaustive consideration of the dynamics of local labour market adjustment in New Zealand would be beyond the scope of a thesis. Instead, insight into how local labour markets respond to shocks was obtained through the empirical exploration of four facets of sub-national labour markets in New Zealand, namely employment change, the impact of homeownership on unemployment rates, the dynamics of the social security system and the impact of infrastructural investment, all from a spatial econometric standpoint.

In the first empirical chapter, Chapter 3, shift-share analysis was used to identify some forces of New Zealand regional employment change over the 1986-2006 period. The shift-share analysis was supplemented by the use of ESDA techniques to explore the spatial structure of the competitive and industry mix components of regional employment change.

The analysis in Chapter 3 found that while industry endowment played a role in regional employment growth, with the industry mix of regions moving to ameliorate disadvantageous (in terms of employment) industrial structure, the national growth effect was dominant in all regions with no LMA standing apart from the restructuring of the national economy that commenced in the mid-1980s. This analysis confirmed that most of this structural change occurred in the first five years of the 1986-2006 period and further found that LMAs exhibited rather spatially unique industry mix effects with spatial correlation in employment growth due to industry mix being statistically insignificant. On the other hand, the statistically significant spatial correlation in the regional competitive effect of the shift-share analysis provided evidence that local economic shock do spill over to surrounding regions.

Chapter 3 also provided additional evidence of the dichotomisation between the metropolitan regions, and their satellite cities, on the one hand, and the declining peripheral and rural regions on the other with some LMA, notably Queenstown recovering rapidly from the 1986-1991 period while in others, such as Tokoroa, Taumaranui and Taihape, employment growth has remained sluggish or negative even during the buoyant years of the early 2000s.

This chapter is supportive of the argument advanced by Poot (2005) that the regions that have done well during the post restructuring period have been those that have responded most effectively to globalization trends, i.e. regions that are innovative in primary production and related processing, provide knowledge-economy linked services, or prosper through international tourism.

The second substantive chapter, Chapter 4, examined the relationship between homeownership and unemployment (the Oswald hypothesis) in New Zealand. In line with the Oswald hypothesis it was found that the homeownership rate has a large positive and statistically significant effect on the LMA unemployment rate over a wide range of specifications with the statistically most satisfactory model, the spatial lag panel model, yielding a coefficient of 0.172 on the homeownership variable. This is somewhat smaller than Oswald's suggested 0.2, but nonetheless of a smilar magnitude. Taken at face value, it would suggest that a decline in homeownership by 10 percentage points would lower the unemployment rate by about 1.7 percentage points. For the period covered in this thesis (1986-2006) this would indicate that around a quarter of the decline in unemployment since the national unemployment peak of the early 1990s could be due to the decline in homeownership levels. Given that the international evidence has on balance not been supportive of the Oswald hypothesis, the New Zealnd finding is particularly interesting but has to be seen in the light of the long-run macroeconomic trends. Following the international financial crisis and the subsequent global recession, unemployment rates have increased again sharply in New Zealand. At the same time, there is no turnaround in the long-term decline in homeownership rates. Consequently, the question arises whether the statistical finding for the post 1986 period would remain robust to the inclusion of 2013 census data.

Chapter 5 examined the extent to which the variation over space and time of LMA labour force participation and social security benefit uptake rates can be attributed to differences in the composition of the labour force of an LMA (in terms of human capital and demographic characteristics), the level and composition of labour demand, and the geography of local labour markets.

The analysis in this chapter found that past periods of high unemployment were associated with higher current period benefit rates and that such high past high unemployment had a negative effect on the labour force participation rate. In addition it was found that in LMAs with higher proportions of their population aged 50 to 64 years labour force participation was lower while uptake of the sickness and invalids benefit was higher. Both of these results being consistent with the kind of explanatory frameworks advanced by Beatty et al. (2000).

In addition to the effects of the previous history of unemployment and the demographic structure of the LMA's labour force, LMAs with higher proportions of solo parent families were found to have lower levels of labour force participation and higher levels of benefit uptake for all benefits, except the unemployment benefit.

In the final empirical chapter, Chapter 6, a model of the impact of local authority infrastructure spending in New Zealand was developed and estimated. The findings of this chapter indicated that the spatial distribution of investment in public infrastructure in New Zealand may be rather haphazard and possibly determined by factors such as funding availability and political considerations rather than conventional economic drivers.

Chapter 6 also provides clear evidence that increases in expenditure on public infrastructure in a LMA spill over to surrounding regions and indicate the presence of self-reinforcing growth processes, consistent with the modern literature on agglomeration such as Glaeser (2010) whereby real income growth is positively affected by both infrastructure growth and population growth, while real income growth itself contributes to growth in infrastructure spending.

Further, the findings of this chapter are consistent with current theories of migration though they provide only weak evidence that increased infrastructure investment is reflected positively in land values. These findings are all in accordance with the extension of Roback's spatial equilibrium model discussed in Section 6.2. They confirm the positive two-way interaction between infrastructure investment and regional economic outcomes.

Having reviewed the results obtain in the substantive chapters it is worth empathizing what is original in this analysis, as there are myriad studies reliant on similar data and a growing number including a spatial dimension. I would argue that in each of these areas, the work with NZ data is not simply a replication of research already published elsewhere. The techniques existed and research on each topic existed, but the combination of NZ data, techniques at the frontier, plus a consideration of recently highly debated issues (such as the Oswald hypothesis and the impact of infrastructure) ensures that the thesis makes a new contribution to the international literature.

7.2 Conclusion and Policy Implications

What general conclusions can be drawn from this? The picture that emerges is that in the face of a global shock individual LMA tend to follow the national trend. However, the strength and speed of recovery from a shock varies markedly between LMAs with some rapidly adjusting while others respond slowly, enduring the consequences of adverse shocks for, perhaps, decades while only weakly recovering during upturns in the national economy This is suggested by both the analysis in Chapter 3 as well as the evidence for hysteresis in Chapter 5.

Mobility plays a key role in the adjustment process with factors that are associated with low mobility, such as homeownership or poor labour market attributes, contributing to worse labour market outcomes (Chapter 4) in the LMA where they are prevalent.

The effects of adverse shocks persist with LMA that have had poorly performing labour markets in the past experiencing higher levels of benefit uptake and lower levels of labour force participation into the future, particularly where those LMA have larger proportions of their labour force in older age groups or vulnerable categories such as solo parents (Chapter 5).

The processes that drive regional growth are self-reinforcing with some clusters of LMA experiencing a virtuous circle of high growth in incomes, population and infrastructural spending (Chapter 6) – one side of the dichotomisation noted in Chapter 3 – while others fall on the less fortunate side of that dichotomy, languishing with stagnant or falling population, incomes and infrastructural investment. This is certainly not a problem unique to New Zealand, see for example for Europe, Davoudi, Wishardt, & Strange (2010).

While this thesis has largely eschewed discussion of policy the question arises at this point, given the foregoing conclusions, what could or should be done to improve the functioning of local labour markets in New Zealand?

In the first instance, the function of local labour markets is to efficiently match the demand for, and supply of, labour at the local spatial scale (Chapter 1). However, it is clear that from the broader welfare perspective labour markets have a greater role to play than just the efficient matching of supply and demand. Work forms the basis of economic and social welfare for both individuals, communities and society as a whole. Hence if we are concerned with equity and equality in the distribution of incomes, resources and opportunity, aspirations and wellbeing (and Wilkinson and Pickett (2009) amongst others point to why we should be), then labour markets must not only efficiently match the demand and supply of labour but must also do so in a manner that minimises inequality and maximises inclusion.

As it stands now the agglomerative force alluded to in Chapter 2.2 have, certainly over the past 25 years, driven economic activity to concentrate in the metropolitan regions, and their satellite cities (particularly the Auckland conurbanisation). This has lead to the increased dichotomisation of the spatial structure of economic activity in New Zealand with an attendant increase in the patterns of spatial inequality discernable in Chapters 3 – 6. A similar development in for example Australia and Europe are being addressed with cohesion policies (e.g. Bachtler, Mendez, & Wishlade, 2010) but New Zealand does not have a history of active devolution of regional policy and cohesion policies.

Policies that might seek to address spatial inequality through fostering mobility without regard for the labour market characteristics of individuals would seem to risk accelerating the movement of those with strong labour market attributes from peripheral LMA thereby worsening spatial inequality. On the other hand policies aimed at inducing industries to set up in peripheral regions would seem to fly in the face of the economic logic inherent in the NEG (Chapter 2.2) and thus be unlikely to be sustainable in the long term. The problem here is to identify policies that promote the adjustment of the supply of labour, in terms of both numbers and skills, in peripheral LMA to a level commensurate with the sustainable level of economic activity while meeting the objectives of equality and inclusion. When designing such policy it is worth recalling the results of Nijkamp and Poot's (2004) meta analysis of the impact of fiscal policies on long-run growth, that education and infrastructural investment are the most effective forms of fiscal policy for long-run growth.

As noted above, mobility is key to the adjustment process but as seen in Chapters 4 and 5 the least mobile are those with poor labour market attributes. A possible answer then may lie in policy aimed at ensuring that individuals in peripheral LMA with poor labour market attributes have access to such skills, training, experience and education as to make them competitive in the labour markets of the dynamic core LMA, thereby increasing the benefits of relocation and inducing mobility. Such a strategy would be less likely to succeed with older individuals, as they have less to gain by relocation, or persons who were immobile for cultural or family reasons. To ensure the inclusion of such individuals, in the interests of social solidarity and equity, in the labour market the above approach could be supplemented by public sector employment, perhaps along the lines suggested by Mitchell (2007).

7.3 Future directions

The empirical analyses that make up this thesis may all be extended in various ways.

While the shift-share techniques used in Chapter 3 provide a useful description of regional employment change by embedding the employment change in a spatial panel econometric model, the factors influencing the competitive effect ought to be identified. This would be an extension of the ANOVA approached pioneered for New Zealand by Patterson (1989). The feasibility of this will depend on the availability of data that relate to regional economic output and capital stock (such as new investment in non-residential buildings, infrastructure, equipment, etc.). Data on regional capital, output and productivity are to date sadly lacking in New Zealand. The usefulness of the shift-share technique (particularly in its multifactor generalisation) for forecasting regional employment change, as shown by Mulligan and Molin (2004), can also be investigated.

Of particular interest is the extent to which a large competitive/shift effect is indicative of agglomeration advantages, such as those resulting from specialization, diversity, competition, localization or urbanization. In this context, the importance of industrial clusters and their impact on innovation systems also warrants future attention.

In addition, the analysis in Chapter 3 suggests that any regression analysis explaining regional shifts should be modified to account for spatial autocorrelation.

Further, the spatial analysis undertaken in Chapter 3 ignores the temporal dimension, by averaging the industry mix and competitive effects shift-share components. A spatio-temporal analysis would allow a more informative exploration of the change in spatial structure of the industry mix and competitive effects over time. A starting point for this might be to adopt a multivariate LISA approach using the industry mix or competitive effect shift-share components and its temporal lag, as suggested by Anselin (2005, pp. 155-164) or the STARS (Space–Time Analysis of Regional Systems) proposed by Rey and Janikas (2006). A more advanced extension would be the development of a formal spatial panel model or the use of a spatial seemingly unrelated regression framework as in Le Gallo and Kamarianakis (2011).

With respect to the investigation of the relationship between homeownership and unemployment in Chapter 4, the fact that geographical mobility of homeowners is more costly than that of renters, ceteris paribus, is not generally disputed. This in itself is not what matters; rather what matters is the extent to which the costs entailed in moving affect job search behaviour. Little is known on this in New Zealand, but future research should investigate this by considering both longitudinal micro data as well as direct evidence by introducing appropriate questions in Computer-Aided Telephone Interviews of a random sample of workers in one or more LMAs.

In addition it would be helpful to disaggregate tenure type so that distinctions maybe made between those who own homes freehold and those who are mortgaged and, using micro data, explore the interaction between skill levels, migration propensity, homeownership and unemployment.

For Chapter 5 three future directions are currently contemplated. The first of these concerns the data used, which is at a high level of aggregation. It would obviously be desirable to obtain data at an individual level from an administrative source, the household labour force survey (HLFS) or even the linked employee employer data (LEED) that might allow the individual movement of persons between benefits, between the social security system and various labour market states and between these labour market states themselves. This of course would be ideal; however it is unlikely that any one of the available sources would serve such a purpose[1]. A less demanding approach, in terms of data requirements, would be to replicate this analysis at a finer level of spatial aggregation using the broader set of LMA derived by Newell (2010).[2]

Secondly the spatial SUR estimator here employs a lag specification for each of the models in the spatial SUR. A number of alternatives existed to this specification, most obviously a spatial error, general spatial (incorporating both spatial lag and spatial error) and the Spatial Durbin model (in which spatial lags on the independent variables are included as explanatory variables in the estimation)[3]. An obvious innovation here would be to identify the most appropriate model specification for each equation in the SUR, using diagnostic tools such as the LM tests proposed by Anselin (1988b), and then run the SUR on the resulting system of equations. A more direct approach, heeding LeSage and Paces observation concerning the robustness of the Spatial Durbin specification (LeSage & Pace, 2009, pp. 157-158) to misspecification of underlying data generating processes, would be to re-specify the SUR in terms of the Spatial Durbin model.

Finally, even in the spatial SUR estimator the interaction between benefit types, and the unemployment and participation rates is not well captured. Given the nature of this problem it may well be amenable to a spatial structural equation approach such as that proposed by Liu et al (2005), Oud and Folmer (2008) or, more in keeping with the topic of chapter 5, Oud et al. (forthcoming).

---

1 The three sources mention here all have limitations aside from availability, for instance the administrative data held by WINZ would contain little information on individuals outside the social security system and even if available would only be so for the period since around 2000 at best. The HLFS would be a rich source of data but only follows individuals for 8 quarters, has some basic limitations for longitudinal studies and lacks geo-referencing at all but a gross scale (regions) while LEED is available only under stringent accessibility conditions in the Wellington Data Lab and lacks almost any information on individual level attributes.

2 Newell has recalculated the more extensive set of LMAs on the basis of 2006 census data. This will not only provide a contemporary spatial frame for analysis of the type in this thesis but will permit an analysis of the determinants of changes in the extent of local labour markets as comparable boundaries for 3 census periods (1991, 2001, 2006) will have been created.

3 See LeSage and Pace (2009) for a discussion of these alternatives.

Lastly, in Chapter 6 a primary difficulty confronting the study was the quality of, and time period covered, by the data available. The former of these, the quality of the data, is unlikely to change with the result that studies of the type undertaken here will be constrained to use a highly aggregated measure of local infrastructural investment that precludes the investigation of the impact of investment in different types of infrastructure. The latter limitation, the length of the time series available for analysis, will inevitably be resolved with the passage of time. In particular the advent of the 2013 census will allow the replication of this study with an additional time period.

In terms of the estimator used an obvious area for further investigation would be the identification of alternative instrumenting strategies. In addition a more comprehensive examination of the specification of the data generating process that underlies the spatial relationship modelled here is required, rather than the a priori assumption of a spatial lag model.

Lastly, in this thesis the nature of the spatial interaction between LMA has been modelled in a fairly abstract fashion. Identifying the specific nature of the interaction between LMA through the use of micro data would allow a clearer identification of the mechanisms driving the dichotomisation of the spatial structure of economic activity in New Zealand and the attendant growth in spatial inequality.

From the above, it is clear that there is much scope and promise, albeit partially dependent on the concurrent improvements in the availability of sub-national data, for further research that can enhance our understanding of the working of local labour markets and the implications for efficiency and equity. By investigating four interrelated issues of local labour market research that had not hitherto been addressed in New Zealand by spatial econometric tools, this thesis has provided the foundation stones for future inquiry.

References

Abdi, H. (2007). The Bonferroni and Sidak Corrections for Multiple Comparisons. In N. Salkind (Ed.), *Encyclopedia of Measurement and Statistics*. Thousand Oaks, CA: Sage.

Acemoglu, D. (2002). Technical Change, Inequality, and the Labor Market. *Journal of Economic Literature, 40*(1), 7-72.

Aghion, P., & Howitt, P. (2009). *The Economics of Growth*. Cambridge MA: MIT Press.

Akerlof, G. (1997). Social distance and social decisions. *Econometrica, 65*(5), 1005-1027.

Aldstadt, J., & Getis, A. (2006). Using AMOEBA to Create a Spatial Weights Matrix and Identify Spatial Clusters. *Geographical Analysis, 38*(4), 327-343.

Anselin, L. (1988a). *Spatial econometrics: methods and models*. Dordrecht: Kluwer Academic Publishers.

Anselin, L. (1988b). Lagrange Multiplier Test Diagnostics for Spatial Dependence and Spatial Heterogeneity. *Geographical Analysis, 20*(1), 1-17.

Anselin, L. (1995). Local Indicators of Spatial Association-LISA. *Geographical Analysis, 27*(2), 93-115.

Anselin, L. (1996). The Moran Scatterplot as an ESDA Tool to Assess Local Instability in Spatial Association. In M. Fischer, H. Scholten & D. Unwin (Eds.), *Spatial analytical perspectives on GIS* (pp. 111-125). London: Taylor and Francis. .

Anselin, L. (1999). Spatial Econometrics Retrieved from http://www.csiss.org/learning_resources/content/papers/baltchap.pdf

Anselin, L. (2001). Rao's score test in spatial econometrics. *Journal of Statistical Planning and Inference, 97*(1), 113-139.

Anselin, L. (2003). Spatial Externalities, Spatial Multipliers and Spatial Econometrics. *International Regional Science Review, 26*(2), 153-166.

Anselin, L. (2005). *Exploring Spatial Data with Geoda: A Workbook Spatial Analysis Laboratory*. Urbana-Champaign.: Center for Spatially Integrated Social Science, Department of Geography, University of Illinois

Anselin, L. (2010). Thirty years of spatial econometrics. *Papers in Regional Science, 89*(1), 3-25.

Anselin, L., Cohen, J., Cook, D., Gorr, W., & Tita, G. (2000). Spatial Analyses of Crime. *Measurement and Analysis of Crime and Justice, 4*, 213-262.

Anselin, L., LeGallo, J., & Jayet, H. (2008). Spatial Panel Econometrics. In L. Matyas & P. Sevestre (Eds.), *The Econometrics of Panel Data, Fundamentals and Recent Developments in Theory and Practice* (3rd ed., pp. 625-660). Berlin and New York: Springer.

Anselin, L., Syabri, I., & Kho, Y. (2004). *Geoda: An Introduction to Spatial Data Analysis*. Urbana: Spatial Analysis Laboratory, Department of Agricultural and Consumer Economics, University of Illinois.

Antecol, H., & Bedard, K. (2007). Does single parenthood increase the probability of teenage promiscuity, substance use, and crime? *Journal of Population Economics, 20*(1), 55-71.

Arbia, G., Basile, R., & Piras, G. (2005). *Using Spatial Panel Data in Modelling Regional Growth and Convergence*. Rome: Istituto di Studi e Analisi Economica - Institute for Studies and Economic Analyses (ISAE).

Aschauer, D. (1989). Is Public Expenditure Productive? *Journal of Monetary Economics, 23*(2), 177-200.

Audretsch, D., & Feldman, M. (1996). Innovative Clusters and the Industry Lifecycle. *The Review of Industrial Organization, 11*(2), 253-273.

Autor, D., Katz, L., & Kearney, M. (2006). The Polarization of the US Labor Market. . *American Economic Review, 96*(2), 189-194.

Autor, D., Levy, F., & Murnane, R. (2002). Upstairs, Downstairs: Computers and Skills on Two Floors of a Large Bank. *Industrial Labor Relations Review, 55*(2), 432-447.

Bachtler, J., Mendez, C., & Wishlade, F. (2010). Challenges, Consultations and Concepts: Preparing for the Cohesion Policy Debate. Glasgow: European Policy Research Centre, University of Strathclyde.

Baddeley, M., Martin, R., & Tyler, P. (1998). Transitory shock or structural shift? The impact of the early 1980s recession on British regional unemployment. *Applied Economics Letters, 30*(1), 19-30.

Baker, D., Glyn, A., Howell, D., & Schmitt, J. (2004). Unemployment and Labor Market Institutions: The Failure of the Empirical Case for Deregulation. New York: Bernard Schwartz Center for Economic Policy Analysis.

Baltagi, B. H., Bresson, G., & Pirotte, A. (2003). Fixed effects, random effects or Hausman-Taylor? A pretest estimator. *Economics Letters, 79*(3), 361-369.

Baltagi, B. H., & Hani, B. (2005). *Econometric analysis of panel data* (3rd ed.). New York: Wiley.

Barro, R. J., & Sala-i-Martin, X. (1992). Convergence. *Journal of Political Economy, 100*(2), 223-251.

Bartels, C. P. A., & Ketellapper, R. H. (1979). *Exploratory and explanatory statistical analysis of spatial data*. Berlin and New York: Springer.

Bartik, T. (2002). Spillover Effects of Welfare Reforms in State Labor Markets. *Journal of Regional Science, 42*(4), 667-701.

Bartik, T. J. (1991). *Who benefits from state and local economic development policies?* Kalamazoo, Michigan: W.E. Upjohn Institute for Employment Research.

Basile, R., Girardi, A., & Mantuano, M. (2010). *Interregional migration and unemployment dynamics: evidence from Italian provinces*. Rome: Istituto di Studi e Analisi Economica - Institute for Studies and Economic Analyses (ISAE).

Battu, H., Ma, A., & Phimister, E. (2006). *Family migration and labour market outcomes: a panel investigation*. Amsterdam: Tinbergen Institute.

Baum, C. F. (2006). *An Introduction to Modern Econometrics Using Stata*. College Station, Texas: Stata Press.

Bavaud, F. (1998). Models for Spatial Weights: A Systematic Look. *Geographical Analysis, 30*(2), 153-171.

Baxendine, S., Cochrane, W., & Poot, J. (2005). Description and Spatial Analysis of Employment Change in New Zealand Regions 1986-2001. Hamilton: Population Studies Centre , University of Waikato.

Beatty, C., Fothergill, S., & MacMillan, R. (2000). A Theory of Employment, Unemployment and Sickness. . *Regional Studies, 34*(7), 617-630.

Beatty, C., Fothergill, S., & Powell, R. (2007). Twenty years on: has the economy of the UK coalfields recovered? . *Environment and Planning A, 39*(7), 1654-1675.

Beck, N., Gleditsch, K. S., & Beardsley, K. (2006). Space is more than geography: Using spatial econometrics in the study of political economy. *International Studies Quarterly, 50*(1), 27-44.

Benabou, R. (1993). Workings of a City: Location, Education, and Production. *Quarterly Journal of Economics, 108*(3), 619-652.

Benati, L. (2001). Some Empirical Evidence on the 'Discouraged Worker' Effect. *Economics Letters, 70*(3), 387–395.

Bennett, R. (1979). *Spatial time series*. London: Pion.

Berggren, C. (1992). *Alternatives to Lean Production: Work Organization in the Swedish Auto Industry*. thaca, N.Y: ILR Press.

Berzeg, K. (1984). A Note on Statistical Approaches to Shift-Share Analysis. *Journal of Regional Science, 24*(2), 277-285.

Biehl, D. (1986). The Contribution of Infrastructure to Regional Development. Final Report of the Infrastructure Studies Group to the Commission of the European Communities. Luxembourg: Luxembourg: Office for Official Publications of the European Communities.

Bishop, K. C., & Simpson, C. E. (1972). Components of Change Analysis: Problems of Alternative Approaches to Industrial Structure. *Regional Studies, 6*(1), 59-68.

Black, D., Daniel, K., & Sanders, S. (2002). The Impact of Economic Conditions on Participation in Disability Programs: Evidence from the Coal Boom and Bust. *American Economic Review, 92*(1), 27-50.

Boden, J., Fergusson, D., & Horwood, L. (2007). Early motherhood and subsequent life outcomes. *Journal of Child Psychology and Psychiatry, 49*(2), 151-160.

Bom, P., & Ligthart, J. (2009). What Have We Learned From the Three Decades of Research on the Productivity of Public Capital? Tilburg: Tilburg University

Boyle, P., Halfacree, K., & Robinson, V. (1998). *Exploring Contemporary Migration* Harlow: Longman.

Brash, D. (2009). Answering the $64,000 question: Closing the income gap with Australia. Wellington: 2025 - 2025 Taskforce.

Brash, D. (2010). Focusing on Growth: Closing the income gap with Australia by 2025. Wellington: 2025 Taskforce.

Brocklehurst, G. (1966). Social Security. *Te Ara - the Encyclopedia of New Zealand*, from http://www.TeAra.govt.nz/en/1966/social-security/1

Brunet, C., & Havet, N. (2009). Propriété immobilière et déqualification dans l'emploi. *Revue Française d'Economie, 24*(1), 121-155.

Butcher, G. V. (1985). *Regional Income, Output and Employment Multipliers: Their Uses and Estimates of Them: MAF Cost Benefit Handbook 4*. Wellington: Ministry of Agriculture and Fisheries.

Capello, R., & Nijkamp, P. (2009). *Handbook of regional growth and development theories*. Cheltenham & Northampton: Edward Elgar.

Casado-Diaz, J. M. (2000). Local Labour Market Areas in Spain. *Regional Studies, 34*(9), 843-856.

Casetti, E. (1972). Generating Models by the Expansion Method: Applications to Geographical Research. *Geographical Analysis, 4*(1), 81-91.

Chapple, S., & Rea, D. (1998). Time series analysis of disparity between Maori and non-Maori labour market outcomes in the Household Labour Force Survey. *Labour Market Bulletin, 2*(1-2), 127-144.

Chatterjee, S. (1996). Ten years on: an appraisal of New Zealand's economic restructuring 1984-1994. *International Journal of Social Economics, 23*(10/11), 23-45.

Chatterjee, S., Conway, P., Dalziel, P., Eichbaum, C., Harris, P., Philpott, B., & Shaw, R. (1999). *The New Politics: A third way for New Zealand*. Palmerston North: Dunmore Press.

Choy, W. K., Maré, D. C., & Mawson, P. (2002). Modelling Regional Labour Market Adjustment in New Zealand. Wellington: New Zealand Treasury.

Cliff, A. D., & Ord, J. K. (1981). *Spatial processes: models and applications*. London: Pion.

Cochrane, W., Grimes, A., McCann, P., & Poot, J. (2010). The Spatial Impact of Local Infrastructural Investment in New Zealand. Wellington: Motu Economic and Public Policy Research.

Cochrane, W., McNeill, K., & Roskruge, M. (2010). *Boom to Bust: An Exploratory Spatial Analysis of Patterns of Social Security Benefit Uptake 2006-2010*. Paper presented at the Fourteenth Labour Employment and Work Conference, Wellington.

Cochrane, W., & Poot, J. (2006). Homeownership and the New Zealand Labour Market. In P. Morrison (Ed.), *The Proceedings of the 12th Labour, Employment and Work in New Zealand Conference (2006)* (pp. 416-426). Wellington: Victoria University.

Cochrane, W., & Poot, J. (2008). Forces of Change: A Dynamic Shift-Share and Spatial Analysis of Employment Change in New Zealand Labour Market Areas. *Studies in Regional Science, 38*(1), 51-78.

Conley, T. G., & Topa, G. (2002). Socio-economic distance and spatial patterns in unemployment. *Journal of Applied Econometrics, 17*(4), 303-327.

Conley, T. G., & Topa, G. (2003). *Dynamic Properties of Local Interaction Models*. Paper presented at the Spatial and Social Interactions in Economics - Specialists Meeting, Upham Hotel, Santa Barbara, CA.

Coombes, M. G. (1996). *Defining boundaries from synthetic data*. Paper presented at the First International Conference on GeoComputation, University of Leeds.

Coombes, M. G., Green, A., & Openshaw, S. (1986). An efficient algorithm to generate official statistical reporting areas: the case of the 1984 travel to work areas revision in Britain. *Journal of the Operational Research Society, 37*(10), 943-953.

Coulson, N. E., & Fisher, L. M. (2009). Housing tenure and labor market impacts: The search goes on. *Journal of Urban Economics, 65*(3), 252-264.

Davoudi, S., Wishardt, M., & Strange, I. (2010). The ageing of Europe: Demographic scenarios of Europe's futures. *Futures, 42*(8), 794-803.

Deno, K. T. (1988). The Effect of Public Capital on U.S. Manufacturing Activity: 1970 to 1978. *Southern Economic Journal 55*(1), 400-411.

Department of Labour (2007). *Mäori Labour Market Outcomes*. Wellington: Department of Labour.

Department of Labour. (2009). *New Faces, New Futures: New Zealand - findings from the Longitudinal Immigration Survey: New Zealand (LisNZ) - wave one*. Wellington: Department of Labour.

Department of Labour. (2010). *The Asian workforce: A critical part of New Zealand's current and future labour market*. Wellington: Department of Labour.

Dinc, M., Haynes, K. E., & Qiangsheng, L. (1998). A Comparative Evaluation of Shift-Share Models and Their Extensions. *Australasian Journal of Regional Studies, 4*(2), 275-302.

Dixit, A., & Stiglitz, J. (1977). Monopolistic competition and product diversity. *American Economic Review, 67*(3), 297-308.

Dohmen, T. J. (2005). Housing, mobility and unemployment. *Regional Science and Urban Economics, 35*(3), 305-325.

Dunn, E. S. (1960). A Statistical and Analytical Technique for Regional Analysis. *Papers in Regional Science, 6*(1), 97-112.

Durlauf, S. (1996a). Neighborhood Feedbacks, Endogenous Stratification and Income Inequality. In W. Barnett, G. Gandolfo & C. Hillinger (Eds.), *Proceedings of the Ninth International Symposium on Economic Theory and Econometrics.* Cambridge: Cambridge University Press.

Durlauf, S. (1996b). A Theory of Persistent Income Inequality. *Journal of Economic Growth, 1*(1), 75-93.

Elhorst, J. P. (2003). Specification and Estimation of Spatial Panel Data Models. *International Regional Science Review, 26*(3), 244-268.

Elhorst, J. P. (2010). Spatial panel data models. In M. Fischer & A. Getis (Eds.), *Handbook of applied spatial analysis* (pp. 377-407). Berlin and New York: Springer.

Ellison, G., & Glaeser, E. (1997). Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach. *Journal of Political Economy, 105*(5), 889-927.

Epifani, P., & Gancia, G. A. (2005). Trade, Migration and Regional Unemployment. *Regional Science and Urban Economics, 35*(6), 625-644.

Errington, C., Cotterell, G., von Randow, M., & Milligan, S. (2008). *A Guide to using data from the New Zealand Census: 1981-2006*. Wellington: Statistics New Zealand and The University of Auckland.

Esteban-Marquillas, J. M. (1972). A Reinterpretation of Shift-Share Analysis. *Regional and Urban Economics, 2*(3), 249-255.

Evans, L., Grimes, A., Wilkinson, B., & Teece, D. (1996). Economic Reform in New Zealand 1984-95: The Pursuit of Efficiency. *Journal of Economic Literature, 34*(4), 1856-1902.

Farber, A., Gallie, D., & Green, F. (2002). Work Skills in Britain, 1986-2001. London: Department for Education and Skills.

Fernandez, R., & Rogerson, R. (1997). Keeping People Out: Income Distribution, Zoning, and the Quality of Public Education. *International Economic Review,, 38*(1), 23-42.

Fingleton, B. (2001). Theoretical economic geography and spatial econometrics: dynamic perspectives. *Journal of Economic Geography, 1*(2), 201-225.

Fingleton, B., & Fischer, M. M. (2010). Neoclassical theory versus new economic geography: Competing explanations of cross-regional variation in economic development. *The Annals of Regional Science, 44*(3), 467-491.

Fischer, M. M., & Nijkamp, P. (Eds.). (1987). *Regional labour markets: analytical contributions and cross-national comparisons*. Amsterdam: North- Holland Publishing Company.

Flatau, P., Forbes, M., Hendershott, P., O'Dwyer, L., & Wood, G. (2002). *Homeownership and unemployment: does the Oswald Thesis hold for Australian regions.* Paper presented at the Path to full employment, 4th Path to Full Employment Conference, Newcastle, NSW.

Flatau, P., Forbes, M., Hendershott, P., & Wood, G. (2003). Homeownership and Unemployment: The Roles of Leverage and Public Housing. Cambridge, Massachusetts: National Bureau of Economic Research (NBER).

Florax, R., & Rey, S. (1995). The impact of misspecified spatial structure in linear regression models. In L. Anselin & R. Florax (Eds.), *New directions in spatial econometrics*. Berlin and New York: Springer.

Florence, P. S. (1939). *Political And Economic Planning, Report On The Location Of Industry*. London: Political and Economic Planning.

Florence, P. S., Fritz, W. G., & Gilles, R. C. (1943). *Measures of Industrial Distribution. In Industrial Location and National Resources*. Washington, D.C:: U. S. National Resources Planning Board.

Fotheringham, A. S., Brunsdon, C., & Charlton, M. (2000). *Quantitative Geography: Perspectives on Spatial Data Analysis*. London: Sage.

Fujita, M. (1988). A monopolistic competition model of spatial agglomeration: a differentiated product approach. *Regional Science and Urban Economics, 18*(1), 87-124.

Fujita, M., & Mori, T. (2005). *Frontiers of the New Economic Geography*. Wakaba, Mihama-ku, Chiba, Japan: Institute of Developing Economies.

Garcia-Mila, T., & McGuire, T. J. (1992). The Contribution of Publicly Provided Inputs to States' Economies. *Regional Science and Urban Economics, 22*(2), 229-242.

Getis, A., & Aldstadt, J. (2004). Constructing the Spatial Weights Matrix Using a Local Statistic. *Geographical Analysis, 36*(2), 90-104.

Getis, A., & Ord, J. K. (1992). The Analysis of Spatial Association by Use of Distance Statistics. *Geographical Analysis, 24*(3), 189-206.

Glaeser, E. (2010). *Agglomeration Economics*. Chicago & London: University Of Chicago Press.

Glaeser, E., Sacerdote, B., & Scheinkman, J. (1996). Crime and social interactions. *Quaterly Journal of Economics, 111*(2), 507-548.

Glaeser, E., & Shapiro, J. (2002). The Benefits of the Home Mortgage Interest Deduction. Cambridge, Massachusetts: National Bureau of Economic Research (NBER).

Global Property Guide. (2009, Apr 28, 2009). Roundtrip transaction costs Retrieved 10 December 2010, from http://www.globalpropertyguide.com/faq/guide-transaction-costs

Goos, M., & Manning, A. (2007). Lousy and Lovely Jobs: The Rising Polarization of Work in Britain. *The Review of Economics and Statistics, 89*(1), 118-133.

Gorbey, S., Briggs, P., & Chapple, S. (1993). Backdating the Household Labour Force Survey :report to the Reserve Bank, the Treasury and the Department of Labour. Wellington: New Zealand Institute of Economic Research (NZIER).

Gorter, C., & Poot, J. (1999). Measuring the impact of labour market deregulation. In G. Crampton (Ed.), *Research in Labour Economics, Advances in European Research in Regional Science* (Vol. 9, pp. 63–90). London: Pion.

Goss, E., & Phillips, J. (1997). The Impact of Homeownership on the Duration of Unemployment. *Review of Regional Studies, 27*(1), 9-28.

Gould, J. (2003). Māori-Pakeha Occupational Segregation and Earnings Differentials: A Comment. *New Zealand Population Review, 29*(2), 1-10.

Goux, D., & Maurin, E. (2000). The Decline in Demand for Unskilled Labor: An Empirical Analysis Method and its Application to France. *Review of Economics and Statistics, 82*(4), 596-607.

Green, R., & Hendershott, P. (2001). Home-ownership and Unemployment in the US. *Urban Studies, 38*(9), 1509-1520

Greenwood, M. J. (1997). Internal Migration in Developed Countries. In M. R. Rosenzweig & O. Stark (Eds.), *Handbook of Population and Family Eonomics* (Vol. 1, pp. 647-720). Amsterdam: Elsevier.

Griffith, D. A. (1996). Some guidelines for specifying the geographic weights matrix contained in spatial statistical models. In S. L. Arlinghaus (Ed.), *Practical handbook of spatial statistics* (pp. 65-82). Boca Raton: CRC Press.

Grimes, A., & Liang, Y. (2010). Bridge to Somewhere: Valuing Auckland's Northern Motorway Extensions. *Journal of Transport Economics and Policy, 44*(3), 287-315.

Gruber, J. (2001). *Risky behavior among youth: an economic analysis*. Chicago: University of Chicago Press.

Gustavsson, M., & Österholm, P. (2010). Labor-Force Participation Rates and the Informational Value of Unemployment Rates: Evidence from Disaggregated US Data. Stockholm, Sweden: : National Institute of Economic Research.

Haining, R. (1990). *Spatial data analysis in the social and envirnmental sciences*. Cambridge: Cambridge University Press.

Haining, R. (2001). Spatial Autocorrelation. In N. J. Smelser & P. B. Baltes (Eds.), *International Encyclopedia of the Social & Behavioral Sciences* (pp. 14763-14768). Amsterdam: Elsevier

Hall, V., & McDermott, C. J. (2007). Regional Business Cycles in New Zealand: Do They Exist? What Might Drive Them? . *Papers in Regional Science, 86*(2), 167-191.

Haughwout, A. (2002). Public Infrastructure Investments, Productivity and Welfare in Fixed Geographic Areas. *Journal of Public Economics, 83*(3), 405-428.

Haynes, K. E., & Dinc, M. (1997). Productivity Change in Manufacturing Regions: A Multifactor/Shift-Share Approach. *Growth and Change, 28*(2), 201-221.

Heckman, J., & Masterov, D. (2007). The Productivity Argument for Investing in Young Children. *Applied Economic Perspectives and Policy, 29*(3), 446 -493.

Hirschman, A. (1958). *The Strategy of Economic Development*. New Haven: Yale University Press.

Holtz-Eakin, D. (1994). Public-Sector Capital and the Productivity Puzzle. *Review of Economics and Statistics, 76*(1), 12-21.

Hoover, E. M., & Giarratani, F. (1999). *An Introduction to Regional Economics* (3rd ed.). New York: Knopf.

Hordijk, L. (1979). Problems in estimating econometric relations in space. *Papers in Regional Science, 42*(1), 99-115.

Hornstein, A., Krusell, P., & Violante, G. L. (2005). The effects of technical change on labor market inequalities. In P. Aghion & S. Durlauf (Eds.), *Handbook of Economic Growth* (Vol. 1, pp. 1275-1370). Amsterdam: Elsevier.

Housing New Zealand. (2005). *Building the future: towards a New Zealand housing strategy*. Wellington: Housing New Zealand.

Hulten, C. R., & Schwab, R. M. (1991). Public Capital Formation and the Growth of Regional Manufacturing Industries. *National Tax Journal, 44*(4), 121-134.

Hyslop, D., & Maré, D. (2009). Skill Upgrading in New Zealand, 1986-2001. *Australian Economic Review, 42*(4), 422-434.

Isebaert, D., Heylen, F., & Smolders, C. (2010). *Houses and/or Jobs: Ownership and the Labour Market in Belgian Arrondissements*. Paper presented at the CESifo Economic Studies Conference on Housing Taxation and Regulation, Munich. http://www.cesifo-group.de/link/htr10_Isebaert.pdf

Juhn, C., Murphy, K., & Topel, R. (1991). Why Has the Natural Rate of Unemployment Increased over Time? *Brookings Papers on Economic Activity 22*(2), 75-126. .

Juhn, C., Murphy, K., & Topel, R. (2002). Current Unemployment, Historically Contemplated. *Brookings Papers on Economic Activity, 33*(1), 79-116. .

Kaldor, N. (1957). Economic growth and Verdoorn's Law: a comment on Mr Rowthorn's article. *Economic Journal, 85*(340), 891-896.

Karagedikli, O., Maré, D., & Poot, J. (2000). Disparities and despair: Changes in regional income distributions in New Zealand 1981-1996. *Australasian Journal of Regional Studies, 6*(3), 323-347.

Karagedikli, O., Maré, D., & Poot, J. (2003). Changes in New Zealand Regional Income Distributions 1981-1996. In E. T. Gomez & R. Stephens (Eds.), *The State, Economic Development and Ethnic Co-existence in Malaysia and New Zealand* (pp. 221-244). Kuala Lumpur: Center for Economic Development and Ethnic Relations, University of Malaya.

Keil, S. R. (1992). On The Value of Homotheticity in the Shift-Share Framework. *Growth and Change, 23*(4), 469-493.

Kelejian, H. H., & Prucha, I. R. (1999). A Generalized Moments Estimator for the Autoregressive Parameter in a Spatial Model. *International Economic Review,, 40*(2), 509-533.

Kelejian, H. H., & Prucha, I. R. (2004). Estimation of Simultaneous Systems of Spatially Interrelated Cross Sectional Equations. *Journal of Econometrics, 118*(1-2), 27-50.

Kelejian, H. H., & Robinson, D. P. (1997). Infrastructure Productivity Estimation and its Underlying Econometric Specifications: a Sensitivity Analysis. *Papers in Regional Science, 76*(1), 115-131.

Kelsey, J. (1996). *Economic fundamentalism: The New Zealand Experiment - A World Model for Structural Adjustment?* London: Pluto Press.

Kelsey, J. (1999). New Zealand "experiment" a colossal failure Retrieved November 17, 2010, from http://www.converge.org.nz/pma/apfail.htm

Knudsen, D. C. (2000). Shift-Share Analysis: Further Examination of Models for the Description of Economic Change. *Socio-Economic Planning Sciences, 34*(3), 177-198.

Koch, W. (2008). Development accounting with spatial effects. *Spatial Economic Analysis, 3*(3), 321-342.

Kohno, H., Nijkamp, P., & Poot, J. (2000). *Regional cohesion and competition in the age of globalization*. Cheltenham & Northampton: Edward Elgar.

Kraft, K. (2001). Unemployment and the Separation of Married Couples. *Kyklos, 54*(1), 67-88.

Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy, 99*(3), 483-499.

Krugman, P. (1993). First nature, second nature, and metropolitan location. *Journal of Regional Science, 33(2)*(129–144).

Krugman, P. (1998). What's new about the new economic geography? *Oxford Review of Economic Policy,* 14(2), 7-17.

Krugman, P. (2011). The New Economic Geography, Now Middle-aged. *Regional Studies*, 45(1), 1-7.

Kuhn, M., & Ochsen, C. (2009). *Labour Markets and Demographic Change*. Wiesbaden: VS Verlag.

Lall, S. V. (2007). Infrastructure and regional growth, growth dynamics and policy relevance for India. *The Annals of Regional Science,* 41(3), 581-599.

Layard, R., & Nickell, S. (1999). Labor Market Institutions and Economic Performance. In O. C. Ashenfelter & D. Card (Eds.), *Handbook of Labor Economics* (Vol. 3, pp. 3029-3086). Amsterdam: Elsevier

Le Gallo, J., & Kamarianakis, Y. (2011). The Evolution of Regional Productivity Disparities in the European Union from 1975 to 2002: A Combination of Shift-Share and Spatial Econometrics. *Regional Studies, 45*(1), 123-139.

Lee, J. (2000). The Robustness of Okun's Law: Evidence from OECD Countries. *Journal of Macroeconomics, 22*(2), 331-356.

Leenders, R. (2002). Modelling Social Influence through Network Autocorrelation. *Social Networks, 24*(1), 21-47.

LeSage, J. P. (1999). *The Theory and Practice of Spatial Econometrics*. Toledo: Department of Economics, University of Toledo.

LeSage, J. P., & Pace, R. K. (2009). *Introduction to spatial econometrics*. Boca Raton: Chapman & Hall/CRC. .

Liu, X., Wall, M. M., & Hodges, J. S. (2005). Generalized spatial structural equation models. *Biostat, 6*(4), 539-557.

Longhi, S., Nijkamp, P., & Poot, J. (2006). Spatial Heterogeneity and the Wage Curve Revisited. *Journal of Regional Science, 46*(4), 707-731.

Longhi, S., Nijkamp, P., & Poot, J. (2010). Joint impacts of immigration on wages and employment: review and meta-analysis. *Journal of Geographical Systems, 12*(4), 1-33.

Loveridge, S., & Selting, A. C. (1998). A Review and Comparison of Shift-Share Identities. *International Regional Science Review, 21*(1), 37-58.

Machin, S. (2001). The changing nature of labour demand in the new economy and skill-biased technology change. *Oxford Bulletin of Economics and Statistics, 63*(s1), 753-776.

Maré, D., & Timmins, J. (2004). Internal Migration and Regional Labour Markets in New Zealand. Wellington: Motu Economic and Public Policy Research.

Marglin, S. A., & Schor, J. B. (1990). *The golden age of capitalism: reinterpreting the postwar experience*. New York: Oxford University Press, USA.

Martin, R. (1999). The new "geographical turn" in economics: some critical reflections. *Cambridge Journal of Economics*, 23(1), 65 -91.

Martin, R. (2011). The "New Economic Geography": Credible Models of the Economic Landscape? In A. Leyshon, R. Lee, & L. McDowell (Eds.), *The SAGE handbook of economic geography* (pp. 53-70). SAGE Publications Ltd.

Martin, R., & Sunley, P. (2011). The new economic geography and policy relevance. *Journal of Economic Geography*, 11(2), 357 -369.

Mauro, P., & Spilimbergo, A. (1998). How Do the Skilled and the Unskilled Respond to Regional Shocks?: The Case of Spain. Washington: International Monetary Fund (IMF).

McCann, P. (2008). Globalization and economic geography: The world is curved, not flat. *Cambridge Journal of Regions, Economy and Society, 1*(3), 351-370.

McCann, P. (2009). Economic geography, globalisation and New Zealand's productivity paradox. *New Zealand Economic Papers, 43*(3), 279–314.

McLanahan, S., & Percheski, C. (2008). Family Structure and the Reproduction of Inequalities. *Annual Review of Sociology, 34*(1), 257-276.

McCormick, B. (1997). Regional unemployment and labour mobility in the UK. *European Economic Review, 41*(3-5), 581-589.

McKinlay, P. (1998). *Local Government Reform*. Wellington: Local Government New Zealand.

McLuskey, W., Aitken, A., Grimes, A., Kerr , S., & Timmins, J. (2006). Rating Systems in New Zealand: An Empirical Investigation into Local Choice. *Journal of Real Estate Literature, 14*(3), 381-397.

McVicar, D. (2006). Why do disability benefit rolls vary between regions? A review of the evidence from the USA and the UK. *Regional Studies, 40*(5), 519-533.

Mincer, J. (1978). Family migration decisions. *Journal of Political Economy, 86*(5), 749-773.

Ministry of Social Development. (2006). National Benefit Factsheets - Domestic Purposes Benefit Retrieved 10 December, 2010, from http://www.msd.govt.nz/about-msd-and-our-work/publications-resources/statistics/benefit/2006-benefit-factsheets.html

Ministry of Social Development. (2009). The Statistical Report for the year ending June 2009. Wellington: Ministry of Social Development (MSD).

Mitchell, W. (2007). Why public sector job creation should be fashionable. Newcastle, NSW: Centre of Full Employment and Equity, The University of Newcastle.

Mitchell, W., & Watts, M. (2010). Identifying functional regions in Australia using hierarchical aggregation techniques. *Geographical Research, 48*(1), 24-41.

Molho, I. (1986). Theories of Migration: A Review. *Scottish Journal of Political Economy, 33*(4), 396-419.

Mont, D. (1989). Two earner family migration A search theoretic approach. *Journal of Population Economics, 2*(1), 55-72.

Morrison, P. (2008). *On the Falling Rate of Homeownership in New Zealand*. Wellington: Centre for Housing Research Aotearoa New Zealand.

Mulligan, G. F., & Molin, A. (2004). Estimating Population Change with a Two-Category Shift-Share Model. *The Annals of Regional Science, 38*(1), 113-130.

Munch, J., Rosholm, M., & Svarer, M. (2006). Are Homeowners Really More Unemployed? *The Economic Journal, 116*(514), 991-1013.

Munch, J., Rosholm, M., & Svarer, M. (2008). Homeownership, job duration, and wages. *Journal of Urban Economics, 63*(1), 130-145.

Munro, J. M., & Schachter, G. (2000). Regional Industrial Specialization and Patterns of Structural Unemployment in the European Union. In H. Kohno, P. Nijkamp & J. Poot (Eds.), *Regional Cohesion and Competition in the Age of*

Globalization (pp. 241-261). Cheltenham UK and Northampton MA USA: Edward Elgar.

Myrdal, G. (1957). *Economic Theory and underdeveloped regions*. London: Duckworth.

Nazara, S., & Hewings, G. J. D. (2004). Spatial Structure and Taxonomy Of Decomposition In Shift-Share Analysis. . *Growth and Change, 35*(4), 476-490.

Nerlove, M., & Balestra, P. (1996). Formulation and Estimation of Econometric Models for Panel Data. In L. Mátyás & P. Sevestre (Eds.), *The Econometrics of Panel Data* (2nd ed.). Dordrech: Kluwer

Newell, J. (2010). 2006 NZ Labour Market Catchments and Draft Region Definitions

Newell, J., & Papps, K. L. (2001). Identifying Functional Labour Market Areas in New Zealand: A Reconnaissance Study using Travel-to-Work Data. Wellington: Department of Labour

Newell, J., & Perry, M. (2005). Explaining Continuity in New Zealand's Local Labour Market Areas 1991 to 2001. *Australasian Journal of Regional Studies, 11*(2), 155-174.

Nickell, S., & Bell, B. (1995). The Collapse in Demand for the Unskilled and Unemployment Across the Oecd. *Oxford Review of Economic Policy, 11*(1), 40-62.

Nijkamp, P., & Poot, J. (2004). Meta-Analysis of the Impact of Fiscal Policies on Long-Run Growth. *European Journal of Political Economy 20*(1), 91-124.

Nurske, R. (1953). *Problems of Capital Formation in Underdeveloped Countries*. New York: Oxford University Press.

O'Leary, N., Murphy, P. D., Latreille, P., Blackaby, D. H., & Sloane, P. J. (2005). Accounting for differences in labour market outcomes in Great Britain: A regional analysis using the Labour Force Survey. Bonn: Institute for the Study of Labor. (IZA).

O'Sullivan, D., & Unwin, D. J. (2003). *Geographic information analysis*. Hoboken, New Jersey: John Wiley.

Ohlin, B. (1933). *Interregional and international trade*. Cambridge: Havard University Press.

Oliveau, S., & Guilmoto, C. (2005). *Spatial Correlation and Demography*. Paper presented at the XXVe Congrès International de la Population, Tours. http://hal.archives-ouvertes.fr/halshs-00519260/

ONS, & Coombes, M. G. (1998). *1991- Travel to Work Areas*. London: Office for National Statistics.

Ord, J. K., & Getis, A. (1995). Local spatial autocorrelation statistics: distributional issues and an application. *Geographical analysis, 27*(4), 286–306.

Oswald, A. (1996). A conjecture on the explanation for high unemployment in the industrialised nations: Part 1 Coventry: University of Warwick.

Oswald, A. (1997a). Theory of Homes and Jobs. Coventry: University of Warwick.

Oswald, A. (1997b). Thoughts on NAIRU. *Journal of Economic Perspectives, 11*(1), 227-228.

Oswald, A. (1999). *The housing market and Europe's unemployment: a non technical paper* Coventry: University of Warwick.

Ottaviano, G. I., & Thisse, J. (2005). New economic geography: what about the N? *Environment and Planning A, 37*(10), 1707-1725.

Oud, J., Folmer, H., Patuelli, R., & Nijkamp, P. (forthcoming). A spatial-dependence continuous time model for regional unemployment change in Germany. *Geographical Analysis*.

Oud, J. H. L., & Folmer, H. (2008). A Structural Equation Approach to Models with Spatial Dependence. *Geographical Analysis, 40*(2), 152-166.

Ozgen, C., Nijkamp, P., & Poot, J. (2010). The Effect of Migration on Income Growth and Convergence: Meta-Analytic Evidence. *Papers in Regional Science, 89*(3), 537-561.

Paelinck, J., & Klaassen, L. (1979). *Spatial Econometrics*. Farnborough: Saxon House.

Papps, K. L., & Newell, J. O. (2002). Identifying Functional Labour Market Areas in New Zealand: A Reconnaissance Study Using Travel-to-Work Data. Bonn: Institute for the Study of Labour.

Partridge, M., & Rickman, D. (1997). The Dispersion of US State Unemployment Rates: The Role of Market and Non-market Equilibrium Factors. *Regional Studies, 31*(6), 593-606. .

Patterson, M. G. (1989). Regional Employment in New Zealand 1981-86: Shift-Share versus Regression Analysis. *New Zealand Geographer, 45*(1), 26-35.

Peck, J. (1996). *Workplace: The social regulation of labour markets*. New York: Guilford.

Pehkonen, J. (1999). Unemployment and home-ownership. *Applied Economics Letters, 6*(5), 263-265.

Pehkonen, J., & Tervo, H. (1998). Persistence and Turnover in Regional Unemployment Disparities. *Regional Studies, 32*(5), 445-458.

Piva, M., Santarelli, E., & Vivarelli, M. (2005). The skill bias effect of technological and organisational change: Evidence and policy implications. *Research Policy, 34*(2), 141-157.

Pool, I., Baxendine, S., Cochrane, W., & Lindop, J. (2006). New Zealand Regions, 1986-2001: Dependency and Development of Social Capital: Population Studies Centre , University of Waikato.

Pool, I., Baxendine, S., Cochrane, W., & Lindop, J. (2005a). New Zealand Regions, 1986-2001: Population Dynamics. Hamilton: Population Studies Centre, Univerity of Waikato.

Pool, I., Baxendine, S., Cochrane, W., & Lindop, J. (2005b). New Zealand Regions, 1986-2001: Population Geography. Hamilton: Population Studies Centre, Univerity of Waikato.

Pool, I., Baxendine, S., Cochrane, W., & Lindop, J. (2005c). New Zealand Regions, 1986-2001: Population Structures. Hamilton: Population Studies Centre, Univerity of Waikato.

Poot, J. (1986a). *Models of New Zealand internal migration and residential mobility.* Doctor of Philosophy, Victoria University, Wellington.

Poot, J. (1986b). A System Approach to Modelling the Inter-Urban Exchange of Workers in New Zealand. *Scottish Journal of Political Economy, 33*(3), 249-274.

Poot, J. (2005). The Quest for People: Population and Economic Development. In J. E. Rowe (Ed.), *Economic Development: The New Zealand Experience*. Aldershot UK: Ashgate.

Poot, J. (2010). Trans-Tasman migration, Transnationalism and Economic Development in Australasia. *Asian and Pacific Migration Journal, 19*(3), 319-342.

Poot, J., & Brosnan, P. (1980). The Propensity to Register as Unemployed *New Zealand Economic Papers, 14*(1), 93-107.

Rao, C. R. (1973). *Linear statistical inference and its applications* (2nd ed.). New York: Wiley.

Rauch, J. (1993). Does History Matter Only When It Matters Little? The Case of City-Industry Location. *The Quarterly Journal of Economics, 108*(3), 843-867.

Redding, S. J. (2010). The Empirics of New Economic Geography. *Journal of Regional Science, 50*(1), 297-311.

Reich, R. (1991). The Real Economy. *The Atlantic Monthly, 267*(2), 35-52.

Rey, S. J., & Janikas, M. V. (2006). STARS: Space-Time Analysis of Regional Systems. *Geographical Analysis, 38*(1), 67 - 86.

Richards, M., Hardy, R., & Wadsworth, M. (1997). The effects of divorce and separation on mental health in a national UK birth cohort. *Psychological Medicine, 27*(5), 1121-1128.

Roback, J. (1982). Wages, rents, and the quality of life. *The Journal of Political Economy, 90*(6), 1257-1278

Roskruge, M., Grimes, A., McCann, P., & Poot, J. (2010). Social capital and regional social infrastructure investment: Evidence from New Zealand. Wellington: MOTU.

Rouwendal, J., & Nijkamp, P. (2007). Homeownership and Labour Market Behaviour: Interpreting the Evidence. Amsterdam: Tinbergen Institute.

Samarasinghe, O., & Sharp, B. (2010). Flood prone risk and amenity values: a spatial hedonic analysis. *Australian Journal of Agricultural and Resource Economics, 54*(4), 457-475.

Schabenberger, O., & Gotway, C. A. (2005). *Statistical Methods for Spatial Data Analysis*. Boca Raton: CRC Press.

Sherwood-Call, C. (1990). Assessing Regional Economic Stability: A Portfolio Approach. *Economic Review of the Federal Reserve Bank of San Francisco*(Winter), 17-26.

Shimizu, K. (1995). Humanization of the work production system and work at Toyota Motor Co and Toyota Motor Kyushu. In A. Sandberg (Ed.), *Enriching Production. Perspectives on Volvo's Uddevalla plant as an alternative to lean production* (Vol. , pp. 383-404). Aldersho: Avebury.

Shuttleworth, I. (2007). Reconceptualising local labour markets in the context of cross-border and transnational labour flows: The Irish example. *Political Geography, 26*(8), 968-981.

Siegel, J. S., & Swanson, D. A. (2004). *The Methods and Materials of Demography* (2nd ed.). Amsterdam: Elsevier

Skilling, D. (2004). It's Not Just About the Money: The Benefits of Asset Ownership. Auckland: The New Zealand Institute.

Smith, T. E. (2009). Estimation bias in spatial models with strongly connected weight matrices. *Geographical Analysis, 41*(3), 307-332.

Stabler, J. C., & Olfert, M. R. (1996). Spatial labour markets and the rural labour force. *Growth and Change, 27*(2), 206-230.

Stakhovych, S., & Bijmolt, T. H. (2009). Specification of spatial models: A simulation study on weights matrices. *Papers in Regional Science, 88*(2), 389-408.

Statistics New Zealand. (2007). Housing indicators - Statistics New Zealand. Retrieved October 22, 2008, from http://search.stats.govt.nz /search?w=housing%20indicators

Statistics New Zealand. (2010). Quarterly local authority survey - Statistics New Zealand Retrieved December 18, 2010, from http://www.stats.govt.nz.ezproxy.waikato.ac.nz/surveys_and_methods/completing-a-survey/faqs-about-our-surveys/quarterly-local-authority-survey.aspx

Stephens, R. (1992). Budgeting with the benefit cuts. In J. Boston & P. Dalziel (Eds.), *The Decent Society, Essays in Response to National's Economic and Social Policies*. Oxford: Oxford University Press.

Stephens, R. (2008). The changing social security system. In N. Lunt, M. O'Brien & R. Stephens (Eds.), *New Welfare, New Zealand?* (pp. 27-40). Melbourne: Cengage Learning Australia.

Stetzer, F. (1982). Specifying weights in spatial forecasting models: The results of some experiments. *Environment and Planning A, 14*(5), 571–584.

Stillman, S., & Maré, D. C. (2008). Housing Markets and Migration: Evidence from New Zealand. Wellington: Motu Economic and Public Policy Research.

Stillman, S., Velamuri, M., & Aitken, A. (2010). The Long-Run Impact of New Zealand's Structural Reform on Local Communities. *Journal of Comparative Economics, 38*(4), 432-448.

Stimson, R. J., Stough, R., & Roberts, B. H. (2006). *Regional economic development: analysis and planning strategy* (2nd ed.). Berlin and New York: Springer.

Stock, J., & Watson, M. (2003). *Introduction to Econometrics*. Boston, MA: Addison Wesley.

Sturm, J.-E., Kuper, G. H., & De Haan, J. (1998). Modelling Government Investment and Economic Growth on a Macro Level: A Review. In S. Brakman, H. Vanes & S. K. Kuipers (Eds.), *Market Behaviour and Macroeconomic Modelling* (pp. 359-406). London: MacMillan.

Swain, L., & Garasky, S. (2007). Migration Decisions of Dual-earner Families: An Application of Multilevel Modeling. *Journal of Family and Economic Issues, 28*(1), 151-170.

Te Puni Kōkiri (Ministry of Māori Development). (2009). The Implications of a Recession for the Māori Economy Retrieved December 7, 2010, from http://www.tpk.govt.nz/en/in-print/our-publications/publications/the-implications-of-a-recession-for-the-maori-economy/page/1/

Tobler, W. R. (1970). A computer movie simulating urban growth in the Detroit region. *Economic Geography, 46*(2), 234-240.

Underwood, A. J. (1997). *Experiments in ecology: their logical design and interpretation using analysis of variance*. Cambridge: Cambridge University Press.

Vella, F., & Verbeek, M. (1999). Estimating and Interpreting Models with Endogenous Treatment Effects. *Journal of Business and Economic Statistics, 17*(4), 473-478.

Venables, A. J. (1996). Equilibrium locations of vertically linked industries. *International Economic Review,, 37*(2), 341-359.

Verbeek, M. (2004). *A Guide to Modern Econometrics.* Southern Gate, Chichester, West Sussex, England Hoboken, NJ: Wiley

Watts, M. (2002). *Local Labour Markets and Job Proximity: Conceptual and Measurement Issues*. Paper presented at the Underutilisation of Europe's Labour Resources Workshop, Maastricht.

Watts, M. (2004). Local Labour Markets in New South Wales: Fact or Fiction? Newcastle, NSW: : Centre of Full Employment and Equity,University of Newcastle.

Watts, M. (2005). Conceptualising and measuring spatial segregation: the state of play. Newcastle, NSW: Centre of Full Employment and Equity, University of Newcastle.

Wilkinson, R., & Pickett, K. (2009). *The Spirit Level: why more equal societies almost always do better* London: Allen Lane.

Wilson, M., McLeod, K., & Sathiyandra, S. (2005). Growth in Numbers of Sickness and Invalid's Benefit Recipients 1993-2002: Cohort Analysis Technical Report. Wellington: Ministry of Social Development.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge: MIT Press.

Work and Income New Zealand. (2006). *Key Facts at the end of September 2006: Domestic Purposes Benefit*. Wellington: Work and Income New Zealand.

Work and Income New Zealand. (2008). *Unemployment Benefit: For people who are out of work*. Wellington: Work and Income New Zealand.

Wu, J. J., & Gopinath, M. (2008). What Causes Spatial Variations in Economic Development in the United States? . *American Journal of Agricultural Economics, 90*(2), 392-408.

You, S., Chen, Y., Yang, T., & Huang, B. (2010). Spatial Shift-Share Method: A New Method in the Study of Regional Industrial Structures. *Information Computing and Applications, 106*(8), 507-514.

Zellner, A. (1962). An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias. *Journal of the American Statistical Association, 57*(298), 348-368.