REGIONAL GROWTH AND CONVERGENCE IN
VICTORIA

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ABSTRACT

Widespread variation in per capita income levels and the persistence of long standing income disparities are evident across Victoria. Persistent regional disparities are economically inefficient and socially inequitable. Economic change in Victoria between 1980 and 1998 is analysed to ascertain whether it has led to increased regional inequality. The regions are defined as the Australian Bureau of Statistics Statistical Divisions. Regional inequalities in income and employment are examined as important indicators of economic welfare. The factors influencing aggregate growth in the Victorian economy are identified, and incorporated into a model of regional income growth.

Standard statistical measures of dispersion show that taxable per capita income in the non-metropolitan regions is diverging from the Victorian state mean, whilst the per capita taxable income of Melbourne is increasing. The distribution of income within regions, as measured by the Gini coefficient, is becoming more equal.

Vector autoregression modelling of the aggregate Victorian economy indicates that the terms of trade and supply are the major sources of shocks to the economy. These variables are incorporated into a model of regional income growth, based on neoclassical growth theory. The average speed of convergence of the regions to their individual steady state was rapid at 22 per cent. The terms of trade, the unemployment rate, the gross value of agriculture per capita and average rainfall were found to be significant in the model.

Within the neoclassical framework of regional economic growth, persistent regional disparities can be attributed to barriers to factor mobility and/or economic shocks. The above findings are interpreted within this framework, in relation to the process of regional adjustment, population change, regional labour markets and the possible impediments to economic growth.
DECLARATION

This is to certify that

(i) the thesis comprises only my original work towards the Doctor of Philosophy degree except where indicated in the Preface,

(ii) due acknowledgement has been made in the text to all other material used,

(iii) the thesis is less than 100,000 words in length, exclusive of tables, maps, bibliographies and appendices

............................

Rowan Jane O’Hagan
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ABBREVIATIONS

ABARE  Australian Bureau of Agricultural and Resource Economics
ABS  Australian Bureau of Statistics
ATO  Australian Taxation Office
GSP  Gross State Product
LGA  Local Government Area
VAR  vector autoregression
OECD Organisation for Economic Cooperation and Development
PREFACE

Some of the work in this thesis has been published, under sole authorship, as follows:


CHAPTER 1. INTRODUCTION

‘To discuss and analyze how the economy actually works, it may be necessary to go and look.’ Hahn (1970, p 1).

1.1 Introduction

In this thesis, economic growth and income disparities in Victoria between 1980 and 1998 are investigated. The study is motivated by the need for objective analysis on the question of whether rural Victoria is in economic decline. The extent of regional disparities in income and employment are examined, as these are important indicators of economic welfare. The factors influencing aggregate growth in the Victorian economy are identified, and incorporated into a model of regional growth. The analysis is based on neoclassical growth theory, and the concepts of convergence arising from that theory. The background to the research problem is presented in this chapter. In addition, the aim of the research and the research approach are discussed and the structure of the thesis is outlined.

1.2 Background

The complex process of long-term socio-economic change is central to the present focus on regional development and economic disparities in Australia. Persistent regional inequalities pose important political, theoretical and practical problems and are
undesirable on the grounds of both economic efficiency and social equity. These disparities can arise from short-term economic shocks to the economy, or from the secular process of structural adjustment. The social consequences of economic inequality can be entrenched disadvantage, lack of social cohesion and high unemployment, with concomitant economic inefficiency due to a spatial and temporal mismatch of workers and jobs. As well, when income disparities cause social stratification, further inefficiency is introduced through increased social externalities. Whether poor economies will always be poor, and wealthier economies remain wealthy, is an important economic and social question that arises from the wide-ranging implications of persistent disparities in economic growth.

The differential impact of socio-economic change on regions is important from a political perspective. The widespread perception of an increasing economic divide in Australia prompted the Deputy Prime Minister and leader of the National Party, John Anderson (1999, p 1) to observe:

… I (am) afraid of Australia becoming two nations. The sense of alienation, of being left behind, of no longer being recognised and respected for the contribution to the nation being made, is deep and palpable in much of rural and regional Australia today.

This sense of alienation has manifested itself in a voter backlash in regional areas in Australia, directed against traditional conservative party candidates. Federal and State government policymakers have focused on ‘regional, rural and remote Australia’ as a major issue because of this electoral impact. A problem arises, however, when the exercise of democracy prompts governments to make ad hoc responses for short term electoral gain, rather than developing coherent and appropriate policy, based on an
enhanced understanding of the underlying causes, to address regional economic disparities (Pritchard and McManus, 2000).

In Victoria, economic disparities are apparent in the widespread variation in per capita income levels across Victoria and the persistence of long standing income disparities. The regional income disparities have persisted during major fluctuations in the aggregate growth of the Victorian economy. These disparities are most marked between the non-metropolitan Statistical Divisions of Victoria and the metropolitan Statistical Division of Melbourne. In this thesis, the Statistical Divisions are defined as the Victorian regions, and the term Statistical Division is used interchangeably with region for ease of exposition. Previous research into income disparities at the regional level has been constrained by the availability of data from the five-yearly Census of Population and Housing, whereas annual data allow a more detailed comparison of income disparities and identification of inter-censal changes.

Economic growth theory can provide meaningful insights into how economies change over time and also provide a framework for empirical analysis of economic growth. This framework has been used to examine the question of upward mobility for poor economies, the decline of wealthy economies and to assess the distribution of income between economies. According to the neoclassical theory of growth, the per capita income or output of countries or regions will converge over time by a process of regional adjustment. When there are no barriers to factor mobility, labour is attracted to regions where the ratio of capital to labour is high and therefore wages and incomes are higher, rather than to areas where labour is less expensive and the ratio of capital to labour is low. Conversely, capital is attracted to regions where the ratio of capital to labour is low and the returns to capital are higher.
Income changes and population movements, therefore, occur as people and capital leave, or move to, a region in search of better returns to their labour and their investments and in this way, the incomes of people in regions adjust and converge over time. Furthermore, disparities in economic indicators such as income, employment and investment imply that impediments to the efficient functioning of the economy are present, and there is a need for further adjustment (Barro and Sala-i-Martin, 1995).

1.3 Aim

Detailed in this thesis is an examination of economic changes in Victoria between 1980 and 1998, with the aim of determining if and how these changes have led to increased regional inequality. The following issues are addressed:

- What has been the pattern of economic change and regional adjustment during this period?
- Have regional incomes converged or diverged?
- What factors have influenced this pattern of economic change?
- Are the poor regions growing faster than the wealthier regions?
Chapter 1. Introduction

1.4 Research Approach

The research approach employed in this study involves five steps. The first is a descriptive analysis of key economic and demographic indicators at the Victorian state and regional level. Thus, a clear picture of Victoria and the changes that have occurred in these indicators during the process of economic change and regional adjustment are provided. The Australian Bureau of Statistics’ Statistical Divisions have been chosen as representative regions, for which there is relevant data available. The second is to elucidate current economic growth theory and the empirical methods for analysing economic growth, with an emphasis on the neoclassical theory of economic growth.

The third step is to formally measure the nature and extent of regional income disparities. The fourth is to analyse the major sources and effects of macroeconomic shocks to the Victorian economy. This provides direction as to the possible factors influencing economic change across the state at the regional level. This leads to the final step, in which this knowledge is applied at the regional level in Victoria. This involves the specification and estimation of a model of regional economic growth to investigate the variation in growth in per capita income in the Victorian regions.

No study, to date, has used this approach at the sub-state level in Australia. In addition, no investigation has used annual taxable income data at the regional level in Victoria to examine these questions.
1.5 Thesis Structure

This thesis is structured as follows. The geographic and economic context of Victoria is presented as a descriptive analysis in Chapter 2. The pattern of economic change and regional adjustment during 1980 to 1998 is discussed. The current theory and practice of analysing economic growth is presented in a review of the literature in Chapter 3. The neoclassical theory of economic growth is discussed, as well as the concepts of convergence that arise from the theory. Empirical evidence for regional growth theory is presented, along with the analytical problems that arise from empirical studies. The process of regional adjustment, regional labour markets and the possible impediments to economic growth are discussed.

An overview of the empirical methods used in this study is presented in Chapter 4. An analysis of income dispersion and income growth in Victoria is presented in Chapter 5. In Chapter 6, the construction and estimation of a vector autoregression model of shocks to the Victorian economy is described. This information is used to choose the variables that are incorporated as structural variables in a regional economic growth model described in Chapter 7. The results from estimation of the economic growth model, in relation to the results of the income analysis undertaken in Chapter 5, and the estimation of the vector autoregression model undertaken in Chapter 6, are discussed in Chapter 8. In Chapter 9, the main conclusions to the research are presented.
CHAPTER 2. THE STATE OF VICTORIA

2.1 Introduction.

The aim in this chapter is to provide a background to the State of Victoria. A clear picture of the important social and economic characteristics of Victoria places it within the wider framework of the regional growth theory described in the following literature review. It also sets the ensuing empirical analysis in an historical and geographical context. This is valuable because any empirical analysis, and the implications drawn from it, must be relevant to the economy being investigated. The definition of the major economic indicators and the data sources and derivations are also presented.

2.2. The Victorian Economy

2.2.1. Relationship to the Australian economy

The Australian and Victorian economies are small, open economies. In these types of economies, real interest rates and the terms of trade are determined exogenously. The price level and the exchange rate pertaining at the national level can also be considered exogenous to Victoria. While it can be argued that Australia has been a small open economy since European settlement, Gruen and Shuetrim (1994) suggest that there are three key economic changes that have arisen from the increasing outward orientation
of the Australian economy. They are the decrease in protection, the floating of the Australian dollar in 1983 and financial deregulation. The fall in protection has led to a strong rise in the trade share of Gross Domestic Product since the early 1980s. Consequently, the exchange rate has an increasingly important influence on both domestic inflation and production activity. Another consequence is the diversification and expansion of Australia’s export base.

This study is over the time period post-1983 during which the floating exchange rate and the rising trade share of Gross Domestic Product have contributed to monetary policy acting increasingly through the external sector. This has occurred through altering the nominal exchange rate, which influences the domestic prices of traded goods. The floating exchange rate also significantly changes the response of the economy to terms of trade shocks. The deregulation of financial markets, and the technological advances that have occurred in that sector, allow shocks to world asset markets to be translated quickly to Australia.

The impact of movements in the terms of trade is predominantly through effects on real income causing fluctuations in other macroeconomic variables. The terms of trade indexes reflect compositional changes and changes in the actual prices of exports and imports. Real income can be estimated by adjusting for terms of trade in the constant price Gross Domestic Product estimates. Supply shocks, such as those induced by drought in agriculturally based economies, also lower an economy’s real income. For Australia, and also Victoria, the real income effects of terms of trade changes can be significant. Long and Pitchford (1993) used national data to determine real income adjustments to fluctuations in the terms of trade between 1972 and 1988. They estimated
that the real income effects of terms of trade adjustments were comparable in magnitude to Australia’s Gross Domestic Product growth rates during this period.

2.3.2. Changes in the Victorian economy

Annual growth in the Gross State Product of the Victorian economy fluctuated between -2.5 and five per cent between 1981 and 1996 (ABS, 1997a). These changes are in line with the Australian national figures of Gross Domestic Product. However, Victoria went deeper into recession than the rest of the nation in the early 1990s. Victorian Gross State Product per capita and taxable income per capita ($1996 =100) for the period 1981 to 1997 are shown in Figure 2.1. The main feature of Figure 2.1 is the period of negative growth between 1990 and 1993. The Australian terms of trade index (base 1989/90 =100) is shown in Figure 2.2. The Australian terms of trade declined markedly between 1983 and 1987 and again between 1990 and 1994.

At the same time as these fluctuations in Gross State Product occurred, the structure of the Victorian economy changed. Massive economic restructuring and high levels of state debt affected Melbourne’s performance in the late 1980s and into the recession years of the early 1990s (O’Connor, Stimson and Taylor, 1998). There was a re-allocation of resources from the public to the private sector, growth in the services sector of the economy and a relative decline of the contribution of the agricultural sector to Gross State Product. Concomitantly, there were considerable employment losses in the textile, clothing and footwear industries, which were concentrated in Victoria. In 1983, Victoria’s share of national employment in this sector was 58 per cent, whilst having only
27 per cent of the national labour force (Dixon, Shepherd and Thomson, 2001). In 1997, Victoria has the highest share of employment in the manufacturing industry at 19.6 per cent, compared to the national average of 3.9 per cent (Debelle and Vickery, 1999).

In the rural areas of Victoria, structural change in the economy manifested itself in such phenomena as shifts in population from small to large regional centres, rationalisation of government services and changes in the agricultural and non-agricultural labour force (ABS, 1998).

Figure 2.1. Real Victorian Gross State Product and Victorian Taxable Income, Per Capita, ($96=100), Annual Data for the Period 1981 to 1997
2.3. The Statistical Geography of Victoria.

Victoria is situated in the south-eastern corner of the Australian mainland. It covers an area of 227,767 square kilometres (approximately three per cent of Australia) and has 1,800 kilometres of coastline. Natural resources, including coal, timber, gold and off-shore oil and gas reserves, are important to the Victorian economy, as are natural amenities for recreation such as coastal and alpine areas. The Australian Bureau of Statistics (ABS) collects the majority of the statistical data available in Victoria. Most of the agricultural statistics are derived from the Agricultural Census conducted at 31 March each year by the ABS. In 1997/98, the Agricultural Commodity Survey replaced the Agricultural Survey. In addition, the Australian Taxation Office collects taxation statistics, the Australian Bureau of Agricultural and Resource Economics (ABARE) conducts annual farm surveys to obtain financial information about farm businesses in the major farm sectors and the Bureau of Meteorology collects climate data.
The ABS spatial classification structure is specified in the Australian Standard Geographical Classification (ABS, 1996). Collection Districts are the smallest spatial units and there were 7,886 Collection Districts in Victoria in 1996. Collection Districts are defined for each census and are only current for that census. The Australian Standard Geographical Classification uses the Statistical Local Area as a building block and relates these areas to the associated Local Government Area. Local Government Areas in Victoria have undergone major changes during the period of this study. From 1993 to 1995, the amalgamation of Victorian Local Government Areas resulted in a reduction from 210 to 78.

Australian Statistical Divisions have been designed to be relatively homogeneous regions characterised by recognisable social and economic links with the unifying influence of one or more major towns or cities (ABS, 1996). The geographical boundaries of the eleven Statistical Divisions in Victoria are shown in Figure 2.3 (ABS, 1998). There was a reduction in the number of Statistical Divisions from twelve to eleven between the 1991 and the 1996 Census. The dominance of Melbourne as the metropolitan centre is predominantly explained by the fact that urbanisation in Australia developed before rural and regional settlements were established. As a result, no other major population centres developed to compete with the state capitals. Moreover, since Federation, the Commonwealth political system was such that while it prevented any one capital from becoming dominant, it reinforced the dominance of each metropolitan area within its own state (Butler and Mandeville, 1981)
A comparison of the main features of each Victorian region is shown in Table 2.1. Melbourne has the highest per capita income; the highest proportion of residents with post secondary education; the lowest number of workers employed in the primary sector; and 72 per cent of Victoria’s population. Western District, Wimmera, Mallee and East Gippsland have over 15 per cent of the employed population working in the primary sector. Wimmera and Mallee have the lowest proportion of residents with post secondary education.

A typology of the Victorian regions is introduced to assist the subsequent discussion. Barwon, Central Highlands, Loddon, Goulburn, Ovens-Murray and Gippsland
are defined as non-metropolitan regions and Melbourne is the metropolitan region. The industry structure of the non-metropolitan regions is predominantly a mixture of agriculture, manufacturing and services. Western District, Wimmera, Mallee and East Gippsland are defined as agriculturally based regions but are also included in the broader classification of non-metropolitan regions.

2.4. Demography

The Melbourne region has the majority of Victoria’s population, followed by Barwon and Goulburn, with Wimmera having the lowest proportion (see Table 2.1). Approximately 28 per cent of residents live in regional or non-metropolitan Victoria.

2.4.1. Age structure

The age structure of the Victorian population is shown in Table 2.2. Regional Victoria has a higher proportion of children aged less than seventeen years and a higher proportion of adults over sixty years of age than the Victorian average. Regional Victoria also has a lower proportion of adults in the 18 to 24 and 25 to 34 age groups. This is a reflection of the employment and education opportunities available in metropolitan Melbourne for this age group. In the 35 to 49 and 50 to 59 years age cohort, the patterns are more similar between regional areas and the average for the state. Wimmera stands out as having a very high proportion of adults over the age of seventy, compared to the Victorian average.
### Table 2.1. Comparative Geographic and Demographic Indicators, Victoria, 1996.

<table>
<thead>
<tr>
<th>Region</th>
<th>Per capita income(^a)</th>
<th>Post secondary education(^b)</th>
<th>Primary sector(^c)</th>
<th>Population(^d)</th>
<th>Area square km</th>
</tr>
</thead>
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<td>Victoria</td>
<td>15 197</td>
<td>30.0</td>
<td>4.2</td>
<td>4 560 155</td>
<td>227 767</td>
</tr>
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<td>Regional Victoria</td>
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<td>26.5</td>
<td>12.9</td>
<td>1 276 148</td>
<td>218 933</td>
</tr>
<tr>
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<td>31.3</td>
<td>1.1</td>
<td>3 284 007</td>
<td>8 833</td>
</tr>
<tr>
<td>Barwon (BA)</td>
<td>13 566</td>
<td>28.3</td>
<td>4.4</td>
<td>239 519</td>
<td>8 975</td>
</tr>
<tr>
<td>Western District (WD)</td>
<td>12 931</td>
<td>24.6</td>
<td>23.2</td>
<td>100 168</td>
<td>23 365</td>
</tr>
<tr>
<td>Central Highlands (CH)</td>
<td>12 600</td>
<td>26.3</td>
<td>7.2</td>
<td>134 660</td>
<td>11 460</td>
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<tr>
<td>Wimmera (WI)</td>
<td>12 807</td>
<td>23.3</td>
<td>25.2</td>
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</tr>
<tr>
<td>Mallee (MA)</td>
<td>12 205</td>
<td>21.6</td>
<td>24.7</td>
<td>87 181</td>
<td>40 120</td>
</tr>
<tr>
<td>Loddon (LO)</td>
<td>12 599</td>
<td>27.8</td>
<td>7.5</td>
<td>157 315</td>
<td>14 503</td>
</tr>
<tr>
<td>Goulburn (GO)</td>
<td>12 799</td>
<td>24.7</td>
<td>16.5</td>
<td>182 679</td>
<td>27 324</td>
</tr>
<tr>
<td>Ovens-Murray (OM)</td>
<td>14 039</td>
<td>29.8</td>
<td>8.8</td>
<td>89 091</td>
<td>17 629</td>
</tr>
<tr>
<td>East Gippsland (EG)</td>
<td>12 222</td>
<td>26.1</td>
<td>18.1</td>
<td>80 639</td>
<td>31 935</td>
</tr>
<tr>
<td>Gippsland (GI)</td>
<td>12 637</td>
<td>27.1</td>
<td>13.1</td>
<td>152 609</td>
<td>9 602</td>
</tr>
</tbody>
</table>

\(^a\) Annual gross per capita income from ABS Census of Population and Housing. All other variables were obtained from the Department of Infrastructure (1998).

\(^b\) Post-secondary education for persons 15 years and over is defined as those with a vocational qualification or above.

\(^c\) Primary sector percentage is the percentage of employed persons employed in agriculture, fishing or mining.

\(^d\) Population is the estimated resident population on Census night.
2.4.2. Population changes

Population changes are of interest in monitoring the process of adjustment occurring due to economic change. Population change also has an impact on government service provision, which is generally rendered on a population basis. The rate of population growth slowed considerably between 1991 and 1996, mainly as a result of increased outward inter-state migration. The population of Victoria rose by 551,301 persons between 1981 and 1996. This consisted of a rise of 186,582 persons between 1981 and 1986, 224,113 persons between 1986 and 1991 and 140,606 persons between 1991 and 1996, and indicating decline in the overall rate of population growth in Victoria. Since 1996, however, the rate of population growth has reverted to the long term trend of approximately one per cent annual growth (see Appendix 1 and Figure 2.6 for population details for the individual regions).
Chapter 2. The State of Victoria

The contribution of individual regions to the changes in Victoria’s population over the last two decades is shown in Table 2.3. Wimmera lost population in all three intercensal periods, whereas Western District lost population between 1986 and 1996. Mallee and Gippsland had population increases over the entire period between 1981 and 1996, but lost population between 1991 and 1996. All other Victorian regions increased in population during this time period. Loddon and Ovens-Murray both had consistently above average annual population growth rates.

Maher and Burke (1991) show that the annual rate of population growth, \( r \), can be derived for an intercensal period of \( n \) years by the formula;

\[
    r = \left( \frac{P_n}{P_1} \right)^{1/n} - 1
\]

(2.1)

where \( P_n \) is the population in the \( n \)th year from the base year; and

\( P_1 \) is the base year; and

the intercensal period \( n \) is 5 years.

In a national comparison of population change in Statistical Divisions by Stimson, Shuaib and O’Connor (1998), none of the Victorian Statistical Divisions ranked in the top twenty Statistical Divisions in Australia with the greatest gains in share of national population during the period 1986 to 1996. By contrast, five of the eleven Victorian Statistical Divisions were ranked in the bottom twenty Statistical Divisions with the greatest losses in share of national population between 1986 and 1996. These were Melbourne (-0.85 per cent), Barwon (-0.05 per cent), Western District (-0.09 per cent), Wimmera (-0.05 per cent) and Gippsland (-0.10 per cent). Studies of population trends show that small town rural population is declining at the expense of larger centres and towns within commuting distance of either the larger centres or Melbourne (McKenzie, 1994; Maher and Stimson, 1994).
### Table 2.3. Population Change in the Statistical Divisions of Victoria

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Melbourne</td>
<td>17.7</td>
<td>603 397</td>
<td>0.84</td>
<td>1.06</td>
<td>0.82</td>
</tr>
<tr>
<td>Barwon</td>
<td>19.0</td>
<td>46 618</td>
<td>1.24</td>
<td>1.57</td>
<td>0.40</td>
</tr>
<tr>
<td>Western District</td>
<td>0.1</td>
<td>119</td>
<td>0.36</td>
<td>-0.18</td>
<td>-0.23</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>14.2</td>
<td>19 572</td>
<td>1.22</td>
<td>1.21</td>
<td>0.35</td>
</tr>
<tr>
<td>Wimmera</td>
<td>-7.9</td>
<td>-4051</td>
<td>-0.47</td>
<td>-0.20</td>
<td>-0.59</td>
</tr>
<tr>
<td>Mallee</td>
<td>6.8</td>
<td>6 005</td>
<td>0.47</td>
<td>0.49</td>
<td>-0.08</td>
</tr>
<tr>
<td>Loddon</td>
<td>24.7</td>
<td>39 907</td>
<td>1.85</td>
<td>2.04</td>
<td>0.79</td>
</tr>
<tr>
<td>Goulburn</td>
<td>17.8</td>
<td>33 188</td>
<td>1.30</td>
<td>1.63</td>
<td>0.50</td>
</tr>
<tr>
<td>Ovens-Murray</td>
<td>19.2</td>
<td>17 406</td>
<td>2.00</td>
<td>2.11</td>
<td>0.62</td>
</tr>
<tr>
<td>East Gippsland</td>
<td>17.8</td>
<td>14 402</td>
<td>2.00</td>
<td>1.22</td>
<td>0.14</td>
</tr>
<tr>
<td>Gippsland</td>
<td>14.0</td>
<td>21 549</td>
<td>1.56</td>
<td>0.89</td>
<td>-0.32</td>
</tr>
<tr>
<td>Victoria</td>
<td>16.9</td>
<td>798 112</td>
<td>0.95</td>
<td>1.09</td>
<td>0.66</td>
</tr>
<tr>
<td>Rise in population</td>
<td></td>
<td></td>
<td>186 582</td>
<td>224 113</td>
<td>140 606</td>
</tr>
</tbody>
</table>
The proximity of some areas within the Barwon, Central Highlands, Loddon, Goulburn and Gippsland regions to Melbourne allows people to commute and access the social facilities in the metropolitan area. At the same time, low income families have moved to areas outlying Melbourne and the larger centres in response to lower housing costs (Department of Infrastructure, 1998). These demographic changes strongly influence per capita income and income distribution in these regions.

2.5. Employment and Labour Force

The Australian labour force framework is detailed in the Victorian Year Book (ABS, 2000). Unemployment is defined as persons who are looking for full-time or part-time work and are available to start work. The unemployment rate is the number of unemployed persons expressed as a percentage of persons in the labour force. The labour force is defined as those persons employed or seeking work. The labour force participation rate is the number of persons in the labour force as a percentage of the civilian population of working age. Many factors are involved in the relationship between individual income level, income distribution and labour market conditions, but work force participation has been shown to be a major factor in determining per capita income (Maxwell, Hale and Peter, 1991).

A recent review of rural labour markets in Australia by Borland (1998) reveals that differences across regions within rural (defined as non-capital city) or urban areas are much larger than differences in average rates of unemployment between them. The unemployment rate in larger rural towns is significantly higher than the average level of
unemployment in the Melbourne metropolitan area. The exception is the rate of unemployment in small localities, (defined as less than 200 people), which is usually slightly below that in the metropolitan cities (Garnett and Lewis, 1999). Borland (1998) describes the external pressures on rural labour markets since the early 1980s, which include a reduction in employment in the textile, clothing and footwear industries located in rural areas, primarily as a result of trade liberalisation; reform of the government sector; local government amalgamation; reductions in public sector infrastructure employment in Victoria and deregulation in agricultural product markets.

During the 1990s, there was a decline in population growth, labour force and employment growth rates in small rural communities. Direct employment in agriculture has fluctuated considerably over time but there has been no apparent downward trend since the mid-1970s and there has been a concomitant rise in off-farm employment. As can be seen in Table 2.1, the overall figure for employment in the primary sector in regional Victoria is around 12 per cent, but is as high as 25 per cent in the Wimmera and Mallee regions.

The Victorian labour force and participation rate are shown in Figure 2.4 (a) and (b) respectively for the period 1983 to 1999. Unemployment levels went from a State average of 6.2 per cent in 1986, to 12 per cent in 1993 and back down to 7.3 per cent in 1999 after the recovery from the recession. However, the unemployment rate varied widely both within and between regions over time (see Appendix 2 and Figure 2.6). In Gippsland, the unemployment rate went from 5.5 per cent in 1984, the lowest in the state, to a high of 12.4 per cent in 1998. In the Central Highlands region, the unemployment rate went from 10.3 per cent in 1984, the highest in the state, to 22.7 per cent in 1993.
Figure 2.4 (a) Victorian Labour Force, Number of Persons, for the Period 1983 to 1999.

Figure 2.4 (b) Victorian Participation Rate, Per Cent, for the Period 1983 to 1999.

Source: ABS on-line time series
2.6. Agricultural Geography

Victoria produces 23 per cent of Australia’s agricultural commodities and 30 per cent of its food products while occupying only three per cent of its land area (ABS, 1998, 2001). In terms of farm income, as measured in the Australian National Accounts, the 1995/96 Victorian figure was $1,988 million, which represents 33 per cent of the total Australian figure of $6,071 million (ABS, 1997a). The value of Victoria’s agricultural exports was $5,700 million in 1999/2000. This reliance on agricultural exports (such as wheat, wool, dairy and processed foods) makes Victoria susceptible to terms of trade shocks, caused by agricultural commodity price fluctuations and supply shocks caused by adverse climatic conditions.

Figure 2.5 Victorian Net and Gross Farm Income ($million) for the Period 1981 to 1998 at Market Prices
The favourable climate and topography of Victoria allows intensive and high productivity agriculture compared with much of regional Australia. The major topographical influence on the climate is the Great Diving Range, running east-west across the State and rising to heights of around 2,000 metres. The mountains act as a barrier to the moist south-east and south-west winds and, together with the proximity to the coast, cause the south of the State to receive more rain than the north. Irrigated agriculture is also a feature, particularly in the Goulburn, Ovens-Murray, Loddon and Mallee regions. Annual rainfall is generally between 500 and 800 mm in the Melbourne, Barwon, Western District, Central Highlands, Goulburn and Ovens-Murray regions. The Wimmera, Mallee and Loddon regions are drier, with average rainfall between 250 and 500 mm. Parts of the Gippsland and East Gippsland regions, and some coastal areas to the west of Melbourne have annual rainfall above 800 mm (Bureau of Meteorology, 1999).

In a national comparison of industry employment levels, four of Victoria’s Statistical Divisions ranked in the top twenty Statistical Divisions nationally for the number of agriculture, forestry and fishing workers per 1,000 resident population in 1996 (Stimson, Shuaib and O’Connor, 1998). These were Wimmera (ratio of 102.07), Mallee (100.49), Western District (96.7) and Goulburn (67.25). In the bottom twenty Statistical Divisions nationally for this statistic were Melbourne (ratio of 3.81), Barwon (16.75), Central Highlands (25.67) and Loddon (26.56). Melbourne was the fourth highest agricultural producer, with eleven per cent of Victoria’s agricultural commodities in 1996/97, with production mainly from intensive industries such as nurseries and mushrooms.
In areas in the west, north-east and south-east of Victoria, outside the regional centres, over 50 per cent of the labour force is engaged in the primary sector (agriculture, fishing and mining). The flow-on effects to the service and manufacturing industries in these regions, and in particular to the major regional centres, is substantial. Garnett and Lewis (1997) report that in Western Australia the agricultural sector is responsible for some, possibly much, of the employment and income generated in other sectors, due to linkage effects. These linkage effects could also be expected to apply in Victoria. Recent work by ABARE (2000) has emphasised the importance of farmers’ expenditure on employment and population in rural towns. The dominant industry structure at the Local Government Area level in Victoria in 1998 is shown in Table 2.4. It is evident that, in the majority of Local Government Areas outside the metropolitan area, agricultural businesses are the predominant business type.

2.7 Regional Economic Change

To gain a picture of the changes in three major indicators of regional change, namely population, unemployment rate and average annual per capita taxable income, these indicators are presented for each region in Figure 2.6 (a) to (l). During the 1990s recession, Victorian average annual per capita taxable income declined from 1990 and began to recover by 1994, although it had still not reached its 1989 peak by 1998. The
Table 2.4. Dominant Industry Structure of Victorian Local Government Areas, 1998.

<table>
<thead>
<tr>
<th>Statistical Division</th>
<th>Number of LGAs</th>
<th>Number of LGAs with agriculture dominant</th>
<th>Other dominant industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melbourne</td>
<td>31</td>
<td>1</td>
<td>Various</td>
</tr>
<tr>
<td>Barwon</td>
<td>5</td>
<td>3</td>
<td>Retail</td>
</tr>
<tr>
<td>Western District</td>
<td>5</td>
<td>4</td>
<td>Retail</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>5</td>
<td>4</td>
<td>Retail</td>
</tr>
<tr>
<td>Wimmera</td>
<td>5</td>
<td>5</td>
<td>_</td>
</tr>
<tr>
<td>Mallee</td>
<td>4</td>
<td>4</td>
<td>_</td>
</tr>
<tr>
<td>Loddon</td>
<td>5</td>
<td>4</td>
<td>Retail</td>
</tr>
<tr>
<td>Goulburn</td>
<td>7</td>
<td>7</td>
<td>_</td>
</tr>
<tr>
<td>Ovens-Murray</td>
<td>5</td>
<td>4</td>
<td>Retail</td>
</tr>
<tr>
<td>East Gippsland</td>
<td>2</td>
<td>2</td>
<td>_</td>
</tr>
<tr>
<td>Gippsland</td>
<td>4</td>
<td>3</td>
<td>Retail</td>
</tr>
</tbody>
</table>

Source: Adapted from unpublished data from the ABS Business Register (ABS 1998; 2001). The dominant industry is based on number of business locations.

unemployment rate more than doubled from 1990 to 1992 and population growth slowed considerably (see Figure 2.6 (a)). Melbourne followed the Victorian pattern closely, however, the unemployment rate in Melbourne was slightly lower than the Victorian average and incomes were higher (see Figure 2.6 (b) and Appendix 3).

Barwon also followed the Victorian pattern, however, income growth after recovery from the recession was slow and the unemployment rate at eight per cent in 1999 is well above the 1990 rate of five per cent (see Figure 2.6 (c)). In contrast, Western
District has continued to lose population, whilst the unemployment rate has declined and incomes levels have been rising since 1994 (see Figure 2.6 (d)). Wimmera also appears to be in permanent population decline but with very low rates of unemployment after recovery from the recession and stable income growth (see Figure 2.6 (e)). Central Highlands followed the Victorian pattern, however, its unemployment rate was very high at 22 per cent in 1993 (see Figure 2.6 (f)). Mallee and Goulburn followed the Victorian population and income pattern, but the unemployment rate was below the state average, whilst Loddon was similar except for a higher unemployment rate (see Figures 2.6 (g), (h) and (i) respectively.

Ovens-Murray exhibited an unemployment rate below the state average at its peak in 1992, whilst population growth has stopped since 1996 and incomes have been growing (see Figure 2.6 (j)). East Gippsland appears to be in permanent decline, with stable population since 1990, an unemployment rate in 1999 of 11 per cent, compared to a low of six per cent in 1990 and income in rapid decline since 1991 (see Figure 2.6 (k)). Gippsland appears to be in similar decline to East Gippsland, with an unemployment rate still above ten per cent in 1999, whilst income has declined substantially since 1980 and population decline is more pronounced (see Figure 2.6 (l)).
Figure 2.6 (a) Victoria – Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96)
Figure 2.6.(b) Melbourne - Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96)
Figure 2.6 (c) Barwon – Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96)
Figure 2.6 (d) Western District – Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96)
Figure 2.6 (e) Central Highlands– Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96).
Figure 2.6 (f) Wimmera – Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96).
Figure 2.6 (g) Mallee – Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96)
Figure 2.6 (h) Loddon – Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96)
Figure 2.6 (i) Goulburn – Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96)
Figure 2.6 (j) Ovens-Murray – Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96)
Figure 2.6 (k) East Gippsland – Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96)
Figure 2.6 (l) Gippsland – Population (1980 to 1999, number of persons), Unemployment Rate (1983 to 1999, per cent) and Per Capita Taxable Income (1980 to 1998, $96)
2.8 Conclusion

The main theme that can be derived from this brief overview of Victoria is the constancy of change in the economy. The changes in the economic and demographic indicators described in this chapter, along with a multitude of other factors, influence the welfare of Victorians. The structural adjustments described above are similar to those occurring in other regions of Australia and the rest of the world (Chisholm, 1990; Barkley, 1995; Castle, 1995; Lloyd, Harding and Hellwig, 2000). The adjustments are responses to secular changes in the economy, particularly changes in the agricultural sector and technological change. In addition, there are responses to short term economic shocks such as drought and recessions in the business cycle.

These adjustments, however, appear to have differential impacts on the Victorian regions, and this ‘winners and losers’ phenomenon and changing demographics has important political ramifications (Dorrance and Hughes, 1996; Badcock, 1998). This has been manifest in a voter backlash in regional areas in Victoria, directed against traditional conservative party candidates. This political volatility resulted in an unexpected change of government in Victoria at the state election in 1999. The Bracks Labor Government was elected on a platform of commitment to revitalising economic development in regional Victoria, whilst it is generally accepted that the Kennett Coalition was rejected because of their past performance in regional Victoria.

The renewed focus on regional economic development necessitates better knowledge of regional economic change and development if appropriate policies are to be implemented. The apparent disparities and uneven pattern of economic growth
described in this chapter raise numerous questions that warrant detailed examination. A
detailed analysis may provide a better understanding of the changes in the Victorian
economy, and the policy implications for the future. Indeed, it will be ‘necessary to go
and look’ more closely at the Victorian economy to answer these questions. In the next
chapter, the current theory of economic growth and the methods for empirical analysis of
regional economies are reviewed, in order to provide a framework for further
investigation of the Victorian economy.
CHAPTER 3. ECONOMIC GROWTH – CURRENT THEORY AND EMPIRICS

3.1 Introduction

In this chapter, a review of the neoclassical theory of economic growth, and the current empirical methods of analysing regional economic growth within the neoclassical context, is presented. The purpose of reviewing the theoretical context of neoclassical economic growth theory is to provide a framework for the analysis of economic growth in Victoria and a basis for the subsequent interpretation of results from estimation of the regional growth model. The objective in the brief review of established methods of analysis is to elucidate possible methods to be applied in this research. The review provides an understanding of the analytical methods and their underlying assumptions. This understanding is essential to any critique of the empirical evidence presented in the literature and for application of the methods.

The review begins with the definition of what a region is. Following this, the neoclassical theory of aggregate economic growth in a closed economy is discussed. The discussion of the neoclassical theory is then extended to open economies, and the concepts of convergence between economies are introduced. Endogenous growth models and the ‘new’ economic geography are briefly reviewed. The empirical evidence for convergence is discussed, in conjunction with the analytical issues invoked in measuring convergence. In the final section, the forces that may impede convergence, such as barriers to adjustment and exogenous shocks to economies, are discussed.
3.2 Definition of a Region

Regional science is the application of the disciplines of geography, economics and sociology in a spatial context. Therefore, what constitutes a region can be defined in various ways depending on the discipline and the spatial parameters of the study in question. In the natural sciences and geography disciplines, criteria such as topography and climate are used to classify regions. In contrast, groups of countries are often termed a region, for example the countries in the Pacific region or the European Economic Community. A sub-national area defined by certain boundaries may also be called a region. The nodal or functional approach defines regions in terms of interactions or linkages to the dominant nodes (cities or towns) (Clare, 1991). In practice, regional delineation in most countries owes more to politics and statistical boundaries than anything else.

Regional economies within a country are more open than the national economies in which they are located. Trade links between regions are strong and national governments have a role in transferring income between regions, which may determine regional standards of living and the quality of life generally. In Australia, the regions may vary in size from State or Territory to ABS Statistical Division and Local Government Area or smaller. Popular use of the term ‘regional’ currently refers to non-metropolitan Australia. Australian Statistical Divisions have been designed to be relatively homogeneous regions characterised by recognisable social and economic links with the unifying influence of one or more major towns and cities in line with the nodal approach (ABS, 1996). However, they are formed within State boundaries, which is an artificial restriction on the types of cross-border flows that are likely to occur between Statistical Division boundaries. In this study, the Victorian regions are equivalent to the Victorian Statistical Divisions.
3.3 Economic Growth Theory

3.3.1 Overview

In stating the importance of economic growth theory, Barro and Sala-i-Martin (1995, p 5) claim that:

Even small differences in these (long-term) growth rates, when cumulated over a generation or more, have much greater consequences for standards of living than the kinds of short-term business fluctuations that have typically occupied most of the attention of macro-economists.

… if we can learn about government policy options that have even small effects on the long-term growth rate, then we can contribute much more to improvements in standards of living than has been provided by the entire history of macroeconomic analysis of counter-cyclical policy and fine-tuning.

No comprehensive general theory for the differences in regional economic performance has been developed (Armstrong and Taylor, 2000) Suarez-Villa (1990) argues that the process of long term socio-economic change encompasses the emergence of new industries, the decline of others, the diffusion of new technologies and organisational forms, the changing spatial distribution of the population, as well as the human component, the macroeconomic environment and, at the micro level, the actions of individuals and entrepreneurs. This complexity means that, by necessity, most analysis of economic growth is restricted to only a small segment of the entire process. Nevertheless, the convergence principle holds that where there are no barriers to the operation of market forces, there are strong pressures leading to the general convergence of regional incomes over time. Regional disparities will not be persistent, since inequalities will lead to movements in prices, wages, capital and labour, and thereby impart a strong tendency to regional convergence.
Economic growth can be defined as an increase in the total real value of goods and services produced, which in turn leads to an increase in other economic aggregates such as consumption, employment, income and capital (Butler and Mandeville, 1981). From the mid-1980s, there has been resurgence in interest in long-term economic growth theory. The renewed focus on economic growth theory has arisen from empirical work on growth and the evidence on the convergence in per capita incomes and output between nations. This was in part due to the availability of a suitable data set for cross-sectional analysis, which allowed international comparison of Gross Domestic Product levels for a large number of countries to be made (Summers and Heston, 1991). The Summers-Heston data contained detailed information on macroeconomic aggregates for more than one hundred countries commencing in 1950 or 1960. As well, interest was sparked by the proposal that the existence of convergence across economies was evidence of the validity of the modern theories of economic growth, based on the Solow (1956) and Swan (1956) neoclassical growth model.

The empirical debate on convergence has prompted the re-examination and reorientation of growth theory. This has focused on the inconsistency between the prediction from the neoclassical growth model that national economies tend to converge and the apparent absence of convergence between a wide cross-section of countries, as reported in Sala-i-Martin (1996a) and Easterly, Kremer, Pritchett and Summers (1993). Barro (1991) and Mankiw, Romer and Weil (1992) argue that, from the neoclassical model, conditional convergence is predicted rather than absolute convergence, so the model is not necessarily rejected by such empirical results. This in turn has led to renewed interest into whether sub-national regional per capita incomes are converging because these regions are likely to meet some of the important conditions under which the neoclassical growth model is applicable (Bernat, 2001).
The convergence principle is based on a mixture of neoclassical theories of economic growth and the process of regional adjustment, drawing on the theory of trade, investment and migration. It suggests that, when there are no barriers to factor mobility, labour is attracted to economies or regions where the ratio of capital to labour is high and therefore wages and incomes are higher, rather than to areas where labour is less expensive and capital to labour rates are low. Conversely, capital is attracted to regions where the ratio of capital to labour is low and the returns to capital are higher. Income changes and population movements, therefore, occur as people and capital leave, or move to, a region in search of better returns to their labour and their investments and in this way, the incomes of people in regions adjust and converge over time.

The opposing view to the convergence prediction of neoclassical equilibrium economics is that market forces actually lead to spatial disequilibria and that regional divergence is more likely. The cumulative causation models of regional growth, proposed by Myrdal (1957) and Kaldor (1970), suggest that regional growth is divergent because economies of scale and agglomeration lead to cumulative concentration of productive resources and output in certain regions at the expense of others. In response to empirical findings of slow convergence or divergence, and drawing on principles established in economic geography, the proponents of the new endogenous growth theories seek to explain divergence by treating as endogenous those factors considered exogenous to the neoclassical model, such as technological change and human capital, and by rejecting the neoclassical assumption of diminishing returns to capital.
3.3.2 Neoclassical theory of economic growth

The neoclassical growth model of a closed economy assumes the output of an economy is achieved by the combination of inputs of capital, labour and technology in the economy’s production function. In its simplest form, where there is no technical progress, the model is based on two homogenous and substitutable factors of production and total output is a function of these two factors, so that:

\[ Y = F(K, L) \]  \hspace{1cm} (3.1)

where \( Y \) is the output of the economy;

\( K \) is capital; and

\( L \) is labour.

The underlying assumptions are perfect competition in all markets, constant returns to scale and diminishing returns to any one factor of production. Each factor receives a return equal to its marginal product, so that the total earnings of capital and labour exactly absorb the total output (savings equal investment). The labour force is exogenous, homogenous and equal to the population. The determining factor in long-run aggregate growth in this model is growth in the labour supply: this accounts for aggregate growth but will not result in growth in per capita output. When the model is expanded with the introduction of technological progress as an exogenous variable, aggregate growth is determined by both technological progress and the labour supply, with technological progress determining the growth in per capita output.

A specific form of equation (3.1), with constant returns to scale assumed, is the Cobb-Douglas production function:

\[ Y = AK^\alpha L^{1-\alpha} \]  \hspace{1cm} (3.2)
where $A$ is technical knowledge; and

$\alpha$ is a constant, $0 < \alpha < 1$.

The constants $\alpha$ and $1-\alpha$ are the respective contribution of capital and labour to aggregate output.

The production function is expressed in per capita terms by dividing equation (3.2) through by $L$:

$$y = Ak^\alpha$$  \hspace{1cm} (3.3)

where $y$ is output per capita;

$k$ is capital per worker; and

all other variables are as defined above.

The per capita production function shows that output per worker will only increase if capital per worker increases, and this increase will be at a decreasing rate due to diminishing marginal returns. The assumption of diminishing marginal returns to capital leads the growth process within an economy to eventually reach the steady state growth rate where per capita output, capital stock and consumption grow at a common constant rate. At this point of long-run equilibrium, or ‘balanced growth’, there can be no growth in per capita income (Barro and Sala-i-Martin, 1995, p 19). In the standard growth model, the long-run steady state level of output or income depends positively on the economy’s willingness to save and level of productivity (saving preferences and technology) and negatively on the population growth rate.

To allow for the effect of technical progress on output growth, technical knowledge can be added to the basic production function:

$$Y = F(A,K,L)$$  \hspace{1cm} (3.4)
where all variables are as defined above.

Equation (3.2) can be extended to incorporate the rate of technological progress as an exogenous variable:

\[ Y = Ae^{gt}K^\alpha L^{1-\alpha} \]  

where \( g \) is the constant rate of technical progress; 
\( t \) is the time period; and 
all other variables are as defined above.

This extension of the neoclassical model allows for the possibility of growth in output per worker over the long run, with the growth rate equalling the exogenously given rate of technological progress. In terms of growth, equation (3.5) can be rewritten as:

\[ \frac{\Delta Y}{Y} = ga + \alpha \frac{\Delta K}{K} + (1-\alpha)\frac{\Delta L}{L} \]  

where \( ga \) is the annual rate of technical progress; and 
all other variables are as defined above.

The long-run equilibrium growth rate of output per worker is obtained as:

\[ \frac{\Delta Y}{Y} - \frac{\Delta L}{L} = g/1-\alpha \]  

Regional growth

To consider the growth equation (3.6) in a regional context, it can be written as:

\[ \frac{\Delta Y_r}{Y_r} = + \alpha \frac{\Delta K_r}{K_r} + (1-\alpha)\frac{\Delta L_r}{L_r} \]  

where the subscript \( r \) denotes each region.
Regional growth disparities can then be seen as arising from differences between regions in any of the three terms in equation (3.8), representing the rate of technical progress, the growth of capital stock and the growth of the labour force. To express regional growth in per capita terms, the growth of the labour force can be subtracted from both sides of equation (3.8) to obtain:

\[ \frac{\Delta Y_r}{Y_r} - \frac{\Delta L_r}{L_r} = g_r + \alpha \left( \frac{\Delta K_r}{K_r} - \frac{\Delta L_r}{L_r} \right) \]  

(3.9)

Regional disparities in the growth of output per worker can then be seen as arising from regional differences in the two terms in equation (3.9), representing the rate of technical progress and the growth of the capital/labour ratio (Armstrong and Taylor, 2000).

The neoclassical theory of regional growth is based on the standard assumptions of full employment, perfect competition, aggregate production function, homogeneous capital stock and constant returns to scale. The neoclassical model of aggregate growth in a closed economy can be extended to regional economies. Regional economies, however, are characterised by being open to trade and trade flows are often large and difficult to measure. This openness in regional economies allows adjustment through labour migration and capital mobility, which strengthen the inherent convergence properties of the neoclassical model.

Regional growth involves the complex integration of many factors including natural resources, labour, capital investment, transport and communication facilities, technology, industrial composition, size, export markets, the state of national and world economies, central government spending and the socio-political system (Butler and Mandeville, 1981). Richardson (1973) argues that regional growth is likely to be more of a dis-equilibrating process than growth in the national economy and therefore any
useful theory of regional growth needs to be more than just derivative from a theory of aggregate growth. Barro and Sala-i-Martin (1991) maintain that relaxing some of the assumptions of the model and allowing for a share of trade in the neoclassical production function does not detract from the main tenets of the neoclassical model.

3.3.3 Transition dynamics and concepts of convergence

**Beta convergence**

There are two main concepts of convergence arising from the neoclassical growth model. The first is known as $\beta$-convergence, which is the speed at which economies approach their own steady state. Beta-convergence is found in a cross-section of economies when there is a negative relationship between the growth rate of income per capita and the initial level of income. As demonstrated in Section 3.3.2, the long-run per capita growth rate in the standard neoclassical growth model depends entirely upon the exogenous rate of technological progress. In the short run transition to the steady state, however, the growth rate depends inversely on the initial per capita product or income of an economy and its long-run or steady state position. The convergence rate depends mainly on the speed in which diminishing returns to capital set in. Jones (2000, p 62) has termed this

the ‘principle of transition dynamics’: the further an economy is ‘below’ its steady state, the faster the economy should grow. The further an economy is ‘above’ its steady state, the slower the economy should grow.

The growth equation derived from the transition path of the neoclassical model for closed economies by Barro and Sala-i-Martin (1991) is a log-linear approximation,
in which growth is expressed as the average growth rate of per capita output, \( y \), over any given interval and specified as:

\[
T^{-1} \ln(y_T/y_0) = (1 - e^{-\beta T}) T^{-1} \ln(\hat{y}_*/\hat{y}_0) + x
\]  
(3.10)

where \( \ln(y_T/y_0) \) is the natural log of the growth in output between time \( T \) and time \( 0 \);

\( \beta \) is the speed of convergence;

\( T \) is the length of the time interval;

\( \hat{y} \) is output per unit of effective labour;

\( x \) is the exogenous rate of labour-augmenting technical progress; and

the superscript * denotes steady-state values.

In equation (3.10), the rate of convergence, \( \beta \), is a function of the transitional dynamics of the economy, related to the level of \( \hat{y}_0 \) for each economy relative to its own \( \hat{y} \). Each economy grows faster the lower its initial income, conditional on its long-run steady state target and the different structural characteristics of each economy, hence the term ‘conditional’ \( \beta \)-convergence. Beta is also related to \( x \), which is more likely to be homogenous across regions of a given country that share common levels of technology and savings preferences. Taking a broader view of technology, however, it is possible that factors such as differential levels of resource endowments, human capital and government policies can induce heterogeneity across otherwise similar regional economies.

Absolute \( \beta \)-convergence occurs if a poor economy is growing faster than a richer economy, based on the key assumption that the only difference across economies is the initial level of capital. However, the concept of ‘conditional’ \( \beta \)-convergence realistically
allows for other differences between economies. To test the hypothesis of ‘conditional’ convergence, the steady state of each economy must be held constant. One method is to introduce into the basic growth regression additional variables that proxy for the steady state. If $\beta$ is negative once these regressor variables are included, then the economies are said to display conditional convergence. More than 50 variables have been tested as proxies for the steady state and found to be significant in at least one regression (Barro and Sala-i-Martin, 1995, Chapter 12).

Another method is to compare countries or regions with similar saving preferences, technology, institutions and other factors so that the assumption of similar steady state income levels is feasible. The results of empirical studies using this method has given rise to the term ‘club convergence’, where countries that are similar in structural characteristics and have similar initial conditions have demonstrated a tendency to converge to one another (Chatterji and Dewhurst, 1996; Quah, 1996b) The empirical study of regional convergence within countries has expanded because of these findings.

The estimates of the speed of convergence provide information on the share of capital in the Cobb-Douglas production function. For given values of the parameters of technology, population growth and depreciation rate, the coefficient $\beta$ is determined by the capital-share parameter, $\alpha$. If capital is viewed narrowly then the share of capital in income would be low, diminishing returns to capital would set in quickly and the convergence rate would be high. One body of empirical evidence suggests that $\beta$ is within the range of 1.5 to 3.0 per cent per annum (see Section 3.4). To accord with this observed rate, the capital-share coefficient in the neoclassical model would need to be around 0.75. This may be feasible if the concept of capital is broadened to include human capital (Barro and Sala-i-Martin, 1995, p 38).
The neoclassical growth model, therefore, appears to fit with the empirical estimates of convergence speeds if the broader view of capital is taken, and provides indirect evidence for the importance of human capital accumulation in the process of development. There are several empirical studies, however, which estimate rates of $\beta$-convergence between 10 and 30 per cent per annum (Canova and Marcet, 1995; Castelli, Esquivel and Lefort, 1996; Lee, Pesaran and Smith, 1997) These higher rates of convergence concur with a capital share in the production function of between 20 to 35 per cent, which is closer to the generally accepted figure of approximately one-third capital share obtained from national account estimates. The empirical debate is considered further in Section 3.4.

**Sigma convergence**

The second concept of convergence, known as $\sigma$-convergence, occurs when the dispersion of per capita income or output between economies decreases over time. The existence of $\beta$-convergence will tend to generate $\sigma$-convergence. In the neoclassical growth literature, $\sigma$-convergence is generally measured as the unweighted cross-sectional standard deviation of the log of per capita income.

Other standard statistical measures of cross-sectional dispersion include the population-weighted coefficient of variation $V_w$, the unweighted coefficient of variation $V_{uw}$ and the weighted mean absolute deviation $M_w$ (Williamson, 1965). An increase in any of these measures indicates that income inequality is increasing and regional incomes are diverging. The use of $V_{uw}$ is problematic in cross-country comparisons of intra-regional disparities, as it is determined in part by the number of regions and this varies between countries. However, the use of a population-weighted measure such as $V_w$ is preferable when there are large differences in population between regions. Indeed,
Williamson (1965, p 34) argues that ‘the preference for an unweighted index over a weighted one, …is indefensible.’

The relationship between $\sigma$- and $\beta$-convergence is illustrated by rewriting the growth equation as:

$$\log (y_{it}) = \alpha - (1-\beta) \log (y_{it-1}) + \mu_{it}$$  \hspace{1cm} (3.11)

where $\mu_{it}$ is a disturbance term, that is assumed to be independently distributed; and all other variables are as defined above.

Taking the variance of both sides gives equation (3.12):

$$\sigma^2_{yt+T} = (1-\beta)^2 \sigma^2_{yt} + \sigma^2 \mu$$  \hspace{1cm} (3.12)

The variance of the disturbance term also influences $\sigma$-convergence, so that it can be seen from equation (3.12) that $\beta$-convergence is a necessary, but not sufficient, condition for $\sigma$-convergence, as exogenous shocks to $\mu$ will raise $\sigma^2_{yt+T}$. In addition, across heterogeneous economies, diminishing returns to capital may not lead to $\sigma$-convergence if the poorer economies are closer to their steady states than the wealthier economies.
3.3.4 Endogenous growth models

In the Solow-Swan growth model, the growth in output per capita is driven by the exogenous rate of technological progress and therefore, without technological progress, there would be no growth in the long-run. Since the causes of technological progress are not identified in the model, however, the underlying mechanisms by which technological progress drives growth are not identified either. One of the main critiques of the standard neoclassical model arising from this is the lack of apparent policy instruments to foster economic growth when technological progress is determined outside the model and when convergence of output and incomes is predicted.

To address this shortcoming, growth models have been developed which treat factors such as technological change and human capital as endogenous, hence the name endogenous growth theory. Along with the issue of how trade shapes the distribution of economic growth, the paradigm of increasing returns in the endogenous models raises the question of the geographical distribution of economic growth (Martin and Sunley, 1998). As well, if increasing returns result from different types of investment, this implies that institutions and policy may have a strong role in fostering economic growth (Crafts, 1996).

If there are no diminishing returns to capital then convergence is not predicted and regional differentiation is expected. Bernat (2001) suggests that increasing returns to capital are likely when capital is defined broadly to include information, knowledge and human capital. Romer (1986) argues that the empirical evidence does not support the Solow-Swan convergence implications and the existence of decreasing returns to capital. He claims that, empirically, growth rates are a positive function of the level of economic development and that savings and population growth rates exert an influence
on output growth per capita and postulates a growth model with increasing
returns to all factors.

Martin and Sunley (1998) suggest that there are two different types of endogenous
growth models arising from different concepts of increasing returns. The first are
endogenous broad capital models, which treat capital investment as either generating
externalities, or alternatively, emphasise human capital and relate technological change to
‘learning by doing’ and ‘knowledge spillovers.’ The second type, Schumpeterian or
endogenous innovation models, emphasise the returns to technological improvements
arising from intentional innovation by producers. These main types of endogenous growth
models are described along with the human capital augmented neoclassical model in
Table 3.1. Crafts (1996) points out that the policy implications of these models are
different. Mankiw, Romer and Weil (1992) developed the augmented neoclassical model,
in which growth is not endogenous but where diminishing returns to broad capital will be
less rapid than to physical capital, so that convergence to the steady state is slower and the
transitory effects of increased investment rates on growth will last longer.

Regional growth patterns have been analysed in order to test these models,
however, more empirical work is required to support and enhance their development. In a
comprehensive review of endogenous growth theory, Martin and Sunley (1998) compile
evidence that regional convergence is a slow and discontinuous process, resulting from
the net effect of both convergent and divergent forces. They also note the shortcomings
of endogenous growth approaches in a regional context. For example, they argue that the
endogenous models concentrate on the supply side, and thereby rule out the key effects of
the growth in demand for exports, and balance of payments constraints, on employment
and productivity trends. By doing this, endogenous models do not account for the main
source of increasing returns, under Verdoorn’s Law, whereby rising output is postulated
to generate economies of scale and raise productivity (Verdoorn, 1956).
### Table 3.1. A Typology of ‘new’ Growth Theories

<table>
<thead>
<tr>
<th>Type of growth theory</th>
<th>Main features of theory</th>
<th>Production function</th>
</tr>
</thead>
</table>
| Augmented neoclassical        | Physical and human capital, exogenous technical progress universally available. Slow and conditional convergence within clubs of countries with similar socio-economic structures. | $Y = TK^aL^bH^c$ (a+c < 1)  
Augments the basic production function with a measure of human capital (H).                                                                 |
| Endogenous broad capital      | Capital investment, constant returns through knowledge spillovers. Cumulative divergence, but shaped by government spending and taxation. | $Y = K^{a+x}L^bH^c$ (a+x = 1)  
x represents externalities or social returns which result in constant rather than diminishing returns to investment. |
| Intentional human capital     | Spillovers from education and training investments by individual agents. Convergence dependent on returns to investment, public policy, and patterns of industrial and trade specialisation. | $Y = K^aL^bH^c$ (a+c = 1)  
H is acquired through research and education and the returns to human and physical capital combined are constant. |
| Schumpeterian endogenous innovation | Technological innovation by oligopolistic producers, with technological diffusion, transfer, and imitation. Multiple steady states and persistent divergence likely. Possible club convergence and catch-up. | $Y = CK^aL^bD^d$ (a+b+d = 1)  
where C is a constant and D is an index of the creation of intermediate goods which embody innovative progress. |

Source: Adapted from Martin and Sunley (1998)
In addition, the endogenous models rely, as do most neoclassical models, on static formal equilibrium frameworks that do not take into account the social and institutional contexts that shape the growth process or the spillover effects and linkages between regions that influence similar growth patterns. Martin and Sunley (1998) suggest that the approach of economic geographers to understanding the location of factors of production in space, and the organizational and social divisions of labour and firm strategies as the bases of economic growth, is complementary to endogenous growth theory. Martin and Sunley (1998, p 219) state that:

The fact that external economies, skilled labour and technological innovation all seem to be geographically clustered within nations indicates that geography is fundamental to the growth process. …this geographic unevenness in turn has a major influence on national growth, trade and competitiveness.

This observation reflects that of Richardson (1973, p 1), who suggested that location theory also makes an important contribution to regional growth theory:

To the extent that the macro-economic growth rates of regions reflect the influence of thousands of micro-locational decisions, understanding how location decisions are reached is essential to explanations of regional growth. Access to metropolitan living, social amenities, environmental preferences and economics of urban agglomeration are important determinants of location, probably more important than rates of return to capital, transport cost advantages, cheap labour costs and the other key elements in traditional location theory.

Many of these aspects of economic geography have influenced the theory of endogenous growth so that it has developed in tandem with ‘the new economic geography’, which is based on increasing returns and the existence of externalities (Krugman, 1991; 1998).
3.4 Empirical Analysis of Convergence

3.4.1 Empirical evidence

Cross country evidence

The empirical evidence does not support the absolute convergence hypothesis, that incomes of countries converge to one another in the long-run independently of their initial conditions (Romer, 1986; Lucas, 1998 and Barro, 1991). Whilst Baumol (1986) documented evidence of cross-country convergence across a small sample of thirteen developed countries, this study has been questioned on the basis of sample selection bias and measurement error (De Long, 1988). In addition, Sala-i-Martin (1996a) analysed the Summers and Heston data (110 countries) and found that the cross-country distribution of world income has become increasingly unequal in terms of $\sigma$-divergence and $\beta$-divergence between 1960 and 1990. Pritchett (2001) documents similar increasing disparities between countries.

The empirical evidence of increasing dispersion of output and income between countries can be rationalised within the neoclassical framework by the concept of conditional convergence (see Section 3.3.3). The conditional convergence hypothesis has been tested in numerous empirical studies using cross-sectional country data. Mankiw, Romer and Weil (1992) augmented the Solow growth model by including accumulation of human and physical capital and found evidence of convergence. Barro and Lee (1994) and Sala-i-Martin (1996b) estimated that countries converge to their steady state level of per capita income at a rate of approximately two to three per cent per year. Cashin and Loayza (1995) found similar evidence of convergence among the South Pacific countries.
The hypothesis of club convergence, when a subset of regions converge on a particular steady-state, but where the club as a whole is diverging from the steady-states of other clubs in the data set, is also supported by empirical evidence (Quah, 1996a; Durlauf and Quah, 1999).

**Regional evidence**


The results from the studies reported in Table 3.2 generally support conditional \( \beta \)-convergence at speeds between one and three per cent per annum. The dispersion of income within these countries has either decreased or shown no significant change between 1970 and 1990. Armstrong (1995b) found regional income convergence (state level) in Australia of approximately one per cent per annum between 1953 and 1991 but divergence over the period 1977 to 1993. Cashin (1995) found a slow rate of \( \beta \)-convergence between the colonies of Australasia between 1861 and 1991. Cashin also observed \( \sigma \)-convergence, although there were also periods of \( \sigma \)-divergence corresponding to identifiable economic shocks.
The empirical findings of convergence are apparently sensitive to the time period of estimation and the level of spatial aggregation, as well as the model specification. Petrakos and Saratsis (2000) found evidence of convergence across 51 Greek regions, and attribute part of the reduction in disparities to a recession during the 1980s in the main centres of Athens and Thessaloniki. In contrast, Siriopoulos and Asteriou (1998) found no evidence of regional convergence of per capita income between the thirteen larger Greek regions, but they did find support for the existence of dualism between the southern and northern regions of Greece. Mauro and Podrecca (1994) found similar evidence of dualism among Italian regions, which was in contrast to the Italian findings reported in Sala-i-Martin (1996a). Karagedikli, Maré and Poot (2000) present New Zealand evidence to suggest that there is dualism between the ‘globalised’ economies of the major cities Auckland and Wellington, in contrast to the rural and peripheral areas, and this may account for their observation of $\sigma$-divergence in the presence of unconditional $\beta$-convergence among the non-metropolitan regions.

3.4.2 Empirical issues

As stated earlier, empirical estimates of the speed of conditional $\beta$-convergence are sensitive to time period, sample selection, level of aggregation of the data and the econometric specification. Nevertheless, the speed of conditional $\beta$-convergence across countries and regions is widely accepted to be approximately two per cent (Barro and Sala-i-Martin, 1995).
Table 3.2. Estimates of Convergence of Regional Per Capita Income Levels

<table>
<thead>
<tr>
<th>Entity</th>
<th>Number of regions</th>
<th>Time period</th>
<th>$\beta$-convergence$^a$</th>
<th>$\sigma$-convergence$^b$</th>
<th>1970</th>
<th>1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>6</td>
<td>1953-1991</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1977-1993</td>
<td>-1.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>10</td>
<td>1961-1991</td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>90</td>
<td>1950-1990</td>
<td>1.4</td>
<td>0.20</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>21</td>
<td>1950-1990</td>
<td>1.6</td>
<td>0.10</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>11</td>
<td>1950-1990</td>
<td>1.4</td>
<td>0.20</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>20</td>
<td>1950-1990</td>
<td>1.0</td>
<td>0.33</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>47</td>
<td>1955-1990</td>
<td>1.9</td>
<td>0.23</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>17</td>
<td>1955-1987</td>
<td>2.3</td>
<td>0.27</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>11</td>
<td>1950-1990</td>
<td>1.6</td>
<td>0.17</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>48</td>
<td>1880-1990</td>
<td>1.7</td>
<td>0.17</td>
<td>0.17</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Armstrong and Taylor (2000)

$^a$Estimated rate of conditional $\beta$-convergence per annum

$^b$Regional income dispersion measured by $\sigma$ in 1970 or 1990
There are several empirical studies, however, which estimate much higher rates of $\beta$-convergence. Canova and Marcet (1995) argue that since it is necessary to hold the steady state constant in order to estimate the speed of convergence, the omission of various determinants of long-run income probably bias the estimates of $\beta$ towards zero in standard growth regressions. Consequently, they estimated a Bayesian model with panel data, using fixed effects to control for possible differences across regions, and find rates of convergence around 11 per cent for a sample of OECD countries and 23 per cent for European regions. Similarly, Islam (1995) used a panel data specification with specific country effects and obtained estimates of convergence rates between four and nine per cent for a sample of countries.

Caselli, Esquivel and Lefort (1996) argue that there are two sources of inconsistency in previous cross-country empirical studies. The first is that the incorrect treatment of country-specific effects, representing differences in technology or tastes, has led to omitted variable bias. This is less of a problem when analysing regions within countries that can be expected to have similar technology and preferences. The second criticism is that explanatory variables have been treated as exogenous, when there is a theoretical argument they should be regarded as endogenous. They use a generalised method of moments estimation to overcome these inconsistencies and find speeds of convergence between countries of approximately ten per cent.

Fuente (1997) provides a review of empirical evidence from cross-sectional studies of growth and convergence between countries and regions, with an emphasis on the theoretical issues. He suggests that high speeds of convergence are inconsistent with a neoclassical convergence mechanism that involves decreasing returns to scale and that it implies very strongly decreasing returns to capital. This then raises some interesting
questions about an important role for other sources of convergence such as technological diffusion, factor flows and changes in the sectoral composition of output. Cheshire and Carbonaro (1995) point out that a finding of convergence, whilst in accordance with the prediction of the neoclassical model, is not a direct test of the model and the results are highly sensitive to model specification. Cheshire and Carbonaro argue, along with Quah (1993), that the actual pattern and changes in the pattern of dispersion of regional incomes over time, is more meaningful in terms of policy implications, than measures of $\beta$-convergence. Estimates of $\beta$-convergence indicate net convergence and average convergence, and by ignoring the spatial dimension, are not informative about individual regions or about the possible divergent forces present.

In addition to echoing Cheshire and Carbonaro’s criticism, Bernard and Durlauf (1995) question the methods of obtaining these estimates of regional convergence. They argue that the growth regression approach only relates a region’s growth to its own history and then only by averaging across the trends for all regions. By pooling data for all regions, it is assumed that the underlying convergence-generating process is identical across space, when it is more likely that the rate of convergence will vary from region to region. This is likely to occur as regions converge to different long-term relative income levels that reflect persistent local differences in structural characteristics, and it is therefore insufficient to identify shocks to the system as causing dis-equilibrium.
3.5 Regional Adjustment

In theory, regional adjustment should maximise the potential for economic growth by facilitating the optimal spatial allocation of resources in response to market signals. Within the framework of the neoclassical theory of economic growth, there are two main obstacles to the process of regional adjustment. First, barriers to factor mobility may exist, so that the process of regional adjustment is impeded. Second, economic shocks may shift the path of economic growth and have either transitory or permanent effects, depending on their nature.

3.5.1 The regional adjustment process

The process of regional adjustment is complex but the broad mechanisms by which it occurs are outlined in Table 3.3. A region can adjust by improving its competitiveness through lowering costs, raising productivity and improving quality; by producing different goods and services in response to changes in demand; attracting labour and capital, or reducing them or by a combination of these mechanisms (Industry Commission, 1993). If the three principal resources of production are labour, capital and land, then the owners of these resources have various options in exploiting them according to their own profit-maximising objectives. These options are confined, however, by what may be called the ‘institutional’ constraints within the regulatory system, the labour market and government and institutions, which can act to facilitate or impede regional adjustment. Apart from these institutional impediments to regional
adjustment, there are also social and environmental considerations, as people, firms and governments attempt to maximise their utility functions in response to a diverse range of objectives.

Table 3.3 Regional Adjustment Mechanisms

<table>
<thead>
<tr>
<th>Location and application of resources</th>
<th>Labour</th>
<th>Capital/Industry</th>
<th>Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migration</td>
<td>Migration</td>
<td>Relocate capital/industry</td>
<td>Relocate activities</td>
</tr>
<tr>
<td>Change in employment</td>
<td>Change in employment</td>
<td>Move capital to a different industry/output or change quality and marketing</td>
<td></td>
</tr>
<tr>
<td>Scale of inputs</td>
<td>Hire or shed labour</td>
<td>Widen or narrow the capital base, including the infrastructure base</td>
<td>Use more or less land</td>
</tr>
<tr>
<td>Replace full-time employees with part-time and contractors</td>
<td>Replace full-time employees with part-time and contractors</td>
<td>Widen or narrow the capital base, including the infrastructure base</td>
<td>Use more or less land</td>
</tr>
<tr>
<td>Productivity</td>
<td>Retrain</td>
<td>Use more productive capital</td>
<td>Rezone</td>
</tr>
<tr>
<td>Change work practices</td>
<td>Change work practices</td>
<td>Use more productive capital</td>
<td>Rezone</td>
</tr>
<tr>
<td>Prices</td>
<td>Increase or reduce wages</td>
<td>Negotiate changes in input and/or output prices</td>
<td>Market values will adjust</td>
</tr>
<tr>
<td>Vary non-wage remuneration and conditions of employment</td>
<td>Vary non-wage remuneration and conditions of employment</td>
<td>Negotiate changes in input and/or output prices</td>
<td>Market values will adjust</td>
</tr>
<tr>
<td>Constraints</td>
<td>Regulations and controls</td>
<td>Government jurisdictions</td>
<td>Institutional arrangements</td>
</tr>
<tr>
<td>Taxes and subsidies</td>
<td>Regulations and controls</td>
<td>Government jurisdictions</td>
<td>Institutional arrangements</td>
</tr>
</tbody>
</table>

Adapted from Industry Commission (1993) Volume 1
In relation to the process of convergence, Taylor (2000) draws on a wide range of theory and European empirical evidence to suggest that impediments to the regional adjustment process include:

- the sluggish response of labour to regional disparities in wages (or employment opportunities) even within countries;
- the reluctance of firms to locate production activities in low income regions despite potentially lower wage costs;
- low investment levels in low income regions due to a low savings rate, high borrowing costs and a lack of entrepreneurship;
- the ability of knowledge-rich regions to generate new ideas more rapidly than knowledge-poor regions;
- the likelihood that new ideas are adopted more quickly in high skill regions;
- constraints on the transfer of technology into low income regions by the level of investment activity since a high proportion of new technology is embodied in new capital equipment; and
- the probability that the existence of agglomeration economies may outweigh any advantages to be gained from low labour costs in low income regions.

The labour market aspects of these impediments are discussed in the next section.
3.5.2 The labour market

The labour market is an important component of regional economies. Labour market variables reflect regional economic performance, and unemployment rates in particular are an important indicator of spatial disparities in social exclusion and economic disadvantage (Armstrong and Taylor, 2000). Maxwell, Hale and Peter (1991, p 52) emphasise that there is no simple relationship between employment conditions and household income: family size, family age, educational background, industry structure in the region, the level of public and private employment and numerous other factors influence both household and individual income level and distribution. Nevertheless, income levels and other important socio-economic variables are strongly correlated with the level of workforce participation.

Large and persistent differences in unemployment rates can be viewed as evidence of barriers to adjustment and the failure of wage signals to bring about market equilibrium. Neoclassical adjustment theory proposes three possible mechanisms of adjustment to an economic shock that generates a rise in regional unemployment relative to the average of the parent region. First, there can be a fall in the relative regional wage rate. This supports the argument for regional wage flexibility to respond to local labour market conditions. Second, labour can migrate to regions where the unemployment rate is lower or they can leave the labour force. Third, firms and capital can relocate or expand to take advantage of the pool of available labour and the possible fall in the relative wage. The last two adjustment mechanisms give rise to the desirability of geographic mobility of both labour and capital. There are a number of crucial, but rather unrealistic, assumptions to this theory. These include that labour is
homogenous in both regions, that there are constant returns to scale, that migration costs are zero, that there is a perfectly competitive labour market and that workers will move only in response to wage differentials (Butler and Mandeville, 1991, p 83).

The contribution of the interplay of migration, wages and employment to regional adjustment is complex. For empirical analysis of these factors, see Blanchard and Katz (1992) for the United States, Groenewold (1993) for Australia and a general review by Armstrong and Taylor (2000). Blanchard and Katz found much of the year-to-year movement in state employment is accounted for by movements in aggregate employment; however, the oil and farm states were less linked to aggregate employment than manufacturing states. Debelle and Vickery (1999) demonstrate that at least three-quarters of the variation in a state’s unemployment rate is attributable to variations in national unemployment in Australia, whilst Elhorst (1995) found similarly for Europe. However, at the sub-state level in Australia, Trendle (2000) has demonstrated that the aggregate employment series for Queensland is not cointegrated with the regional employment series. This finding suggests that region-specific factors play an important role in determining employment and economic performance.

In considering adjustments to the regional wage rate, the centralisation of national labour awards and minimum wage legislation has until recently meant the price of labour did not reflect regional differences in productivity (Industry Commission, 1993). The Industry Commission argues that uniformity in wage setting both inhibits migration from declining regions and dissuades capital from entering these regions. Recent reforms under the Federal Workplace Relations Act, which promote workplace agreements over industry-wide awards, are designed to increase wage flexibility, but
this remains to be assessed empirically. The perennial problem of the lack of
data on regional labour markets impedes progress in many areas of labour market
analysis.

The Industry Commission (1993) also argues that the uniformity and duration of
unemployment benefits in Australia are seen as contributing to people migrating to, and
remaining in, regions with lower costs of living and lifestyle advantages, but not
necessarily better job prospects. Policies to compel the unemployed to migrate to areas
with low unemployment (and thereby enforce a degree of geographic mobility) may be
counter-productive if the policies are based on the assumption that a low unemployment
rate means there are more jobs available. It is possible that low unemployment rates are
associated with few opportunities and low jobs growth, as is the case in some regional
areas, or alternatively, that high unemployment rates may be found in a region with high
jobs growth potential but undergoing a stage of rapid adjustment (Howard, 1999;
Howard and Buultjens, 2000).

Harris (1985) surveyed four towns in rural non-coastal New South Wales and
reported that unemployment rates in these towns, where a large proportion of the jobs
were low skilled, were much higher than the national unemployment rate and the
duration of unemployment was twice the national figure. Despite low participation
rates, which were influenced by a perceived lack of suitable jobs, there was little
movement of labour away from the towns. Similarly, Mauro and Spilimbergo (1999)
found that in Spain highly skilled workers migrate very quickly in response to a decline
in regional labour demand, whereas the low-skilled workers drop out of the labour force
or stay unemployed. The potential rise in income afforded by moving to a region with
better employment opportunities can be offset by the loss of community and family
support, differential housing costs and inadequate infrastructure in rapidly growing
areas. It is apparent that the choices people make about how and where they wish to live are not based solely on wage differentials and that the availability of suitable jobs and social support is also important.

Despite these tangible and intangible barriers to migration, Blanchard and Katz (1992) conclude that the empirical evidence for the United States shows that interregional migration of labour is the major adjustment mechanism to regional employment shocks. In their analysis, a state returns to its trend rate of employment growth after a shock to employment, but at a lower level of employment due to out-migration of labour. In Australia, the Industry Commission (1993) used a similar analytical framework to Blanchard and Katz and found that changes in the participation rate rather than migration are important in adjustment in Australia. Similarly, Decressin and Fatas (1995) found that changes in the participation rate rather than migration was the response to regional shocks in Europe. In contrast, Debelle and Vickery (1999) and Groenewold (1997) found that migration plays an important role in equalising labour markets between states, but the process takes some time and persistent differences in unemployment rates remain. Debelle and Vickery suggest the different results obtained from the Industry Commission adaptation of the Blanchard-Katz model was due to different stationarity assumptions and a shorter sample period in that study.

In relation to firm migration and capital mobility, in the Blanchard-Katz model, it is assumed that while both high unemployment and low wages lead to labour migration, only lower wages induce firms to move into a region. Thus the more the initial decline in demand is reflected in unemployment, rather than wages, the larger the long-run effect of adverse shocks on employment is likely to be. High unemployment rates that are not accompanied by lower relative wages, however, can have an adverse effect on in-migration of firms. Higher unemployment implies a larger pool of workers,
which is attractive to firms, but it also implies other negative externalities that
would deter firms. Firms are less likely to move to a depressed area because of demand
spillovers. For instance, an area where there are low wages and high unemployment is
unlikely to be attractive to a service industry. Debelle and Vickery (1999) conclude that
firm migration is not a significant contributor to the adjustment process in Australia,
although lack of data hampers an empirical analysis of this process.

3.5.3 Shocks to small, open economies

Terms of trade

The Australian and Victorian economies are small, open economies, in which
the real interest rate and the terms of trade are exogenously determined. For the
Victorian economy, the price level and the exchange rate are also exogenously
determined by conditions prevailing at the national level. The terms of trade has a
substantial effect on real exchange rates. Gruen and Wilkinson (1991) provide evidence
of a stable, positive, long-run relationship in Australia between real exchange rates and
the terms of trade. In a theoretical sense, it is normally assumed that an increase in a
country’s net holdings of foreign assets is assisted by an improvement in the terms of
trade and leads to an appreciation of the domestic real exchange rate. Since the floating
of the Australian dollar in late 1983, Australia’s rising current account deficit has been
associated with a depreciation of the Australian dollar. The exchange rate has a
significant impact on Australian farm incomes because the majority of farm output and
around a third of farm inputs are traded on the international market. Changes in interest
rates affect firms directly through the change in interest payments and income from
deposits as well as indirectly by induced changes in the exchange rate.
The impact of an adverse terms of trade shock on the current account will in theory have three effects. First, it will lower current income relative to future income, inducing a consumption-smoothing effect by reducing aggregate saving. Second, it will increase the current price of imports relative to the future price of imports, inducing a consumption-substitution effect. Third, it will increase the price of tradables relative to the price of non-tradables, thereby affecting the real exchange rate. The balance of these three effects will determine the overall effect on the current account. Cashin and McDermott (1998) found that the terms of trade are an important cause of variation in the current account position for Australia, New Zealand, Canada, the United Kingdom and the United States. They used a vector autoregression model to determine that shocks to the terms of trade are persistent for all of the above countries except the United States.

Easterly, Kremer, Pritchett and Summers (1993) found a significant role for terms of trade shocks in determining the distribution of world income. Lefebre and Poloz (1996) found evidence of differential impacts on the Canadian provinces from terms of trade shocks as a function of the sectoral composition of the provincial economy, using vector autoregression modelling. They suggest this has implications for convergence studies in that underlying convergence may be underestimated when regions are adversely affected by terms of trade shocks; alternatively, the estimates of convergence may be measuring re-equilibration following a terms of trade shock rather than underlying convergence.
Supply shocks

In regions that are heavily reliant on the agricultural sector, drought-induced supply shocks cause major output and income fluctuations. Campbell, Crowley and Demura (1983) estimated that half the decline in Australia’s real Gross Domestic Product of approximately two per cent during the recession of 1982 and 1983 could be attributed to the effects of drought, mainly through the linkages between farming businesses and their local economies. Rural producers have economic linkages as buyers of materials and labour inputs for use in the production process, as producers and sellers of commodities, either for final consumption or processing and as buyers of consumption and investment goods, especially plant and machinery (Campbell, Crowley and Demura, 1983). These supply shocks lead to divergence of regional output levels by shifting affected regions away from their long-run steady state level, but may increase regional growth rates during the transition towards the long-run steady state growth position. A similar transition is predicted after a supply shock caused by a drop in commodity prices or major industry restructuring.
3.6 Conclusion

The neoclassical model of economic growth has been widely adopted as a framework for regional economic analysis, despite some limitations and some conflicting empirical results. The neoclassical model predicts convergence of per capita income levels and growth rates between regions. Endogenous growth theory, and models arising from the ‘new’ economic geography, have been developed and tested to a limited extent in a regional context, but require further empirical analysis. In the neoclassical model, impediments to convergence are attributed to barriers to factor mobility, which violate a key assumption of the model, or to exogenous shocks, which cause economies to deviate from the steady state position and take a transitional path to equilibrium. The neoclassical framework is used to explore facets of economic growth in Victoria in the following chapters.
CHAPTER 4. METHODS

4.1 Introduction

As economic growth is a complex process, there is no single method of analysis that is sufficient for a thorough investigation of the Victorian economy. Rather, different aspects of the growth process require different approaches. Several key questions arise from the information and discussion in Chapter 2 and the literature review in Chapter 3. In this chapter, these key questions are posed and the research method proposed to answer them is outlined. The specific application of each method is presented in the relevant chapter, which also include the data, the results and the discussion arising from each individual study.

4.2 Measuring Income Changes

It is evident from the regional per capita taxable income charts presented in Figure 2.6 that regional incomes have fluctuated considerably between 1980 and 1998. The regions with a heavy reliance on the agricultural sector and those undergoing major economic restructuring are in apparent decline relative to Melbourne. It is useful to have
recourse to formal measures of income variation in order to answer the questions that arise from this:

- How have Victorian regional incomes changed over time?
- Has the distribution of income within and between regions changed?

To measure the dispersion of income between the Victorian regions, standard statistical measures of the extent to which regional incomes vary about the state mean income are used, based on Williamson (1965). These include the population-weighted coefficient of variation $V_w$, the unweighted coefficient of variation $V_{uw}$, and the weighted mean absolute deviation $M_w$ (see Section 3.3.3).

$V_w$ is a weighted coefficient of variation that measures the dispersion of the regional per capita income levels relative to the Victorian state mean with each regional deviation weighted by its share in the state population. $V_{uw}$ measures the dispersion of the regional per capita income levels relative to the Victorian state mean, but with each region weighted equally. $M_w$ considers absolute deviations of regional per capita income from the state mean, and thereby provides a check on the $V_w$ result, which may be sensitive to a few extreme deviations in per capita income (Williamson, 1965). An increase in any of these measures indicates that income inequality between regions is increasing and regional incomes are diverging.

In addition, Barro and Sala-i-Martin (1991) use a related measure of dispersion, where the dispersion of per capita income is expressed as the unweighted cross-sectional standard deviation of the log of per capita income. This measure is known as $\sigma$ and a
reduction in the dispersion of incomes between cross-sectional units using this measure is termed \( \sigma \)-convergence (see Section 3.3.3).

The unweighted coefficient of variation measure and the standard deviation measure are often used interchangeably to measure changes in income inequality over time. However, the two measures are not entirely comparable and the coefficient of variation more specifically accounts for changes in the overall level of income (Bernat, 2001). This is because both the weighted and unweighted coefficient of variation are calculated relative to the aggregate income for the parent region, (in this case, Victoria), rather than relative to the mean of the income series, which is equivalent to the ‘average of the averages’. Therefore, the coefficient of variation is measuring convergence or divergence relative to the state mean rather than convergence or divergence to the mean of the income series, as is the case with \( \sigma \).

Two measures of income, gross personal income and taxable personal income are examined. Gross personal income data is collected at the ABS Census of Population and Housing. Census data is a reliable measure of gross income and is applicable in Australia-wide regional analyses of income inequality (Hunter and Gregory, 1996). To address the question of income distribution within a population, the Gini coefficient, which is a standard measure of income distribution, is calculated from the gross personal income data collected at the census. The detail on income ranges in the census income question allows calculation of the Gini coefficient.
The detail required to calculate Gini coefficients is not available for the taxable income data, which is compiled from the Australian Taxation Office (ATO) annual Taxation Statistics. In contrast to census data this innovative use of taxable income data from the ATO has three main advantages. First, it allows annual measurement of income over a reasonable time series. Second, the availability of data by postcode areas, the boundaries of which are generally stable, means it can be aggregated to consistent Statistical Division boundaries, which often change between census. Third, the majority of social security transfer payments are excluded, as they are generally non-taxable.

The statistical measures outlined above are used to ascertain the distribution of per capita income within and between the Victorian regions, to gain an understanding of the pattern of regional income changes between 1980 and 1998. This analysis is presented in Chapter 5.

4.3 Shocks to the Victorian Economy

The question arising from the pattern of aggregate economic growth identified in Chapter 2 is: what is the source of these variations in the Victorian economy? Annual output growth, as measured by Gross State Product, was zero in 1986, five per cent in 1987, -2.5 per cent in 1991 and four per cent in 1996 (ABS, 1997a). It is informative to know whether supply, demand or external terms of trade shocks have predominated in
causing these fluctuations in the Victorian economy. Once identified, these factors can be extrapolated to fluctuations at the regional level.

Vector autoregression models have been used in forecasting and analysing Australian macroeconomic variables (see Trevor and Thorp, 1988; Smith and Murphy, 1994; Otto, 1995 and Dungey and Pagan, 1997). The proponents of vector autoregression modelling argue that simultaneous equations modelling places too many a priori restrictions on structural parameters, whereas vector autoregression models provide a flexible framework free from the constraint of macroeconomic theory. This technique does not impose any theoretical structure on the interactions between the variables but models the evolution over time of each variable as an unconstrained function of past values of that variable, along with current and past values of the other variables in the system.

Blanchard and Quah (1989) constructed a bivariate vector autoregressive model of a closed economy, which they applied to the United States economy. Otto (1995) extended the Blanchard-Quah model to include the impact of terms of trade shocks on the Australian economy. In this study, Otto’s version of the extended Blanchard-Quah model is applied using Victorian quarterly data on Gross State Product and the unemployment rate and the Australian terms of trade. The econometric framework is designed to simultaneously identify the effects of various types of structural shocks on output growth and the unemployment rate. Data constraints preclude similar modelling at the regional level. However, the results can be used to identify factors likely to influence growth at the regional level. This analysis is presented in Chapter 6.
4.4 Regional Growth and Convergence

Once the major influences on the aggregate Victorian economy are identified, the questions that arise from this are:

- What effect do these factors have on the income growth of the regional economies?
- Are the poorer regions catching up with the wealthier regions?

The approach adopted here is to use the neoclassical growth model, incorporating the variables of interest, to analyse regional growth and convergence. In the absence of a measure of gross regional product for these regions, the per capita taxable income level is substituted.

Barro and Sala-i-Martin (1991, 1992) proposed the neoclassical framework for the evaluation of growth and convergence in a cross-sectional analysis (see Section 3.3.3). It has also been extended for analysis of time-series cross-sectional data, with additional explanatory variables, by Cashin and Loayza (1995) and for panel data by Islam (1995) and Canova and Marcet (1995). This framework for analysis achieves two objectives. By incorporating explanatory variables in the model, it ascertains which factors contribute to variation in per capita income at the regional level in Victoria. It also allows for investigation of the existence and rate of conditional β-convergence, which indicates whether the poorer regions are catching up with the wealthier regions.
Taking growth in per capita income as the dependent variable, growth in per capita income in each region is hypothesised to be a function of initial per capita income, agricultural land use, value of agricultural production, rainfall, unemployment rate, participation rate, population growth and the terms of trade. A panel of these variables is constructed and the regional growth model estimated. This analysis is presented in Chapter 7.
4.5 Conclusion

The research methods described in this chapter are derived from the large literature on economic growth. They are appropriate for answering the particular questions that arise from the aim of a thorough examination of economic growth and change in the Victorian economy. These aspects of economic change, namely income changes, shocks to the Victorian economy and regional growth and convergence are analysed in Chapters 5, 6 and 7 respectively. The details of the specific methods chosen are elaborated in the method/model section of the relevant chapter.
5.1 Introduction

An analysis of income levels and disparities in Victoria between 1980 and 1998 is presented in this chapter. The objective in this analysis is to gain an overview of regional income changes and the extent of income disparities. This analysis can be interpreted within the framework of neoclassical growth theory, and used to formulate the subsequent regional growth model. Standard statistical tests are used to assess income disparities between the Victorian regions and to determine the degree of convergence or divergence of per capita income levels.

Two early and influential studies using the neoclassical framework are Borts and Stein’s (1964) study of regional development in the United States and Williamson’s (1965) comparison of regional income in a group of developed countries. Interestingly, the results of Williamson’s study showed, at the state level, that Australia had close to the most equal distribution of income in the countries studied. Williamson reported that the weighted coefficient of variation of state per capita incomes was 0.058 between 1950 and 1960, and this was then cited as evidence that Australia did not have a ‘regional problem’. However, at the sub-state level, Butler and Mandeville (1981) suggest that a high degree of urbanisation and the decline of rural areas are features of ‘the Australian regional problem.’ They note that income disparities between sub-state regions would be expected to be higher than for the states as these regions are more heterogeneous in
resource endowments, economic structure, population growth rates and service accessibility.

There was, however, little analysis of income equality at the sub-state level until the 1970s. Analysis of trends in income inequality in Australia was impeded by lack of data until 1969, when the ABS began surveys of income distribution, which were repeated in 1974, 1979 and 1982 (McLean and Richardson, 1986). In addition, since 1976, an income question has been included in the five-yearly Census of Population and Housing (ABS, 1997b) Census respondents are asked to nominate the range into which their individual weekly gross income falls.

Maxwell and Peter (1988), Maxwell and Hite (1992) and Cashin and Strappazon (1998) investigated the dispersion of income between, and the income distribution within, Australian Statistical Divisions. These studies were based on income data from the census, collected at five-yearly intervals since 1976. Maxwell and Hite (1992) reported low household income in the agriculturally based and warm coastal regions of Australia between 1976 and 1986, and high household income in the capital city regions, most notably Sydney. In Victoria, Cashin and Strappazon (1998) found that there was an overall tendency for convergence of per capita incomes between Statistical Divisions during the period 1976 to 1991. However, they reported that there were long-standing disparities between Statistical Divisions, with agriculturally based Statistical Divisions in the west of Victoria having persistently lower per capita incomes. More recent investigations of household income show continuing regional inequalities between metropolitan and non-metropolitan Australia (Smith, 1999; Lloyd, Harding and Hellwig, 2000). Lloyd, Harding and Hellwig (2000) present evidence that, whilst not all regional
areas in Australia are in decline, a number of the Victorian regions suffered a severe
decline in household income between the 1991 and 1996 Census.

In a comprehensive analysis of the extent of Department of Social Security (DSS,
now called Centrelink) transfer payments, Bray and Mudd (1998) found that 14.6 per cent
of personal disposable income in Melbourne in 1996 was derived from DSS transfers,
whereas the figure was 20 per cent for the Balance of the State. In this context, personal
disposable income is classified as income remaining after the deduction of income tax
from gross income. It does not necessarily mean total dependence on DSS payments, as
some of the payments include family payments and additional allowances such as rent
assistance. There were concentrations of Statistical Local Areas in Melbourne’s west,
north west and outer south-east where social security transfers accounted for more than
25 per cent of personal disposable income. Outside Melbourne, some Statistical Local
Areas had levels of social security transfer payments over 30 per cent. The All Gippsland
region (encompassing Gippsland and East Gippsland Statistical Divisions into a DSS
region) had the highest regional average at 21.8 per cent.

In this chapter, both gross personal income and taxable income data are analysed.
Gross personal income data, collected at the ABS Census of Population and Housing, is
analysed first. Census data for Victoria from 1981 to 1996 is fitted to boundaries for the
1996 Statistical Divisions and analysed on a per capita basis to assess changes in income
levels between and within regions. The detail in the Census income question enables an
assessment of income distribution to be made, as the Gini coefficient can be calculated.
This study extends the work of Cashin and Strappazon (1998) to include data from the
1996 Census.
The second analysis is undertaken on taxable income data obtained from the Australian Taxation Office. Taxable income per capita is calculated using the annual population estimates from the ABS for the Statistical Divisions. Growth in per capita taxable income then serves as the dependent variable in the subsequent economic growth model specified in Chapter 7. The data and methods of analysis are discussed in the following section.

5.2 Method

5.2.1 Coefficient of variation

Standard statistical measures of the extent to which regional incomes vary about the state mean income include the population-weighted coefficient of variation $V_w$, the unweighted coefficient of variation $V_{uw}$, and the weighted mean absolute deviation $M_w$. (Williamson, 1965). In addition, the dispersion of per capita income $\sigma$ is expressed as the unweighted cross-sectional standard deviation of the log of per capita income (Barro and Sala-i-Martin, 1991). The predominance of the Melbourne region in the share of Victorian population would tend to skew any result that does not take population share into account, so that $V_w$ and $M_w$ are the preferred measures over those that are unweighted for population.

The unweighted coefficient of variation can be expressed as:

$$V_{uw} = \left[ \sum_i (y_i - \bar{y})^2 N^{-1} \right]^{1/2} \bar{y}^{-1} \quad (5.1)$$
where $y_i$ is income per capita of the $i$th region;

$\bar{y}$ is income per capita for the aggregate of the regions; and

$N$ is the number of regions.

The weighted coefficient of variation weights each region’s income by the proportion of the aggregate population that the region contains, and is specified as:

$$V_w = \left[ \sum_i (y_i - \bar{y})^2 f_i n^{-1} \right]^{1/2} (\bar{y})^{-1}$$

(5.2)

where $n$ is the aggregate population;

$f_i$ is the population in the $i$th region; and

all other variables are as specified above.

Whereas $V_w$ considers squared deviations of income relative to the mean, $M_w$ considers absolute deviations, and is specified as:

$$M_w = (\sum_i \xi y_i - \bar{y} \xi f_i n^{-1}) 100 (\bar{y})^{-1}$$

(5.3)

where all terms are as defined above.

The unweighted cross-sectional standard deviation of the log of per capita income $\sigma$ is specified as:

$$\sigma = \left[ \sum_i (y_i - \bar{y})^2 N^{-1} \right]^{1/2}$$

(5.4)

where $y_i$ is the natural logarithm of income per capita of the $i$th region;

$\bar{y}$ is the mean of the series; and

$N$ is the number of regions.
Victorian mean income is calculated by summing across all regions and dividing by the total Victorian population for both gross and taxable income. Multiplying the midpoint of each income bracket by the number of respondents in each interval and summing across all income brackets calculates the nominal gross income of each region. The highest income bracket is an open interval so the midpoint is taken as 1.5 times the lower limit of the interval. The mean income of each region is calculated by dividing the total gross income or total taxable income by the number of persons in the region.

5.2.2 Gini Coefficient

The Gini coefficient is a summary measure of inequality of income distribution. It can vary between zero (income is distributed evenly) to one (one income unit has all of the income). Here the distribution of income within a region is assessed using Needleman’s (1978) Gini coefficient.

5.3 Data

Income and population data for the analysis of gross personal income were obtained directly from the ABS (see Appendix 4). The definition of income includes all pensions and benefits, wages and salaries and other sources of income; however, although it allows for the deduction of business and rental expenses, it is not net of
income tax. Major changes occurred to the boundaries of Victorian Statistical Divisions between 1986 and 1991. The data set was derived from the 1981, 1986, 1991 and 1996 Australian Census of Population and Housing by aggregating data from Collection Districts in census years on a best-fit basis to the boundaries pertaining to the 1996 census. Data for the 1976 census was not included because of the difficulty in fitting this data to the 1996 boundaries. It is possible that census respondents understate their income but there is no evidence to suggest that the extent of this has changed relatively over the last four census. A comparison of census income data with Income Distribution Surveys and the National Accounts by Hunter and Gregory (1996) shows that census data is suitable as a measure of gross income.

For the analysis of taxable income, annual data on personal taxable income from the Australian Taxation Office, which is available at the postcode level, was aggregated to the 1996 Statistical Division boundaries (see Appendix 5). Per capita taxable income was calculated using ABS data, made available through the Victorian Department of Infrastructure. The data period was 1980 to 1998. This measure of personal income excludes the majority of social security transfer payments, as they are generally non-taxable.

All monetary values are in 1996 dollars, calculated by using the national Implicit Price Deflator Indexes for Gross Domestic Product (1996 base) supplied by the ABS.
5.4 Results

5.4.1 Gross personal income

Dispersion

The dispersion of per capita income between Victorian regions increased over the period 1981 to 1996. Summary statistics of the gross per capita personal income data analysis are shown in Table 5.1. In real terms, the Victorian mean per capita income increased by 20 per cent between 1981 and 1996. The unweighted standard deviation, the population-weighted coefficient of variation $V_w$, the unweighted coefficient of variation $Vu_w$ and the weighted mean absolute deviation $M_w$ all increased between 1981 and 1986, were stable between 1986 and 1991 and increased again between 1991-96. The value of $\sigma$ increased between 1981 and 1986 and then remained stable for the rest of the period.

The proportion of regional per capita income relative to the Victorian mean per capita income and the percentage change in this variable over time are shown in Table 5.2. A percentage change in regional per capita income relative to the mean per capita income of greater than two per cent is considered significant. This figure is arbitrary but is consistent with other studies (see Maxwell and Hite, 1992). Armstrong (1995a) cautions against confusing this classification of the individual growth performance of regions with the concept of $\beta$-convergence arising from the neoclassical model. Convergence in the neoclassical sense is not toward the mean per capita income, but rather towards a long-run steady state value. Nevertheless, this classification is useful as it reveals that the performance of individual regions can vary greatly, even within a pattern of broadly convergent or divergent growth.
Overall, during the period 1981 to 1996, five regions exhibited downward divergence (movement away from the Victorian average from below), one region (Ovens-Murray) exhibited upward convergence (movement towards the Victorian average from below) and the remaining five regions showed no significant change. Gippsland has the most significant downward divergence. Wimmera had large fluctuations in per capita income but exhibited downward divergence overall. Mallee and East Gippsland both had the lowest per capita income at eighty per cent of the Victorian mean in 1996.

Table 5.1 Summary Statistics for Victorian Statistical Divisions

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<tr>
<td>Victorian mean per capita income</td>
<td>12 624</td>
<td>13 285</td>
<td>13 801</td>
<td>15 197</td>
</tr>
<tr>
<td>Standard deviation across regions</td>
<td>741</td>
<td>934</td>
<td>948</td>
<td>1 121</td>
</tr>
<tr>
<td>$V_{uw}$</td>
<td>0.11</td>
<td>0.14</td>
<td>0.14</td>
<td>0.15</td>
</tr>
<tr>
<td>$V_{w}$</td>
<td>0.07</td>
<td>0.09</td>
<td>0.09</td>
<td>0.10</td>
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<tr>
<td>$M_{w}$</td>
<td>6.38</td>
<td>7.81</td>
<td>7.85</td>
<td>8.53</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.06</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
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* Annual gross income. Monetary values in 1996 Australian dollars.
### Table 5.2 Real Per Capita Income as a Proportion of the Victorian Average

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<tbody>
<tr>
<td>Melbourne</td>
<td>1.04</td>
<td>1.05</td>
<td>1.06</td>
<td>1.06</td>
<td>1.02</td>
<td>0.04</td>
<td>0.43</td>
</tr>
<tr>
<td>Barwon</td>
<td>0.90</td>
<td>0.90</td>
<td>0.89</td>
<td>0.89</td>
<td>-0.06</td>
<td>-1.33</td>
<td>-0.20</td>
</tr>
<tr>
<td>Western District</td>
<td>0.86</td>
<td>0.85</td>
<td>0.84</td>
<td>0.85</td>
<td>-0.84</td>
<td>-0.89</td>
<td>0.92</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>0.83</td>
<td>0.83</td>
<td>0.83</td>
<td>0.83</td>
<td>0.24</td>
<td>0.22</td>
<td>-0.57</td>
</tr>
<tr>
<td>Wimmera*</td>
<td>0.92</td>
<td>0.82</td>
<td>0.91</td>
<td>0.84</td>
<td>-9.36*</td>
<td>8.86*</td>
<td>-6.8*</td>
</tr>
<tr>
<td>Mallee*</td>
<td>0.88</td>
<td>0.79</td>
<td>0.80</td>
<td>0.80</td>
<td>-9.18*</td>
<td>0.66</td>
<td>0.51</td>
</tr>
<tr>
<td>Loddon*</td>
<td>0.86</td>
<td>0.85</td>
<td>0.86</td>
<td>0.83</td>
<td>-1.15</td>
<td>0.22</td>
<td>-2.65*</td>
</tr>
<tr>
<td>Goulburn</td>
<td>0.86</td>
<td>0.84</td>
<td>0.85</td>
<td>0.84</td>
<td>-2.64*</td>
<td>0.96</td>
<td>-0.29</td>
</tr>
<tr>
<td>Ovens-Murray*</td>
<td>0.89</td>
<td>0.89</td>
<td>0.94</td>
<td>0.92</td>
<td>0.10</td>
<td>4.82*</td>
<td>-1.19</td>
</tr>
<tr>
<td>East Gippsland*</td>
<td>0.91</td>
<td>0.88</td>
<td>0.86</td>
<td>0.80</td>
<td>-2.88*</td>
<td>-1.58</td>
<td>-5.81*</td>
</tr>
<tr>
<td>Gippsland*</td>
<td>0.96</td>
<td>0.92</td>
<td>0.87</td>
<td>0.83</td>
<td>-4.17*</td>
<td>-4.70*</td>
<td>-3.97*</td>
</tr>
<tr>
<td>Std Deviation</td>
<td>0.06</td>
<td>0.07</td>
<td>0.06</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Downward divergence  † Upward convergence

### Gini coefficients

The distributions of income within regions improved when assessed using the Gini coefficient as a measure of income distribution. The Gini coefficients for the Victorian regions, are reported in Table 5.3. A decrease in the Gini coefficient is an indication that income distribution within the region has become more equal. Only in the case of East Gippsland did the Gini coefficient increase between 1981 and 1996, mainly as a result of an increase between 1981 and 1986.
5.4.2 Taxable income

*Income growth*

The average annual per capita taxable income and the aggregate taxable income for Victoria are shown in Figure 5.1. The aggregate taxable income appears to have been adversely affected by drought and recession in the early 1980s, followed by a period of growth, before the prolonged recession in the early 1990s and subsequent slow but steady recovery.
The average annual growth rate in per capita taxable income for the Victorian regions between 1980 and 1998 was 1.08 per cent. However, taking the two periods 1980 to 1989 and 1990 to 1998 separately, the average annual growth rate in per capita taxable income was 2.96 per cent in the first period and negative 0.21 per cent in the second period. The impact of these changes was different in each region, as can be seen by the contribution of each of the regions to these growth rates (see Figure 5.2). Gippsland had a negative rate of income growth overall for the entire period from 1980 to 1998. East Gippsland had a significant decline in income growth between 1990 and 1998. However, in East Gippsland there was a period of high income growth between 1980 and 1989, rising from a low base in 1980.

Dispersion

Summary statistics of income dispersion for the Victorian regions are shown in Table 5.4 and Figure 5.3 (for full table see Appendix 5). All measures of dispersion relative to the state mean show divergence in per capita taxable income from 1980 to 1998. This result accords with the divergence evident in the gross per capita income figures from the Census data shown in Section 5.4.1. Using the measure of the standard deviation of the log of per capita income, which measures dispersion between regions, there has been slight $\sigma$-convergence during this time period. However, there have been periods of $\sigma$-divergence, which appear to vary with the prevailing business cycle and other identifiable shocks to the Victorian economy, such as a supply shock caused by drought conditions. These results suggest that, whilst per capita taxable income in the majority of the regions is converging, these regions are also diverging away from the
Victorian state mean per capita income. This result is evident in a comparison of taxable per capita income for each region over the period 1980 to 1998 (see Figure 5.4).

Other income indicators, such as proportion of the Victorian average annual per capita taxable income, the percentage share of aggregate Victorian taxable income in each region and the growth in total income for each region suggest that divergence is occurring (see Table 5.5; for explanation of divergence/convergence in this context, see Section 5.4.1). Whilst Melbourne exhibited upward divergence from the Victorian average annual per capita income, Central Highlands showed upward convergence toward the Victorian average. All other regions showed downward divergence, with Gippsland moving from above the Victorian average to a position well below.

Table 5.4 Summary Statistics for Victorian Statistical Divisions

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Victorian mean per capita income</td>
<td>10 949</td>
<td>12 506</td>
<td>14 300</td>
<td>12 954</td>
<td>14 217</td>
</tr>
<tr>
<td>Standard deviation across regions</td>
<td>1 185</td>
<td>1 391</td>
<td>1 509</td>
<td>1 277</td>
<td>1 308</td>
</tr>
<tr>
<td>$V_{uw}$</td>
<td>0.14</td>
<td>0.18</td>
<td>0.18</td>
<td>0.19</td>
<td>0.19</td>
</tr>
<tr>
<td>$V_{w}$</td>
<td>0.08</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.11</td>
</tr>
<tr>
<td>$M_{w}$</td>
<td>5.93</td>
<td>8.19</td>
<td>8.83</td>
<td>8.99</td>
<td>9.30</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.12</td>
<td>0.14</td>
<td>0.12</td>
<td>0.11</td>
<td>0.10</td>
</tr>
</tbody>
</table>

*Monetary values are in 1996 Australian dollars
Figure 5.1  Mean Annual Per Capita Taxable Income, ‘000s, and Aggregate Taxable Income, $96 millions, for the State of Victoria, 1980 to 1998
The share of the aggregate Victorian taxable income increased in Melbourne, Central Highlands and Ovens-Murray and was stable in Loddon. This is a reflection of the above Victorian average growth in total income in these regions. The share of total income and the growth in total income is only partly accounted for by population growth in the regions. Loddon had the strongest population growth but had only just above average growth of total income, whilst Melbourne has the highest growth in total income with a population growth rate just above the Victorian average. Western District had less than half the growth of total income, whilst maintaining zero population growth.
## Table 5.5 Per Capita Taxable Income Indicators for the Victorian Statistical Divisions

<table>
<thead>
<tr>
<th>Statistical Division</th>
<th>Proportion of state mean</th>
<th>Share of total income %</th>
<th>Population growth %</th>
<th>Growth of total income %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melbourne</td>
<td>1.04</td>
<td>1.07</td>
<td>74.6</td>
<td>77.3</td>
</tr>
<tr>
<td>Barwon</td>
<td>0.98</td>
<td>0.89</td>
<td>5.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Western District</td>
<td>0.86</td>
<td>0.79</td>
<td>2.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>0.77</td>
<td>0.81</td>
<td>2.3</td>
<td>2.4</td>
</tr>
<tr>
<td>Wimmera</td>
<td>0.89</td>
<td>0.79</td>
<td>1.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Mallee</td>
<td>0.79</td>
<td>0.75</td>
<td>1.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Loddon</td>
<td>0.86</td>
<td>0.79</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Goulburn</td>
<td>0.91</td>
<td>0.86</td>
<td>3.6</td>
<td>3.4</td>
</tr>
<tr>
<td>Ovens-Murray</td>
<td>0.87</td>
<td>0.86</td>
<td>1.6</td>
<td>1.7</td>
</tr>
<tr>
<td>East Gippsland</td>
<td>0.81</td>
<td>0.73</td>
<td>1.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Gippsland</td>
<td>1.12</td>
<td>0.80</td>
<td>3.8</td>
<td>2.7</td>
</tr>
<tr>
<td>Victoria</td>
<td>18.9</td>
<td>54.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Upward divergence  * Downward divergence  #Upward convergence
Looking at $\beta$-convergence (see Section 3.3.3), the relationship between $\ln(y_{1980})$ (initial income) and the geometric average growth rate of per capita incomes between 1980 and 1998 for each of the Victorian regions is presented in Figure 5.5. The simple correlation between initial income and growth is -0.53. The negative relationship between them indicates $\beta$-convergence for the eleven regions. In Figure 5.5, it is apparent that the Central Highlands and Melbourne regions have had faster income growth than would be predicted by their initial income and Gippsland region has had slower income growth. The $\beta$-convergence relationships are examined more closely in Chapter 7 using panel data estimates of the regional growth model.

Figure 5.5  Average Annual Taxable Income Growth 1980 and 1998, Per Cent, against Log of Per Capita Taxable Income for the Victorian Statistical Divisions

5.5 Discussion

The results of the gross income analysis are consistent with Cashin and Strappazzon (1998) for 1981, 1986 and 1991, but extending the analysis to include 1996 data shows increasing dispersion in the mean per capita incomes of Victorian regions and the persistence of long-standing disparities. The weighted coefficient of variation of gross per capita income was 0.07 in 1981 and 0.10 in 1996. In comparison, the unweighted standard deviation of the log of per capita income went from 0.06 to 0.8 between 1981 and 1986 but remained at 0.8 in 1991 and 1996. The finding of an increase in the dispersion of per capita gross incomes between the regions in Victoria between 1981 and 1996 is in line with the general trend found by Maxwell and Hite (1992), who reported divergence of mean household incomes in agriculturally based regions across Australia between 1976 and 1986. Cashin and Strappazon (1998) also reported a clear divergence from the Victorian mean income in the predominantly agricultural regions of the Wimmera and Northern Mallee (since renamed Mallee) over the period 1976 to 1991, although they found no evidence of increasing dispersion of per capita incomes between Victorian regions as a whole during this period.

Although the results for agriculturally based regions were not uniform, and most of the Victorian regions have a mixture of agriculture and manufacturing, Cashin and Strappazon concluded that the dominance of the agriculture sector in the region was a major influence on per capita incomes, as a flow-on effect from fluctuations in the broadacre cropping industries in these regions between 1976 and 1991. In this study, within the four predominantly agriculturally based Victorian regions, Wimmera, Mallee and East Gippsland had significant declines (greater than two per cent) in their mean per capita income relative to the Victorian mean from 1981 to 1996, while Western District showed no significant change. Gippsland and Loddon, which have a mixture of agriculture and manufacturing, also had significant income decline, with the Gippsland
region having the largest decline of all the regions. Restructuring in the power industry and subsequent high unemployment and low participation rates in the Latrobe Valley in the Gippsland region appear to have had a major impact on income levels.

Gini coefficients for the Victorian regions decreased between 1981 and 1996. That is, the distribution of income within regions improved by this measure, and the position of the regions relative to each other in terms of income distribution did not change significantly. The exception to this was East Gippsland, which had a rise from the lowest Gini coefficient in 1981 to the highest in 1986 but then went down again to be mid-range of the other regions by 1996. The demography of a region and its economic structure has a bearing on the income distribution within it, so that regional Gini coefficients need to be interpreted carefully. Regions where incomes received are in a fairly narrow range tend to have a more even distribution of income than regions that also incorporate significant numbers of retirees, professionals or an urban population surrounded by rural areas (Maxwell, Hale and Peter, 1991). The settlement of retirees along the coastal areas of the East Gippsland region and restructuring in the timber and resource industries may help explain why the Gini coefficient for this region increased between 1981 and 1996.

The per capita taxable income analysis also showed the dispersion of regional per capita taxable incomes around the Victorian state mean became greater between 1980 and 1998. However, there was a slight $\sigma$-convergence of per capita taxable incomes between regions between 1980 and 1998, although there were periods of divergence also. The weighted coefficient of variation increased from 0.08 in 1980 to 0.11 in 1998. However, for most of this period, the weighted coefficient of variation was quite stable at approximately 0.10. Sigma went from 0.12 in 1980 to 0.10 in 1998, but periods of divergence did occur, with $\sigma$ being 0.16 in 1983 and 0.14 in 1994. The other taxable income indicators, such as proportion of the Victorian mean per capita income, the percentage share of aggregate taxable income in each region and the growth in total
taxable income for each region suggest that divergence is occurring and there is persistence in long-term income disparities. Exceptions are Central Highlands, which improved its position relative to the Victorian mean and Gippsland, which came from a position above to finish well below the Victorian mean in 1998.

5.6 Conclusion

The implications of the increasing disparity and the volatility of per capita incomes between Victorian regions are twofold. The first implication is that the economic status of people in the regions exhibiting downward divergence of incomes appears to have worsened. There is evidence of dualism, in that Melbourne has continued to grow and maintain high per capita income levels, whilst the majority of the regions suffered a decline in income levels. The second implication is that structural change and economic shocks have had a differential impact on the regions. To ascertain the sources of economic shocks to the aggregate Victorian economy, a model of the Victorian state economy, which identifies the macroeconomic influences on output and employment at the aggregate level, is presented in the following chapter.
CHAPTER 6. SHOCKS TO THE VICTORIAN ECONOMY

6.1 Introduction

The general demographic, economic and labour market trends in Victoria, described in Chapters 2 and 4, indicate a process of continuous economic change and widely fluctuating fortunes in the Victorian regions between 1980 and 1998. To investigate these trends further, it is informative to get an overall picture of the forces that shape the aggregate Victorian economy. Is it supply, demand or external terms of trade shocks that have been the dominant source of these fluctuations in the Victorian economy? Victoria is a small, open economy, which takes the real interest rate and terms of trade as exogenously given by conditions existing in the rest of the world (see Section 2.2). Studies of other small, open economies have shown the terms of trade has a strong, though variable, influence on economic growth, and the influences of demand and supply shocks on macroeconomic variables have differed between economies.

The sources of macroeconomic fluctuations have an important influence on the cyclical dynamics of the trade balance and the business cycle. Macroeconomic theorists (notably Blanchard, 1989) have suggested that strong demand growth leads to an increase in both output and prices in the short-run. Demand and terms of trade shocks can lead to variations in output in the same direction. However, demand and terms of trade shocks can have different effects on real exchange rates and, as a consequence, different effects on trade variables. Aggregate supply has been found to influence the determination of output and prices in both the long- and short-run. The effects of supply shocks on trade variables often differ substantially from the effects of demand or terms
of trade shocks, particularly in the long-run. Therefore, the relative importance of demand, supply and terms of trade shocks is likely to vary considerably over different time horizons and between countries. In so far as governments and agencies are able to influence macroeconomic variables, knowledge of the relationships between these variables and the source of different economic shocks are important policy tools.

The aim of the analysis reported in this chapter is to ascertain the major sources and effects of shocks to the Victorian economy over the period from 1984 to 1997. The period of investigation is constrained by the availability of data on quarterly Gross State Product for Victoria. The shocks investigated are demand, supply and the terms of trade shocks. The effect of these shocks on the unemployment rate and real output growth in Victoria is measured.

To achieve this aim, a structural vector autoregression (SVAR) model is constructed. The model is based on a bivariate vector autoregressive (VAR) model of the United States economy, constructed by Blanchard and Quah (1989). Blanchard and Quah define two types of shocks affecting unemployment and output: the first type of shock has no permanent effect on either output or unemployment and the second type of shock has no permanent effect on unemployment but may have a permanent effect on output. Having defined the two types of shocks by these identification restrictions, Blanchard and Quah then suggest an economic interpretation of the first type of shock as a demand shock and the second type of shock as a supply shock. While Blanchard and Quah assume a closed economy, others have extended the framework to open economies. Otto (1995) identified the impact of terms of trade shocks on the Australian economy. Prasad (1998) provided quantitative estimates of macroeconomic fluctuations on the dynamics of international trade, while Cashin and McDermott (1998) compared
the contribution of terms of trade shocks to fluctuations in current account positions in five countries.

The extended Blanchard-Quah model is applied using quarterly data on Victorian Gross State Product and the unemployment rate and the Australian terms of trade. The econometric framework is designed to simultaneously identify the effects of various types of structural shocks on output growth and the unemployment rate. The key features of VARs and the empirical model used in this study are presented, including a description of the data and its time series properties. Then, the results of the model estimation are presented and analysed and the results are discussed.

6.2 Method – The VAR Model

In general, a VAR model can be described as a multi-equation model in which, in an $N$-variable VAR of order $p$ (VAR $(p)$), $N$ different equations are estimated. In each equation, the relevant dependent variable is regressed on $p$ lags of itself and $p$ lags of every other variable. A VAR model is suited to forecasting variables where each variable helps forecast other variables by allowing for cross-variable dynamics. The right hand side of the equation contains only predetermined variables and the error terms are assumed to be serially uncorrelated with constant variance. The probability distribution of the error terms is specified, the usual specification being that they follow a joint normal distribution and that each has zero mean and constant variance.
The mathematical form of a VAR($p$) is:

$$
\mathbf{x}_t = \mathbf{A}_0 + \mathbf{A}_1 \mathbf{x}_{t-1} + \mathbf{A}_2 \mathbf{x}_{t-2} + \ldots + \mathbf{A}_p \mathbf{x}_{t-p} + \mathbf{e}_t
$$

(6.1)

where, $\mathbf{x}_t$ = an $(n \times 1)$ vector containing each of the $n$ variables included in the VAR;

$\mathbf{A}_0$ = an $(n \times 1)$ vector of intercept terms;

$\mathbf{A}_i = (n \times n)$ matrices of estimated coefficients; and

$\mathbf{e}_t = an (n \times 1)$ vector of error terms.

Sims (1980) argues that in principle all equations in a simultaneous system should have the same right-hand side variables in order to capture all possible forms of interaction among variables. In practice, the size of VAR models is limited by the fact that each variable (including lags) appears in each equation, yet estimation requires sufficient degrees of freedom. There are some constraints therefore on the number of variables and the lengths of the lags used.

As well as the above constraints, restrictions can be placed upon the interactions and the dynamics to produce sensible responses and to resolve the problem of identification of a system of simultaneous equations. Linear exclusion restrictions are a common way of doing this. The role for economic theory in resolving the identification problem is to provide information on the restrictions relevant to each equation and the cross-equation restrictions.

Vector autoregression is used for analysing the dynamic impact of different types of random disturbances on systems of variables. This can be referred to as ‘policy analysis’ where policy is interpreted narrowly to mean the addition of a known
innovation shock to the model. An assumption is that the behaviour of the system is not sensitive to the underlying economic origin or nature of the shock. The variance decomposition of a VAR provides information on the relative importance of the random innovations by showing how much of the \( k \)-step-ahead forecast error variance of one variable is explained by innovations to the other variables. The source of this forecast error is variation in the current and future values of the innovations. Impulse response functions can be used to illustrate the qualitative responses of the variables in the system to a one standard deviation shock to one of the innovations.

### 6.3 Model Specification and Estimation

The model specification follows that of Blanchard and Quah (1989) with the extension to a three variable model as in Otto (1995). The VAR model in this study has the following structure;

\[
\Delta \begin{bmatrix} TT_t \\ RY_t \\ U_t \end{bmatrix} = B(L) \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \quad (6.2)
\]

where \( B(L) = B_0 + B_1L + \ldots \) is a 3x3 matrix of polynomials in the lag operator \( L \);

\( \Delta \) is the first difference operator;

\( TT_t \) is the terms of trade;

\( RY_t \) is real output and
$U_t$ is the unemployment rate.

The structural disturbances $\varepsilon_{1t}$ to $\varepsilon_{3t}$ correspond to a terms of trade shock, a supply shock and a demand shock respectively. Implicit in equation (6.2) are some assumptions about the time series properties of the three variables, in that all are assumed to be I(1) in levels and require first differencing to be stationary. The innovations are assumed to have a zero mean and to be contemporaneously uncorrelated. To justify these assumptions, the results of tests of the order of integration are presented in the data section.

Assuming $B(L)$ is of order $p$, the model equations can then be written as:

\[
\Delta TT_t = \sum_{i=1}^{p} \gamma_{tt}, i \Delta TT_{t-i} + \sum_{i=0}^{p} \gamma_{ty}, i \Delta RY_{t-i} - i \\
+ \sum_{i=0}^{p} \gamma_{tu}, i \Delta U_{t-i} + \varepsilon_{1t} \quad (6.3)
\]

\[
\Delta RY_t = \sum_{i=0}^{p} \gamma_{yt}, i \Delta TT_{t-i} + \sum_{i=1}^{p} \gamma_{ty}, i \Delta RY_{t-i} - i \\
+ \sum_{i=0}^{p} \gamma_{yu}, i \Delta U_{t-i} + \varepsilon_{2t} \quad (6.4)
\]

\[
\Delta U_t = \sum_{i=0}^{p} \gamma_{ut}, i \Delta TT_{t-i} + \sum_{i=0}^{p} \gamma_{uy}, i \Delta RY_{t-i} - i \\
+ \sum_{i=1}^{p} \gamma_{ut}, i \Delta U_{t-i} + \varepsilon_{3t} \quad (6.5)
\]

where all variables are defined as above.

However, there are two identifying restrictions on the model. The first restriction arises from the assumption that the Australian terms of trade are exogenous to the
Victorian economy. This restriction can be imposed by putting the parameters of the
\( \Delta RY \) and \( \Delta U \) terms in equation (6.3) at zero. Equation (6.3) thereby becomes (6.6):

\[
\Delta TT_t = \sum_{i=1}^{p} \gamma_{yt,i} \Delta TT_{t-i} + \varepsilon_{tt} \tag{6.6}
\]

The second restriction arises from the definition of aggregate demand shocks as
shocks which have no permanent effect on either real GSP or unemployment rate. This
restriction can be imposed by restricting the sum of the coefficients on \( \Delta U \) in equation
(6.4) to equal zero. That is,

\[
\sum_{i=0}^{p} \gamma_{yu,i} = 0 \tag{6.7}
\]

The imposition of these coefficient restrictions leads to equation (6.8):

\[
\Delta RY_t = \sum_{i=0}^{p} \gamma_{yt,i} \Delta TT_{t-i} + \sum_{i=1}^{p} \gamma_{yt,i} \Delta RY_{t-i} + \sum_{i=0}^{p-1} \beta_{yu,i} \Delta U_{t-i} + \varepsilon_{2t} \tag{6.8}
\]

where \( \beta_{yu,0} = \gamma_{yu,0} \)

and \( \beta_{yu,1} = \gamma_{yu,0} + \gamma_{yu,1} \)

\( \beta_{yu,p} = -(\gamma_{yu,0} + \gamma_{yu,1} + \ldots + \gamma_{yu,p-1}) \) where \( p \) is the lag interval.

With these restrictions, the SVAR model then becomes:

\[
\Delta TT_t = \sum_{i=1}^{p} \gamma_{yt,i} \Delta TT_{t-i} + \varepsilon_{tt} \tag{6.9}
\]
\[
\Delta RY_t = \sum_{i=0}^{p} \gamma_{yr,t-i} \Delta TT_t - i + \sum_{i=1}^{p} \gamma_{yf,t} \Delta RY_t - i \\
+ \sum_{i=0}^{p-1} \beta_{yu,t} \Delta U_t - i + \varepsilon_{yt},
\]

(6.10)

\[
\Delta U_t = \sum_{i=0}^{p} \gamma_{ut,t-i} \Delta TT_t - i + \sum_{i=0}^{p} \gamma_{uy,t} \Delta RY_t - i \\
+ \sum_{i=1}^{p} \gamma_{ut,t} \Delta U_t - i + \varepsilon_{3t},
\]

(6.11)

where all variables are as described above.

The above restrictions ensure that the structural disturbances, \( \varepsilon_{1t} \) to \( \varepsilon_{3t} \), are then mutually uncorrelated, and that, for example, \( \varepsilon_{3t} \) is the orthogonalised portion of the demand shock that does not change in response to movements in supply or the terms of trade. In the model equations (6.9), (6.10) and (6.11), the structural disturbances \( \varepsilon_{1t} \) to \( \varepsilon_{3t} \) then correspond to the underlying terms of trade, supply and demand shocks, respectively. All statistical tests were undertaken, and the model equations were estimated, using RATS386 Version 4.21 (© 1992-7 Thomas A. Doan). The error variance was calculated from the SVAR analysis, with eight lags of each variable in each of the three equations. The decomposition of the forecast error variance measures the percentage of the \( k \)-step ahead forecast error variance in each variable that is due to terms of trade, supply and demand shocks. The impulse response function describes the response of each variable to a one standard deviation shock in each innovation by tracing the effect on current and future values of the variable.
6.4 Data

Quarterly, seasonally adjusted data collected over the period from the third quarter 1984 to the second quarter 1997 was used (see Appendix 6). The Australian terms of trade (TT, base 1989/90=100) and Victorian unemployment rate (U) was obtained from the Australian Bureau of Statistics online time series. The terms of trade index is defined as the ratio of the implicit price deflator for exports of goods and services over the implicit price deflator for imports of goods and services. Time series for Victorian Gross State Product, seasonally adjusted and in constant 1989/90 prices, was obtained from the ABS Australian National Accounts: State Accounts and is as defined therein. For the SVAR model, the deseasonalised terms of trade and real output data were used.

Data on the Victorian terms of trade was only available for a limited period of 21 quarters between 1992 and 1997 (see ABS, 1997a). The Australian terms of trade was substituted to ensure a reasonable number of observations. The correlation between the Victorian terms of trade and the Australian terms of trade over this period was 0.96. Victorian Gross State Product increased from 1984 to 1997 with the exception of a decrease during 1990 and 1991 (see Figure 6.1). The Victorian unemployment rate rose significantly during 1990 and 1991, peaking above nine per cent in 1994 and decreasing to less than eight per cent in 1997. The Australian terms of trade index declined markedly during 1986, increased during 1988 and 1989 before going through another trough in 1993 and rising again from 1994 onwards.
Figure 6.1 (a) Victorian Gross State Product ($million, 1989/90 base), Quarterly 1984:3 to 1997:2

Figure 6.1 (b) Victorian Unemployment Rate, Per Cent, Quarterly 1984:3 to 1997:2
The SVAR model implies that real output, unemployment rate and terms of trade are non-stationary in levels, stationary in first differences and are not cointegrated. There is some debate in the literature on the use of I(1) data in VAR systems. While it is not strictly true that a VAR requires I(0) data to produce stable results, the inclusion of I(1) data has been shown to bias coefficient estimates (Hamilton, 1994). The results from the Phillips-Perron (1988) unit root test, computed using the Bartlett kernel and with lag lengths determined by the data-dependent method of Andrews (1991), show that all three series were I(1) in levels and stationary in first differences (see Table 6.1).

The results from the SVAR are conditioned on the maintained hypothesis of no cointegration among the levels of the variables used in the analysis. The results of the Phillips-Ouliaris (1990) $Z(t)$ residual-based test for cointegration among the three I(1) variables showed a test statistic of -2.10. The critical value at the five per cent level of significance is -3.77, thereby implying that the null hypothesis of no cointegration among the three variables cannot be rejected. Following Blanchard and Quah (1989) and
Keating and Nye (1999), a sequence of likelihood ratio tests indicated that a lag length of eight was appropriate for the SVAR. Choice of lag length with limited data availability presents some dilemmas, however sensitivity analyses indicated that the results reported below did not vary greatly when alternative lag lengths were used.

Given the above properties of the data and the requirements of the model, the SVAR variables are defined as follows. The change in terms of trade variable $\Delta TT = \frac{(tt_it - tt_{i(t-1)})}{tt_{i(t-1)}}$, where $tt_i$ is the terms of trade for period $t$ and $tt_{i(t-1)}$ is its level in the previous period. The change in real output $\Delta RY = \frac{(ry_2t - ry_{2(t-1)})}{ry_{2(t-1)}}$, where $ry_2t$ is the level of real Gross State Product for Victoria for period $t$ and $ry_{2(t-1)}$ is its level in the previous period. The change in unemployment $\Delta U = \frac{(u_3t - u_3(t-1))}{u_3(t-1)}$, where $u_3t$ is the Victorian unemployment rate and $u_3(t-1)$ is its level in the previous period.

Table 6.1 Summary Statistics and Unit Root Tests

<table>
<thead>
<tr>
<th>Variable</th>
<th>Standard Deviation</th>
<th>Unit Root Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Levels</td>
</tr>
<tr>
<td>Terms of Trade</td>
<td>0.0228</td>
<td>-1.779</td>
</tr>
<tr>
<td>Real Growth</td>
<td>0.0067</td>
<td>0.281</td>
</tr>
<tr>
<td>Unemployment</td>
<td>0.0280</td>
<td>-1.025</td>
</tr>
</tbody>
</table>

The Phillips-Perron (PP, 1988) test regressions include an intercept term and four lags. An asterisk (*) indicates that the null hypothesis of a unit root can be rejected at (at least) the five per cent level of significance and two asterisks (**) indicates rejection of the null hypothesis at the ten per cent level of significance. (For the PP test, the critical value at the five per cent level is -2.93 and at the ten per cent level is -2.6 for 50 observations)
The time series for these variables are shown in Figure 6.2. Growth in real output for Victoria was stable except for a fall in 1991. The change in the unemployment rate was also stable except for a large rise in 1992. The change in the Australian terms of trade was also stable.

Figure 6.2 (a) Change in Victorian Gross State Product, Per Cent, Quarterly 1984:3 - 1997:2

Figure 6.2 (b) Change in Victorian Unemployment Rate, Per Cent, Quarterly 1984:3 - 1997:2
6.5 Results of Model Estimation

The decomposition of the forecast error variance from the SVAR model, presented in Table 6.2, shows the relative importance of the three shocks in contributing to the variation in output and unemployment. The primary source of shocks to Victorian output from these results is the terms of trade. The decomposition shows that, in the short-run (five quarters), shocks to the terms of trade explain 68 per cent of the variation in growth in real output. This effect increases to 71 per cent after ten quarters and remains at 62 per cent in the long-run, that is, after 20 quarters. As well, terms of trade shocks explain 18 per cent of the variation in the change in unemployment rate after five quarters and this rises to 41 per cent after 20 quarters.
Table 6.2  Decomposition of Forecast Error Variance, Per Cent Change

<table>
<thead>
<tr>
<th>Quarters</th>
<th>Growth in Real Output</th>
<th>Change in Unemployment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Terms of Trade</td>
<td>Supply</td>
</tr>
<tr>
<td>1</td>
<td>62</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>68</td>
<td>26</td>
</tr>
<tr>
<td>10</td>
<td>71</td>
<td>24</td>
</tr>
<tr>
<td>20</td>
<td>62</td>
<td>32</td>
</tr>
</tbody>
</table>

In addition, supply shocks are also an important source of shocks to Victorian output. Supply shocks explain 38 per cent of the change in real output growth after five quarters. This effect declines to 24 per cent after ten quarters but rises again to 32 per cent after 20 quarters. Supply shocks explain four per cent of the change in unemployment rate in the short-run, but the effect increases to 36 per cent after ten quarters and remains at 35 per cent after 20 quarters. In contrast, demand shocks appear to have little effect on the growth in real output over the long- or short-run. These results indicate that both terms of trade and supply shocks have a large effect on the Victorian economy and these effects are persistent.

The impulse response functions are presented in Figure 6.3. As the variables were entered as first differences in the VAR, the resulting impulse response functions were cumulated to obtain the impulse responses shown here for the levels of variables. A positive shock to the terms of trade produced increased output, which peaked around eight quarters and then stabilised above the equilibrium level in the long-run. Terms of trade shocks were associated with a decrease in the unemployment rate that reached a minimum after approximately 12 quarters, but remained persistent. The response of
output and unemployment to demand and supply shocks were as predicted. Supply shocks generated a decline then a rise in the terms of trade, yet the long-run effects of supply (and demand) shocks asymptote to zero. A positive supply shock produced a long-run permanent increase in output. As expected, given the long-run restrictions imposed in the model construction, a positive supply shock had no significant effect on the unemployment rate after an initial rise over the first seven quarters. Demand shocks had no effect on output but produced a small and persistent rise in the unemployment rate.

Figure 6.3 (a) Impulse Response Functions of Terms of Trade to a one Standard Deviation Terms of Trade Shock, Supply Shock and Demand Shock (Cumulated)
Figure 6.3 (b) Impulse Response Functions of Real Output to a one Standard Deviation Terms of Trade Shock, Supply Shock and Demand Shock (Cumulated)

Figure 6.3 (c) Impulse Response Functions of Unemployment Rate to a one Standard Deviation Terms of Trade Shock, Supply Shock and Demand Shock (Cumulated)
6.6 Discussion

The results from this analysis show that terms of trade shocks are the major source of fluctuations in output and unemployment in Victoria. After twenty quarters, as much as 62 per cent of the variation in output growth, and 41 per cent of the variation in the change in the unemployment rate, could be attributed to a shock to the terms of trade. Supply shocks are also important, contributing approximately a third of the variation in both output growth and change in the unemployment rate.

The contribution of terms of trade shocks to the variance in output growth in Victoria can be contrasted with that estimated for Australia by Cashin and McDermott (1998). They found that, for the Australian economy over the period 1970-1997, terms of trade shocks explained about twenty per cent of the variation in real output after twenty quarters. Similarly, Otto (1995) found, using the Australian balance of trade as a proxy for demand, that terms of trade shocks explained ten percent of the variance in real output after twenty quarters and 44 per cent of the variance in the trade balance for Australia. While the effect of terms of trade shocks on unemployment in Victoria after twenty quarters is similar to Otto’s result for Australia, (41 per cent) the contribution of terms of trade shocks to output growth in Victoria reported here is significantly higher after twenty quarters (62 per cent). This is a reflection of the export orientation of the Victorian economy. However, this latter figure should be interpreted with caution as the current model is limited by not including a variable that would indicate the significant influence of the Australian economy on the Victorian economy. Extending the model to
include a variable that would reveal the role of the Australian economy and thereby further decompose the economic shocks would be worthwhile.

Whilst supply shocks in Victoria have less effect on output growth than supply shocks reported in the literature for Australia, the influence of supply shocks was important (32 per cent after twenty quarters). Keeping in mind the above limitations of the model, this compares with 88 per cent determined by Otto (1995). Ahmed and Park (1994) found that domestic supply shocks in Australia explained approximately 80 per cent of the variation in output after 20 quarters. In addition, Cashin and McDermott (1998) found for Australia that the major source of fluctuation in real output occurred through the 69 per cent of variation explained by supply shocks. However, Dungey and Pagan (1997) found a greater role for demand rather than supply shocks in the Australian economy in both the long- and short-run, when a combination of ten domestic and overseas variables were incorporated into a SVAR model. They found that Gross Domestic Product did not necessarily rise in response to a positive terms of trade shock as the shock was ameliorated by a strong exchange rate response.

The responses to demand and supply shocks in Victoria are qualitatively similar to those of Blanchard and Quah (1989) for the United States and Otto (1995) for Australia. In Victoria, the unemployment rate rises in the short-run but exhibits a small and persistent decrease in the long-run in response to a positive supply shock. In comparison, Keating and Nye (1999) found that supply shocks cause the unemployment rate to rise for some countries and not others when they used the Blanchard-Quah model to analyse demand and supply in the G7 countries. The unemployment rate rose temporarily following a positive supply shock for the United Kingdom, Italy and France.
The unemployment rate in Germany had little response to a supply shock while the United States, Japan and Canada exhibited a fall in the unemployment rate.

Keating and Nye concluded from this that each economy was subject to a variety of supply shocks but were more structurally sensitive to one type of shock; ‘these different sensitivities across countries could be related to different structural parameter values and possibly to differences in the variability of shocks to labour supply and technology’ (Keating and Nye, 1999, p 275). They also point out, as do Blanchard and Quah, that the Blanchard-Quah model has the simplifying assumption of aggregate shocks and does not identify the underlying type of supply and demand shock. That is, if more than one type of supply shock is operating which affects output and unemployment in different ways then the overall response of the economy may be difficult to interpret. Nevertheless, the results suggest an important role for terms of trade shocks and supply shocks in Victoria relative to demand shocks.

6.7 Conclusion

In this chapter, the terms of trade and supply side factors have been identified as strong positive influences on output and employment growth in the Victorian economy. In the next chapter, the terms of trade and supply variables are incorporated into an economic growth model, to analyse growth and convergence at the regional level in Victoria.
CHAPTER 7. REGIONAL ECONOMIC GROWTH IN VICTORIA

7.1 Introduction

The aim in this study is to specify a model to investigate economic growth in the eleven Victorian regions, utilising the analytical framework of the Solow-Swan neoclassical growth model (Solow, 1956; Swan, 1956; see Section 3.3). The adaptation of the neoclassical growth model by Barro and Sala-i-Martin (1992) is used to analyse regional growth and convergence and to ascertain which factors contribute to regional variation in per capita income in Victoria. Conditioning variables are included in order to hold the steady state of each region constant and formally measure whether the poorer regions are catching up with the wealthier regions. The conditioning variables are proxies for the structural characteristics of the regions, which predispose individual regions to particular economic shocks.

Economic growth theory provides meaningful insights into how economies can be expected to change over time. A resurgence of interest in economic growth theory has focused on the inconsistency between the prediction from the neoclassical model that the income levels of different national economies tend to converge and the apparent absence of convergence between a wide cross-section of countries, as reported in Sala-i-Martin (1996a). In turn, this inconsistency has led to renewed interest into whether sub-national regional per capita incomes are converging, because these regions are likely to meet some of the important conditions under which the most widely accepted neoclassical growth model is applicable (Bernat, 2001). A finding of convergence
among regions is interpreted as supporting the neoclassical theory of economic growth, whereas divergence is predicted by the alternative endogenous growth theories.

Barro and Sala-i-Martin (1991, 1992) proposed the neoclassical framework for the evaluation of growth and convergence in a cross-sectional analysis, with additional explanatory variables. Canova and Marcet (1995) and Islam (1995) extended the analysis to regional and country panel data. This is the first analysis using this approach at the sub-state level in Australia. It is also the first panel analysis of taxable income data at the regional level in Victoria.

Taking growth in per capita income as the dependent variable, growth in per capita income in each region is hypothesized to be a function of initial per capita income, agricultural land use, value of agricultural production, rainfall, unemployment rate, participation rate, population growth and the terms of trade. Supply factors and the terms of trade were identified as important influences on economic growth in Victoria (see Chapter 6).

7.2 Method – Empirical Model

Panel data techniques allow the analysis of both cross-sectional and time series variation. The main advantage of panel data over a cross section is that it allows flexibility in modelling differences in behaviour across individuals (Greene, 2000). The advantages of time series cross-sectional analysis are increasing the numbers of degrees of freedom and controlling for the time dimension of the data. The basic framework is a classical regression model of the form;
\[ y_{it} = \alpha_i + \psi x_{it} + \epsilon_{it} \]  

(7.1)

where \( y_{it} \) is the dependent variable;

\( i \) indexes individual cross-sectional group;

\( t \) indexes time;

\( \alpha_i \) is the individual effect;

\( \psi \) is a vector of coefficients;

\( x_{it} \) is the independent variable; and

\( \epsilon_{it} \) is an independent error term.

There are \( K \) regressors in \( x_{it} \), not including the constant term. The individual effect is \( \alpha_i \) which is taken to be constant over time \( t \) and specific to the individual cross-sectional unit \( i \). If \( \alpha_i \) is taken to be the same across all units, then ordinary least squares provides consistent and efficient estimates of \( \alpha \) and \( \psi \). There are two alternatives to the assumption that \( \alpha_i \) is the same across all units. The fixed effects approach takes \( \alpha_i \) to be a group specific constant term in the regression model. The random effects approach specifies that \( \alpha_i \) is a group specific disturbance, similar to \( \epsilon_{it} \), except that there is a single draw for each group that enters the regression identically in each period (see Table 7.1).
The regional economic growth model is based on Barro and Sala-i-Martin (1992), where the geometric average growth rate over the interval $t-r$ and $t$ for discrete periods for any given region $i$ is:

$$\ln(y_{it}/y_{i,t-r}) = C_i - (1-e^{-\beta r})\ln(y_{i,t-r}) + \varepsilon_{it} + \text{other variables} \quad (7.2)$$

where $i$ is the region;

$y_{i,t-r}$ is per capita income for each region at time $t-r$, the beginning of the subperiod;

$r$ is the average length of the subperiod in years;

$y_{it}$ is per capita income at time $t$;

$\beta$ is the convergence coefficient;

$e$ is the exponential constant;

$\varepsilon_{it}$ is an independent error term; and

$C_i$ is the region-specific constant.

For the panel data analysis, $(1-e^{-\beta r})\ln(y_{i,t-r})$ is incorporated in the vector $X$, so that Equation 7.2 can be rewritten as:

$$\ln(y_{it}/y_{i,t-r}) = \alpha + \theta' X_{it} + \rho' Z_{it} + \pi' W_i + u_{it} \quad (7.3)$$
where $X_{it}$ is a vector of variables that vary across both regions and time

$Z_t$ is a vector of variables that vary only over time

$W_i$ is a vector of variables that vary only between regions

$\alpha, \theta, \rho, \pi$ are vectors of coefficients

$u_{it}$ is a composite residual.

The composite residual can be expanded to:

$$u_{it} = \mu_i + \lambda_t + \nu_{it}$$  \hspace{1cm} (7.4)

where $\mu_i$ is a region-specific component;

$\lambda_t$ is a time-specific component and

$\nu_{it}$ is a component that varies over both regions and time.

If time-specific effects are unimportant, this reduces $u_{it}$ to the classical disturbance term without $\lambda_t$. It is assumed that $u_{it}$ is distributed independently of both $\ln(y_{i,t-r})$ and $u_{jt}, i \neq j$.

The formula for the speed of convergence is:

$$\gamma = -(1 - e^{-\beta r})$$  \hspace{1cm} (7.5)

where $\gamma$ is the value of the parameter on initial income and $r$ is the average length of the subperiod in years.

The coefficient $\gamma$ is an approximation, as it is a linear estimate of a non-linear term.

It follows that the implied annual speed of convergence, $\beta$, is calculated as:
\[ \beta = -\frac{\ln(1+\gamma)}{r} \]  \hspace{1cm} (7.6)

The half-life formula for \( T \) is \( \ln(2)/\beta \).

The appropriate estimation technique depends upon the structure of the error term and the correlation between the components of the error term and the observed determinants of per capita income. In the simplest case, in which there are no region- or time-specific effects, ordinary least squares is appropriate. However, both unobservable region-specific and time-specific factors may have an effect on per capita taxable income and therefore need to be taken into account.

Unobservable effects can be accounted for using one of two techniques. First, the unobservable effects can be included in the error term. The variance-covariance matrix of the resulting non-spherical errors must be transformed to obtain consistent estimates of the standard errors. In this case, the random effect estimator is appropriate (Greene, 2000). However, a problem arises with the random effects estimator if the unobservable effects, which have been included in the error term, are correlated with some or all of the regressors. This simultaneity would make the random effects estimator inconsistent.

As a consistent alternative to the random effects estimator, a dummy variable can be included for each region. This estimation approach, known as either the fixed effects or least-squares dummy variable approach, yields consistent estimates regardless of correlation between region-specific error components and the regressors. However, it is less efficient than the random effects estimator. This inefficiency occurs because the fixed effects estimator requires a separate parameter to be estimated for each region in place of the single variance estimate that is required for the random effects estimator. However, one advantage of allowing for individual regional effects in the estimation of
the parameters of the model is that estimates of these individual effects can be recovered directly as they are the estimated coefficients of the regional dummies (Islam, 1995).

7.4 Data

The model is estimated over the period from 1980 to 1998. The data is fitted to the 1996 ABS Victorian Statistical Division boundaries. Changes in Statistical Division and Local Government Area boundaries, and in the scope of the Agricultural Survey, during this period have been taken into account. The 1980 to 1998 period is then broken down into subperiods 1980 to 1984; 1985 to 1989; 1990 to 1994 and 1995 to 1998. This is done, in preference to the use of annual data, to reduce the influence of business cycle fluctuations and the likelihood of serial correlations between disturbances (Islam, 1995). Comparing data from intra-state regions and a single collection agency has the benefit of reducing potential bias resulting from measurement error in the dependent variable. Another advantage is the assumption of similar technology and preferences between regions, allowing the further assumption of similar steady state income levels between regions.

In this model, variables expected to vary across both regions and time (components of the vector $X_{it}$) are log of income in the initial period, variables related to the labour market such as participation rate and unemployment rate, and variables added to capture the influence of agriculture, namely rainfall, land used for agricultural production in each region and the estimated gross value of agricultural production per capita in each region. The theoretical expectation is that the influence of participation rate is positive, as an increase in participation rate implies an increased supply of labour
and labour force participation is a crucial determinant of individual income. An increase in the unemployment rate, in contrast, is anticipated to have a negative influence on income growth as it implies excess labour supply and insufficient demand in the economy.

Rainfall deciles of average and above are anticipated to have a positive influence on income levels in regions that rely on agriculture. Land use is an indicator of how much land is being utilised for agriculture. An increase in the amount of land used for agriculture in a region would be expected to have a positive effect on regional income by increasing revenue from agricultural production. However, if the land use variable is designed to capture a region’s reliance on agriculture, it could have a negative influence on income growth. Reliance on agriculture in a regional economy is hypothesised to result in lower incomes, based on the evidence of low and variable incomes in the agriculturally based regions presented in Chapter 5. The value of agricultural production would be expected to have a similar effect to land use on regional incomes.

The vector of variables that vary only over time, $Z_t$, contains only a single variable in this model. This is the change in the Australian terms of trade because no regional terms of trade measure is available. An increase (an improvement) in the terms of trade would be expected to have a positive effect on income through increases in output and employment, based on the evidence presented in Chapter 6. In this model, there are no variables in the vector $W_i$ that vary only between regions. Further details on the definition, source and construction of each variable are shown in Appendix 7 and descriptive statistics are shown in Appendix 8. The panel is shown in Appendix 9.
7.5 Results of Model Estimation

The model is estimated using a balanced sample of 11 regions, with the annual data aggregated into four subperiods as indicated above. This creates T=4 subperiods and, with N=11 regions, provides 44 observations. The panel regressions are run by regressing the subperiod average changes in per capita income against per capita income in the initial year of each subperiod and the remainder of the right-hand side variables.

To deal with the estimation issues raised in Section 7.3, the model is estimated using the pooled ordinary least squares regression, followed by the fixed effects model with N individual specific constant terms and no overall constant, and then the random effects model estimated by two-step generalized least squares. The regressions estimate equations of the form of equation (7.3) where specifically $y_{i,t-r}$ is real (1996 A$) per capita taxable income in region $i$ at the beginning of each subperiod and $y_{it}$ is real per capita taxable income at time $t$. In the pooled ordinary least squares specification, it is assumed that $\alpha = \alpha_t$ (see Table 7.1).
Table 7.1 Model Specification for Estimation of Growth Equation

<table>
<thead>
<tr>
<th>Features</th>
<th>Independent Variables</th>
<th>Specification¹</th>
<th>Estimation</th>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>Log of change in per capita income, change in terms of trade (average), unemployment rate (average), gross value of agricultural production per capita, rainfall (average), change in population (average).</td>
<td>( y_{it} = \alpha + \psi'x_{it} + \varepsilon_{it} )</td>
<td>Pooled ordinary least squares</td>
<td>Single set of slope coefficients for all observations; ( \varepsilon_{it} ) is independently and identically distributed.</td>
</tr>
<tr>
<td>Model 2</td>
<td>Log of change in per capita income, change in terms of trade (average), unemployment rate (average), gross value of agricultural production per capita, rainfall (average),</td>
<td>( y_{it} = \alpha + \psi'x_{it} + \varepsilon_{it} )</td>
<td>Pooled ordinary least squares</td>
<td>Single set of slope coefficients for all observations; ( \varepsilon_{it} ) is independently and identically distributed.</td>
</tr>
<tr>
<td>Model 3</td>
<td>As for Model 2</td>
<td>( y_{it} = \alpha_i + \psi'x_{it} + \varepsilon_{it} )</td>
<td>Fixed effects ordinary least squares</td>
<td>Single set of slope coefficients for all observations; ( \varepsilon_{it} ) is independently and identically distributed; each cross-section has its own intercept ( \alpha_i )</td>
</tr>
<tr>
<td>Model 4</td>
<td>As for Model 2</td>
<td>( y_{it} = \alpha_i + \psi'x_{it} + \varepsilon_{it} )</td>
<td>Random effects generalised least squares</td>
<td>Intercepts drawn from a common distribution with mean ( \alpha ) and variance ( \sigma_{\alpha}^2 ); estimates inconsistent if individual intercepts are correlated with the independent variables.</td>
</tr>
</tbody>
</table>

¹ See equation 7.1 for explanation of variables.

(Dependent variable is \( \ln(y_t/y_{t-1}) \), growth in per capita income)
The independent variables were initially selected based on a priori assumptions about their relationship to the dependent variable and then on their correlation with the dependent variable. Additional variables with low correlations with the dependent variable, namely the average participation rate, average land used for agriculture, change in the initial terms of trade, initial rainfall and change in initial population, were incorporated into the model but were insignificant after model estimation. One exception was average rainfall, which was retained for its significance in the models despite a low correlation with the dependent variable. Model 2 has the same independent variables as Model 1 with the exception of the change in population (average) variable.

The econometrics program used is TSP 4.5 (© 1999 TSP International) and specification tests are incorporated into the model estimation. Where region-specific effects exist, the value for the Hausman chi-squared test statistic is an indication whether they are correlated with the observable regressors (Hausman, 1978). High values of the Hausman test statistic imply that the fixed effects model specification is preferred. Once having rejected the random effects model specification in favour of one of the classical regression models, the appropriate choice between a pooled model and a fixed effects model is made using an F-test between the two models. For each F-test, a P-value and an alternative critical value are calculated in TSP 4.5. The critical value is based on a Bayesian flat prior and is a more stringent criterion than the probability value (Leamer, 1978).

The result for the estimation of the models is presented in Table 7.2. For comparison, alternative specifications of Model 2 are presented as Model 3 (fixed effects ordinary least squares) and Model 4 (random effects generalised least squares). The regressions are run with a constant term (except the fixed effects specification) and
a one-factor (region effects) estimation technique. Test statistics show that the choice of
the pooled ordinary least squares estimators is appropriate for the combinations of
variables in the regressions in Models 1 and 2. The Hausman test statistic of chi-squared
(4 degrees of freedom) is 9.16, which had a marginally acceptable probability value of
0.057. However, using the F-test of pooled versus fixed effect to distinguish between
the pooled ordinary least squares and the fixed effects model specification, the test
statistic of 2.51 (10, 28 degrees of freedom) is below the critical value of 3.82. This
implies acceptance of the hypothesis that all intercepts are equal and therefore the
choice of the pooled ordinary least squares specification of the model.

The model estimate of the coefficient on the log initial per capita income
(LNPCINC) is negative and highly significant. The implied rate of conditional β-
convergence is 22.4 per cent per annum in Model 2. The speed of non-conditional
convergence, calculated by using the coefficient on log of initial per capita income in
the growth regression without the additional variables, is 14.5 per cent per annum. The
coefficient on change in terms of trade average variable (CHTTAV) is positive and
highly significant. The unemployment rate (average) variable (UNEMAV) has a
negative coefficient and is highly significant. Average rainfall (RAINAV) was
significant with a positive coefficient. The coefficient on the gross value of agricultural
production per capita variable (GVPC) is negative and is highly significant. The
coefficient on change in population initial variable (CHPOPINT) was positive but not
significant. This variable was subsequently removed and Model 2 is chosen as the final
preferred model.
Table 7.2 Regression Results for the Victorian Statistical Divisions

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) Pooled OLS</th>
<th>(2) Pooled OLS</th>
<th>(3) FE OLS</th>
<th>(4) RE GLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>5.908</td>
<td>6.22</td>
<td>-</td>
<td>6.55</td>
</tr>
<tr>
<td></td>
<td>(5.03)</td>
<td>(5.87)</td>
<td></td>
<td>(6.15)</td>
</tr>
<tr>
<td>LNPCINC</td>
<td>-0.6259</td>
<td>-0.6555</td>
<td>-0.7217</td>
<td>-0.6927</td>
</tr>
<tr>
<td></td>
<td>(-5.06)</td>
<td>(-4.47)</td>
<td>(-4.56)</td>
<td>(-6.02)</td>
</tr>
<tr>
<td>CHTTAV</td>
<td>0.0180</td>
<td>0.0158</td>
<td>0.0176</td>
<td>0.0156</td>
</tr>
<tr>
<td></td>
<td>(2.66)</td>
<td>(2.72)</td>
<td>(2.94)</td>
<td>(2.86)</td>
</tr>
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<td></td>
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<td>(2.67)</td>
<td>(3.60)</td>
<td>(3.09)</td>
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<tr>
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</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>R²</td>
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<tr>
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Dependent variable is ln(yt/yt-r), growth in per capita income. The associated t statistics are shown in parentheses beneath the estimated coefficients. β is the implied speed of convergence. The Hausman statistic tests the null hypothesis that the individual effects are uncorrelated with the other regressors. The p-value for the Hausman test statistic, given in square brackets, corresponds to a χ² with 4 degrees of freedom. The F-test statistic tests the null hypothesis that the individual intercepts equal the group intercept. The p value, given in square brackets, corresponds to an F test with 10, 28 degrees of freedom.
7.6 Discussion

This analysis of the economic growth of the eleven Victorian Statistical Divisions confirms the convergence predictions of the neoclassical growth model. The main finding, however, that conditional $\beta$-convergence occurred at the high rate of 22 per cent per annum over the period 1980 to 1998, is quite surprising. The half-life for convergence is approximately three years. The finding of non-conditional $\beta$-convergence at the rate of 14.5 per cent per annum suggests that the income growth rates of the regions were also converging rapidly in an absolute sense.

Of the additional variables in the analysis, the terms of trade had a significant positive influence on the growth of per capita income in the estimated model. As anticipated, the level of unemployment had a significant influence on per capita income growth in the regions. The significant of the positive coefficient of the average rainfall variable in the model also emphasises the importance of agriculture to regional incomes. The estimated coefficient on the gross value of agricultural production per capita in the model is negative and highly significant. The significance of the positive coefficient of the average rainfall variable in the model also emphasises the importance of agriculture to regional incomes.
7.7 Conclusion

The aim in the study reported in this chapter is to analyse economic growth in the eleven Victorian regions over the period 1980 to 1998, by estimating regression equations from a regional growth model based on neoclassical economic growth theory. The finding of an implied rate of $\beta$-convergence of 22 per cent supports the convergence predictions of the neoclassical growth theory, but is higher than most previous empirical estimates for regions in other countries. The initial level of regional per capita income, the terms of trade, the unemployment rate, the gross value of agriculture per capita in each region and average rainfall were significant variables in the model. These findings are discussed in more detail in Chapter 8.
CHAPTER 8. GENERAL DISCUSSION

8.1 Introduction

The aim in this research is to determine if and how economic change in Victoria between 1980 and 1998 has resulted in greater regional inequality. The key findings were:

- the divergence of regional incomes and the persistence of income disparities;
- the important contribution of terms of trade and supply shocks to disparities in regional economic growth;
- a high speed of convergence of the regional economies to their own steady state; and
- evidence of the process of regional adjustment mediated through factor mobility.

The purpose in this chapter is to draw together and discuss the important aspects of these findings.

This general discussion is structured as follows. First, the evidence on the dispersion of per capita incomes is discussed and the measures of income dispersion compared. The implications of the importance of terms of trade and supply shocks to disparities in regional economic growth in Victoria are then discussed. This is followed by discussion of the implications from the estimates of the speed of $\beta$-convergence, and the significance of the conditioning variables, in the regional growth model. These empirical
findings are then discussed within the context of the regional adjustment process and structural change in the economy. This is followed by the policy implications from the study and avenues for further research. The main conclusions are presented in the next chapter.

8.2 Divergence in Per Capita Incomes

There was an increase in the dispersion of gross per capita income between 1981 and 1996 for the Victorian regions, with concurrence between all measures of dispersion. Although the coefficient of variation and \( \sigma \) often being used interchangeably in the literature, when calculated using the equations defined in Section 5.2.1, the two measures of dispersion are measuring two different aspects of convergence. Measures of both \( V_w \) and \( M_w \) (on a population-weighted basis) and \( V_{uw} \) (without accounting for population) show that the regional per capita incomes are diverging from the state mean. The measurement of \( \sigma \) indicates that, with all regions treated equally on a population basis, the dispersion of regional per capita incomes either increased or, in the latter period of the study, was stable.

The dispersion of regional per capita taxable incomes around the Victorian state mean, measured by \( V_w, V_{uw} \) and \( M_w \), became greater between 1980 and 1998. In terms of \( \sigma \), there was a slight convergence of regional per capita taxable incomes between regions during this period, however there were periods of substantial \( \sigma \)-convergence also (see Figure 5.3 and Table 5.4). This demonstrates that regional per capita taxable incomes diverged from the state mean, but that dispersion between the regions, or at least between a
subset of regions, was reduced in the latter period of the study. Other indicators such as the proportion of the Victorian mean per capita income, the percentage share of aggregate taxable income in each region and the growth in total taxable income for each region support the evidence from the formal measures of dispersion that divergence is occurring and there is persistence in long-term income disparities (see Table 5.5).

The disparity between the $V_w$, $V_{uw}$ and $M_w$ measures and the measure of $\sigma$ for the taxable income data is in contrast to the concurrence between measures of dispersion for the gross income data. The difference between the gross income and the taxable income result possibly reflects the use of annual data over an extended time period from the gross income analysis, which provides a clearer picture of income changes over time than the five-yearly census data. There is a high correlation between the taxable income data and the gross income data in each census year (greater than 90 per cent), however, there are no previous studies of taxable income in Victoria for comparison. Dewhurst (1998) argues that the results obtained in convergence studies depend on the choice of income variable, and therefore it is quite possible that a group of economies may exhibit convergence with respect to one measure of income and not another, and that each regional data set will be different.

The difference between the results of the taxable income analysis in the measures of the weighted coefficient of variation and the standard deviation of the log of per capita incomes substantiates the criticism by Quah (1996a), who argues that the measurement of $\sigma$-convergence is not informative about changes in the income distribution between regions, or whether the economic status of regions is improving over time. In this context, the measure of $V_w$ is more meaningful in terms of the proposition that the problem of
regional inequality in Victoria is more about the regions lagging behind Melbourne, than about increasing dispersion amongst the regions.

These findings substantiate the proposition that the income level and, by supposition, the welfare of people in the non-metropolitan regions in Victoria lagged behind that of Melbourne during this period. The results support the findings of Lloyd, Harding and Hellwig (2000) of an increasing income divide between metropolitan and non-metropolitan Australia. This dualism is also a feature of the New Zealand economic distribution examined by Karagedikli, Maré and Poot (2000). Their evidence suggests that there is dualism between the ‘globalised’ economies of the major cities, Auckland and Wellington, in contrast to the rural and peripheral areas. Siriopoulos and Asteriou (1998) and Mauro and Podrecca (1994) report similar findings of dualism for Greece and Italy respectively.

The income distribution within the regions, measured by the Gini coefficient, showed a slight improvement over the period 1981 to 1996, except in East Gippsland. The decrease in the Gini coefficient implies that the increasing dispersion of income between regions did not adversely affect income distribution within the regions. This could be interpreted as resulting from a narrower range of incomes being received in regions when average per capita income declined. High unemployment affects income distribution at the lower end of the income scale, with the likelihood of an increase in the Gini coefficient. However, Maxwell and Peter (1988) argue that depressed regions experience less income inequality because high income earners prefer to live elsewhere and this counters the unemployment effect. This analysis is confined to census data, whereas Gini coefficients calculated from annual data may be more informative.
The divergence in regional incomes is in apparent contradiction to the predictions of the neoclassical model. Within the neoclassical framework, the interpretation of these results is that the income divergence may be considered the result of a short-term response to a severe economic shock and/or evidence of the existence of impediments to the process of adjustment, both of which are discussed in following sections. The tendency to slight $\sigma$-convergence in taxable income appears to vary with the prevailing business cycle and other identifiable shocks to the Victorian economy, such as a supply shock caused by drought conditions and the impact of the recessions in 1983 and the early 1990s. In this instance, the $\sigma$ measure of dispersion of per capita taxable income decreased during the period of economic expansion between 1983 and 1989 and then fluctuated between 1990 and 1998. It would require further analysis to determine any particular pro- or anti-cyclical trend of income dispersion associated with the business cycle.

**8.3 Economic Shocks to the Victorian Economy**

The terms of trade and supply were found to be important sources of shocks to the Victorian economy. In relation to the terms of trade, Australia has a low trade share of Gross Domestic Product in comparison with other small, open economies. In addition, Australia is still reliant on commodity exports whilst its imports are predominantly manufactures and services (Gruen and Shuetrim, 1994). This trading situation also applies to Victoria, though the international trade share of Gross State Product in Victoria is higher than that of Australia. It is likely that volatility in the prices of commodity exports and the lack of diversity in the export base leads to volatility in the terms of trade and adds to the
persistence of terms of trade shocks. The heavy reliance in Victoria on agricultural exports makes Victoria susceptible to terms of trade shocks caused by agricultural commodity price fluctuations, whilst facing essentially the same terms of trade and trading climate as Australia.

It is only possible to generalise about the nature of the supply fluctuations in Victoria from the VAR model. However, supply fluctuations can generally be characterised into two types. The first type is usually short-term and applies to agriculturally based economies, where adverse climatic conditions can generate a negative supply shock by reducing output and/or increasing the cost of production. Victoria’s reliance on exports and commodities such as wheat, wool and processed foods makes it vulnerable to supply shocks caused by severe droughts and low commodity prices. The effects of agricultural supply shocks in Victoria can be ameliorated to a certain extent by substituting trade in inputs and products from other states, as well as by secular improvements in agricultural productivity.

The second type of supply fluctuation relates to changes in the cost of production. This may be either a negative supply shock due to increased input costs or a positive supply change resulting from technology changes. Changes in telecommunications, information technology, transport and agricultural practices have had an impact on aggregate supply in Victoria, as elsewhere. As well, there has been rapid structural change in the Victorian economy, particularly since drought and recession in the early 1990s and the election in 1993 of the reformist Kennett Liberal–National Coalition Government (Department of Treasury and Finance, 1998). Government spending was heavily curtailed and assets sold to reduce the high level of state debt. It is difficult to say what effect these structural changes
had on Victorian Gross State Product and unemployment and what the impact on individual regions has been. However, there is strong evidence in the case of Gippsland that privatisation and restructuring in the power industry have been major contributors to the economic decline of the region. Whether there has been compensatory benefit to the rest of the state requires further analysis.

8.4 Convergence in Growth Rates

The observed $\beta$-convergence rate of 22 per cent is considerably higher than the finding of Barro and Sala-i-Martin (1991) for the United States and Sala-i-Martin (1996b) for regions within the United States, Canada, Japan and Europe (see Section 3.4.1). In these empirical studies, a consistent rate of $\beta$-convergence of approximately two to three per cent per year was found. Kangasharju (1998, 1999) found $\beta$-convergence of approximately two per cent analysing taxable income data for Finland, but this appears to be the only analysis of taxable income available for comparison. The higher speed of $\beta$-convergence can be partly attributed to the measure of income used and the different characteristics of the regional data. In comparison, Canova and Marcet (1995) found a convergence rate of 23 per cent between European regions. They concluded that the steady state growth rate was not the same for all cross-sectional units in their sample and that initial income conditions were the most important determinant of the cross-sectional dispersion of steady states (see Section 3.4.2). Islam (1995) used a panel data specification with specific country effects and obtained estimates of convergence rates between four and nine per cent for a sample of
countries. Caselli, Esquivel and Lefort (1996) found speeds of convergence between countries of approximately ten per cent.

The prediction of the neoclassical model is that the growth rate of an economy will be positively related to the distance that separates it from its own steady state. In a cross-section of regional economies, those further away from their steady state will grow faster. The major implication of a high rate of conditional convergence is that the regional economies must be close to their steady state (Caselli, Esquivel and Lefort, 1994). As a consequence, the observation of large differences in the levels of per capita income between regions could be interpreted as arising from different steady state income levels between the Victorian regions, rather than from differences in the position of regions along similar transition paths (Evans and Karras, 1996).

This interpretation is also supported by the statistical significance of the additional conditioning variables in the model. The additional independent variables are proxies for the structural characteristics of the different regions and are thereby a method of accounting for the differential impact of short-term shocks to the regional economies. The concept of absolute $\beta$-convergence implies a tendency towards the equalisation of per capita incomes as initially poor regions grow faster until they catch up with the richer ones. In absolute convergence, in the long-run, the expected per capita income level is the same for all regions, regardless of its initial value. There may still be inequality, however, as economic shocks will have differential, if only transitory, impacts on each region. In contrast, conditional $\beta$-convergence implies that each region converges only to its own steady state, which may be different from other regions.
Defined in this way, a finding of convergence in an unconditional convergence regression (growth rate against initial income without additional conditioning variables) does not necessarily imply absolute convergence because the existence of the same steady state income levels are only assumed (by the similarity of the regions within the parent region) and the determinants of the steady state are not directly incorporated in the regression. When the estimate of $\beta$ is positive, the important result is whether the conditioning variables are significant. If the conditioning variables are significant, as in this case, it can be implied that the steady state growth rates are different across the Victorian regions and therefore convergence is conditional and not absolute (Fuente, 1997). The significance of the conditioning variables indicates that the structural characteristics of the Victorian regional economies, particularly those that are influenced by supply and terms of trade, are important in determining their steady state growth rates.

The finding of a high rate of conditional $\beta$-convergence is consistent with an open economy non-augmented model of the neoclassical growth model (Bourdot, Frith and Wells, 1998). A high rate of conditional convergence is difficult to reconcile with ‘augmented’ versions of the neoclassical production function, which feature augmentation of the physical capital component of the production function with human capital, because of the implication of the low capital share from high speeds of convergence. Barro and Sala-i-Martin (1995) show that a two to three per cent rate of convergence is consistent with a capital share of around 75 per cent, whereas a 22 per cent rate of convergence would suggest a capital share closer to one-third, in keeping with estimates from national accounts.
In addition, open economy versions of the neoclassical growth model predict higher speeds of convergence, as convergence effects associated with technological diffusion are more important in an open economy setting. Indeed, instantaneous convergence is predicted if there is perfect factor mobility. Whilst a negative relationship between growth and initial income is considered evidence of decreasing returns in the neoclassical model, Fuente (1997) suggests, if income per capita is highly correlated with the level of technological development, the estimated coefficient of initial income in growth regressions may also be partly capturing the effect of technological transfer. Fuente cites supporting evidence from the work of Dowrick and Nguyen (1989), who constructed a model extending the neoclassical framework, in which the speed of technological diffusion is incorporated into the rate of technical progress. Within this model, the coefficient of initial income is a measure of the speed of technological diffusion. The observed reduction in income disparities within the OECD in Dowrick and Nguyen’s study can be interpreted as resulting from a rapid improvement in technology. Technological diffusion across the Victorian regions could be expected to be high, given the close proximity and the absence of institutional barriers.

It should be noted that, whilst the detection of β-convergence shows that the data are consistent with neoclassical theory, it is not a direct test of diminishing returns to capital or of the income equalising consequences of factor mobility. One shortcoming of the neoclassical model is that it does not shed light on the actual processes by which technological progress enhances growth. Cheshire and Carbonaro (1995) observe that the estimated coefficient can be seen as the net effect of a number of processes. Some, such as regional policy, labour mobility, or technological diffusion possibly induce convergence, and others, such as increasing returns, are responsible for divergent behaviour. Other
divergent processes may include congestion diseconomies, trickle-down effects and government fiscal transfers. Barro and Sala-i-Martin (1991) suggest that divergence would also occur if human and physical capital move from poor to rich economies, particularly if immigrants to rich economies have above average endowment of human capital. Another shortcoming is that the neoclassical growth model does not take into account how the growth of each region is influenced by the growth of other regions (Quah, 1993).

The terms of trade was found to have a significant positive influence on the growth of per capita income in the regional growth model. This reflects the important contribution of trade to the Victorian economy and accords with the results from the VAR modelling of the impact of the terms of trade on the output of the Victorian state economy and the unemployment rate (see Section 6.5). The results from the VAR model showed a long-run increase in output and a decrease in unemployment when there is an improvement in the terms of trade, which could be expected to increase incomes across the regions. Lefebre and Poloz (1996) found similar evidence of differential impacts on the Canadian provinces from terms of trade shocks, dependent on the sectoral composition of the provincial economy.

The estimated coefficients on the unemployment rate, gross value of agricultural production per capita and average rainfall variables were also significant in the regional growth model. The unemployment rate is discussed within the context of the labour market in Section 8.5.2. The gross value of agricultural production per capita and rainfall are discussed in Section 8.5.3.
8.5 Regional Adjustment

The Victorian economy is undergoing constant change through structural adjustment to government microeconomic reform, increased globalisation of markets, trade liberalisation, technological advances and the increased substitution of capital for labour in agriculture and manufacturing. There has been shifts in population toward larger regional centres, rationalisation of government services, an increasing emphasis on promoting regional identity as a means of achieving economies of scale to compete in global markets and changes in the structure of the labour force (O’Toole, 1997; Trigg, 1998).

The pattern of economic growth in Victoria quite clearly shows large variations in Gross State Product, employment, income and population growth between 1980 and 1998, and these major fluctuation in the state economy are reflected in the fortunes of the regional economies (see Figure 2.6). Neoclassical theory suggests that the regional economies have a capacity to adjust to these short term (though recurring) shocks and secular adjustment pressures by mobilising capital and labour. This process of regional adjustment, and the barriers to factor mobility that may impede the process, such as various forms of capital fixity, labour market rigidities and structural changes, are discussed in the following section.
8.5.1 Adjustment in Victorian regions

At the state level, during the recession that began in 1990, the Victorian average annual per capita taxable income declined from 1990 and began to recover by 1994, although it had still not reached its 1989 level by 1998. The unemployment rate more than doubled from 1990 to 1992. In response to these changes, population growth slowed considerably and there was significant out migration from Victoria, mainly to Queensland and New South Wales.

In all the Victorian regions, in response to major economic shocks, such as the 1983-1984 and 1990-1991 recessions and the drought in 1982-1983, when the unemployment rate rose and incomes declined, population growth slowed or actually stopped (see Figure 2.6). In response to the additional pressure of long term structural change, the agriculturally based regions had average rates of population growth below the Victorian average of seventeen per cent during 1980 to 1998 (see Section 2.4). McKenzie (1994) argues that population changes are significant in rural areas if they lead to changes in service thresholds. In addition, at the regional level, overall population trends may mask some aspects of decline, such as the growth of regional centres at the expense of their rural hinterland. Melbourne followed the Victorian pattern of change closely, which is expected given the influence of Melbourne’s large population and diverse industry base on the state economy. However, the unemployment rate in Melbourne was slightly lower than the Victorian average and incomes were higher (see Figure 2.6 (b)).

The findings of increased per capita income dispersion and persistence of income disparities, despite the compensating movements in population, however, are in contrast to
the long-run predictions of the neoclassical theory of regional income convergence. One interpretation of this is that trade and financial deregulation, which has opened up the Australian economy to world markets in the last two decades, has allowed the regions to take advantage of specialisation and trade. While in theory these changes should increase the efficiency of resource allocation, and therefore growth in the economy as a whole, the consequence is that some regions become vulnerable to industry- or regional-specific shocks.

As a corollary to this increased vulnerability, Krugman (1995) suggests that the long-run tendency for wages to be equalised across regional economies of a country can give rise to disparities in competitiveness, because those regions that can produce goods and services with lower unit labour requirements will have an absolute advantage, and be able to export competitively to other regions and internationally. Some regions, however, may have an absolute advantage in a limited number of goods and services and therefore be susceptible to changes in tastes and technology. When the rate of adjustment of these regions to negative shocks is impeded, divergence rather than convergence between comparable regions is observed.

The Wimmera region, and to a lesser extent the Mallee, would appear to be good examples of this phenomenon. Population and capital have left these regions in response to a negative shock to the dominant broadacre cropping industry, as would be predicted by the theory. This adjustment, however, appears to have been insufficient to increase per capita income in these areas, at least within this time period. By comparison, Western District had zero population growth with no significant change in per capita income. It is possible that the more diverse economic base in this region has enabled the rate of adjustment to reach a
balance over time. In contrast, Gippsland underwent a major restructuring of its
dominant power industry in the 1990s and, although there has been a decline in population
over time, there has not been a concomitant adjustment in employment or incomes. It
would appear that the severity of the shock and the extent of loss of specialised jobs,
combined with other barriers to factor mobility, have contributed to a major adjustment
problem in Gippsland.

In neoclassical theory, it is postulated that capital moves location in response to
changes in regional rates of return. The main implication is that fixed differences in
amenities, either for labour or capital, lead to sustained differences in growth rates, given
the underlying assumption of constant returns in production and long-run mobility of
labour and capital. However, when capital is land based then constant returns no longer
apply and fixed amenities instead lead to differences in employment and income levels. In
circumstances when capital is both functionally and spatially fixed, Clark, Gertler and
Whiteman (1986, p 261) argue that the existence of capital rigidity poses a significant
obstacle to the assumption of capital mobility in the neoclassical theory of regional
adjustment. The manner in which past location of fixed capital constrains any subsequent
investment is a major contributor to the concept of regional growth within cumulative
causation theory. When the value of capital is gradually being eroded, as happens when a
region is in decline, the owners of the capital can become locked in.

ABARE (1996) estimates that 80 per cent of broadacre farm capital is in land and
fixed improvements. The scarcity of alternative land uses contributes to capital immobility
in the agricultural sector and in the regions with an economic reliance on this sector.
Increases in farm size and concomitant population loss can lead to an increase in the capital
to operator ratio but not necessarily to an increase in aggregate capital investment in a region or industry sector. In addition, secular pressures of technological change and farmers’ declining terms of trade on farm incomes can be exacerbated in the short term by downturns in commodity prices and poor seasonal conditions. These circumstances deter investment in agricultural businesses and add to the fixity of capital in the sector.

The problem of capital fixity also applies to private capital invested in the housing sector. Whilst regional price indices are not available to compare regional differences in the cost of living, housing costs are lower and transport costs are higher in non-metropolitan areas. In Australia, the appreciation of capital invested in home ownership is a major source of lifetime wealth accumulation (see Badcock and Beer, 2000). In regions that are in economic decline, the value of housing assets is diminished. This is a barrier for people wishing to relocate for employment opportunities to areas where the housing costs are higher. The differential cost of housing may be to the advantage of those wanting to move to non-metropolitan areas, but is a constraint on long term wealth accumulation.

8.5.2 Labour market

As anticipated, the significance of the unemployment rate variable in the model indicates that unemployment is negatively correlated with regional income growth and high unemployment rates contribute to lower regional per capita income. The continued disparities in regional per capita income may be attributed in part to barriers to labour mobility that impede regional adjustment. One of these barriers is considered to be the
wage system. The Industry Commission (1993) argues that the uniformity of national labour awards and employment benefits means the price of labour does not reflect regional differences in productivity, thereby inhibiting migration from declining regions and dissuading capital from entering these regions.

In the context of the agricultural sector, although broad acre farmers have limited requirements for direct hiring of labour, increases in farm size, coupled with decreased on-farm labour, has led to increased use of contractors in crop preparation, chemical application, harvesting, transport and other essential farm services. Intensive agricultural industries, whilst having a higher labour requirement, have also followed this trend. Increasingly, financial and advisory services are obtained from larger business centres or capital cities, and off-farm income is utilised to support farm enterprises (ABARE, 1996). Similar changes have occurred in non-farm businesses and have led to out-sourcing and utilisation of business services and inputs from other locations. The price of both the labour and non-labour components of these inputs is influenced by the price of labour in the national market and does not necessarily reflect local returns to factors of production. This causes rigidity in the cost structure of regional businesses, even if regional wage flexibility was to lower the cost of the local labour component.

The Industry Commission (1993) also argues that Australia exhibits low geographical labour mobility and that adjustment to regional employment shocks is generally mediated by a reduction in the participation rate. In contrast, Debelle and Vickery (1999) (Debelle and Vickery 1999) demonstrate that migration is an important adjustment mechanism in Australia at the inter-state level. In addition, Ferry (1991)(Ferry 1991) argues that Australia appears to have a high degree of labour market mobility by international
standards and therefore any compression of regional wage relativities by the wages system does not seem to be impairing labour market mobility. Data on inter-regional migration for Victoria is unavailable, so it is difficult to ascertain the degree of labour mobility between the Victorian regions, other than drawing inferences from population changes. The population changes documented here show that the regions do shed population when there is a shock to regional employment. In addition, the aging population evident in some regions suggests that younger people are more geographically mobile and have left these regions for opportunities elsewhere.

Dispersion in unemployment rates is one way of assessing labour mobility, for if labour is perfectly mobile between regions, then all the regions would be expected to have the same unemployment rate in the long run, everything else being equal (Debelle and Vickery, 1998, p 15). Blanchard and Katz (1992) reported a high correlation between unemployment rates over time in the United States, and Armstrong and Taylor (2000) cite similar evidence for the United Kingdom. Ferry (1991) maintains that, although unemployment is higher in many non-metropolitan areas, disparities in regional unemployment rates in Australia are low by international standards and there are few institutional barriers to mobility in terms of employment or housing opportunities.

There appears to be no consistent pattern of persistence of unemployment rates over time in the Victorian regions, although it has not been formally tested in this study. Between 1985 and 1998, Barwon and Wimmera had a small increase in unemployment rate, East Gippsland and Gippsland had a large increase in unemployment rate, whilst all other regions experienced a decrease. In 1985, only Wimmera and Mallee had lower unemployment rates compared to Melbourne, whilst in 1998, Wimmera, Mallee, Western
District, Goulburn and Ovens-Murray had unemployment rates below Melbourne. The changes in unemployment rates may reflect different structural changes or different source of shocks underlying regional employment shocks, or it may be an indication of some degree of labour mobility.

In addition, if labour mobility acts to equalise unemployment rates in the long-run, the implication is that persistent disparities in unemployment rates between regions reflect compensation differentials, such as real wages or lifestyle factors (Borland, 1998). The amenities in an area can attract people willing to tolerate poorer job prospects in order to take advantage of good amenities. Unemployment rates are one indicator of a region’s employment capacity but high unemployment does not necessarily mean low job growth, as fast growing industries may initially attract workers to a region, bringing a rise in the unemployment rate. Low unemployment may be a sign that job prospects are few and that job seekers have moved elsewhere. For example, Wimmera and Mallee are regions where the unemployment rate is lower than the state average.

8.5.3 The agricultural sector

The estimated coefficient on the gross value of agricultural production per capita in the regional growth model is negative and highly significant. This shows that the extent of reliance on agriculture is an important structural characteristic determining regional income growth. It implies that the more a region relies on agriculture, the lower the income growth over time is likely to be. Taxable income per capita in the agriculturally based regions in Victoria is lower and more variable than the regions that have a diversified economic base.
This reflects in part the level and variability of regional incomes that are a consequence of higher levels of employment in the lower paying agricultural and service industries, coupled with the volatility of the agricultural sector. It is also the result of structural changes, such as capital substitution and new technology, which have occurred in the agricultural sector (Productivity Commission, 1998).

This result needs to be qualified, however, in respect of the measure of agricultural production used in the model. In developed countries, there is a secular reduction in the relative size of the agricultural sector because of the low-income elasticity of demand for most food products and increases in agricultural productivity. Longmire (1994) maintains that structural change in Australian agriculture is not significantly different from that of other OECD countries, both in share of Gross Domestic Product and workforce characteristics. However, Cummings (2000) makes the important point that while Australian national accounting figures show a decline in the relative contribution of agriculture to Gross State Product over time, the importance of agriculture is underestimated. It is measured as production from ‘on-farm’ activity and neglects the contribution of agriculture measured through other sectors, such as manufacturing and services. This contribution is increasing rapidly, whilst the on-farm contribution to Gross Domestic Product is growing slowly relative to other sectors. Leones, Schluter and Goldman (1994) caution that there needs to be a clear distinction between production agriculture and the ‘food and fibre sector’ when assessing both the contribution of the agricultural sector to Gross State Product and the size of the linkages that agriculture has with other sectors of the state economy. The measure used in this study focuses on production agriculture and therefore almost certainly understates the contribution of agricultural activity beyond the farm gate to regional income growth.
The significant of the positive coefficient of the average rainfall variable in the model also emphasises the importance of agriculture to regional incomes. Victoria experienced widespread severe drought in 1982 and 1983 and again in 1991 and 1992, and prolonged drought in some localised areas. The reduced agricultural production resulting from these adverse climatic conditions are reflected in the regional income levels, having both a direct impact on farm businesses and linkage effects to related sectors (Campbell, Crowley and Demura, 1983). In areas in the west, north-east and south-east of Victoria, outside the regional centres, over fifty per cent of the labour force is engaged in the primary sector (agriculture, fishing and mining). The flow-on effects to the service and manufacturing industries in regions with a large primary industry workforce, and in particular to the major regional centres, is substantial (ABARE, 2000). Garnett and Lewis (1997) report that, in Western Australia, the agricultural sector is responsible for much of the employment and income generated in other sectors, due to linkage effects. The evidence from the regional growth model suggests that these linkage effects could be expected to apply in Victoria as well.

However, there is some debate about the extent of the linkages between the agricultural sector and other sectors. Stayner and Reeve (1990) suggest that these linkages will become weaker as the agricultural sector undergoes structural changes, such as those outlined in Section 8.4.2, and regional economies diversify. They found substantial evidence that the economic performance of agriculture in Local Government Areas of New South Wales is relatively ‘uncoupled’ from key indicators of economic and demographic change in these regions. They found that population, employment and retail sales changed in the opposite direction to the value of agricultural production between 1981 and 1986.
Stayner and Reeve used a similar measure of gross value of agricultural production to this study (being the only one available from the ABS), which underestimates the off-farm contribution of agriculture and, as it is based on prices received, is not an accurate measure of farmers’ net returns. In contrast, Levantis (2001), analysing ABARE data, found evidence that small towns in Australia that proportionally rely heavily on the expenditure of farmers tend to be those that are losing population. Godden (1997) suggests that capital substitution affects both supply and demand in small towns: less services are required (and provided) when population declines, while concomitantly, increasingly specialised services are required from other locations.

8.6 Policy Implications

Tim Fischer, former deputy Prime Minister and Minister for Trade argues that the use of government resources in developing and implementing regional growth policies is inefficient, and that emphasis on sound macroeconomic policies will be of most benefit to the welfare of all citizens (Fischer, 1997). Campbell (1985) maintains that farmers’ welfare is more affected by fiscal, monetary, exchange rate, wages, tariff and general trade polices than by commodity-related policy or rural-sector oriented policy. However, at the policy level in Victoria, there is limited capacity to influence the macroeconomic variables that dictate Victoria’s trading conditions when fiscal, monetary and wage policy is made nationally. In turn, the Australian economy is largely circumscribed by the economic conditions in the rest of the world. If external terms of trade shocks are an important
driving force behind Victoria’s economic fluctuations, as suggested here, then instruments at the state level to ameliorate these are limited.

Nevertheless, microeconomic reforms, which improve the competitiveness of industry and increase diversification of the export base, may act to reduce the effect on Victoria of shocks to the terms of trade. The long-run nature of terms of trade shocks suggest that short-run policy reactions are likely to be ineffective, whereas planning for output and employment changes from permanent changes in the terms of trade may be beneficial. Given the nature of supply fluctuations, the policy strategies for offsetting the effects of short term supply disturbances would also be short term, such as drought relief and income measures distributed through the welfare system. However, there is also scope for the adoption of agricultural practices that improve the resilience of the sector to adverse climatic conditions.

One of the main critiques of the standard neoclassical model is that it suggests there is little need for regional policy to foster economic growth when convergence of output and incomes is predicted and when technological progress is determined outside the model. Sala-i-Martin (1996b, p 1342), on finding similar speeds of convergence between regions in several countries, states:

Since the degree to which national governments use regional cohesion policies is very different, the fact that the speeds of convergence are very similar suggests that public policy plays a very small role in the overall process of regional convergence.

Aside from the lack of counterfactual evidence in this argument, there is also evidence that estimated speeds of convergence are sensitive to model specification, level of aggregation of the data and the time period investigated, and that in some countries there is no convergence or evidence of convergence clubs across regions (Durlauf and Quah, 1999). In
addition, Cheshire and Carbonaro (1995) argue that the empirical estimates of convergence rates are a measure of the average speed of convergence and are thereby the net effect of both convergent and divergent forces, which are not elucidated in the model.

Income inequalities may increase, despite a finding of $\beta$-convergence, as $\beta$-convergence is a necessary but not sufficient condition for $\sigma$-convergence. Therefore, there may be scope for policies that target the causes of divergence, or that seek to shift the steady state growth rate upwards in the long run. Stemming from the sources of long term per capita regional growth identified in the neoclassical production function (see equation 3.9), these policies would need to target investment that increases the rate of technological progress and growth in the ratio of capital to labour. Krugman (1995, p 48) argues:

In economic geography …the supply of factors to any one region or location will typically be very elastic, because they can come from someplace else. And so while a Big Push for the economy as a whole may be implausible, a Big Snowball for a particular region may make perfectly good sense.

Evidence from the regional growth model suggests that rapid convergence to different steady state growth rates and different steady state income levels is occurring across the Victorian regions. Regions may adjust relatively quickly to economic shocks, but disparities in income levels between regions will persist if the fundamental differences between the regions remain. In most instances, the differences between regions are the natural endowments and structural characteristics of the economy of each region, if it is assumed that technological diffusion between regions is unimpeded. The policy implications are, therefore, that each region must seek to develop what advantages they have and to improve their competitiveness.
Armstrong and Taylor (2000) suggest that the strength of the neoclassical model is the emphasis on the crucial role of technical change in the growth process. Regional differences in productivity occur through differences in the ability to absorb and use new technology and the ability to generate technical progress, as well as differences in the institutional environment. The importance of human capital in the growth process has led growth theorists to distinguish between embodied and disembodied technical progress. Technology embodied in capital goods is exogenous and embodied in the acquired technology. Disembodied technical progress is independent of the capital stock with which it is combined in order to produce output and is more likely to be produced in regions that are rich in knowledge and human capital. Regions less well-endowed with human capital will tend to specialise in routine activities which rely on technical knowledge embodied in the capital equipment available globally and will therefore depend heavily upon being cost competitive in world markets. Therefore regional disparities in economic development can and do persist, even in the long run, with the primary reason for long-term persistence being that some regions are more able to generate their own technical change (Armstrong and Taylor, 2000, p 87).

Whilst the regional growth model suggests that reliance on agriculture is contrary to regional income growth, the agriculturally based regions have an absolute advantage in the production of certain commodities. Capital fixity in the agricultural sector presents difficulties in alternative use of agricultural capital. Given these circumstances, it would make sense to improve the productivity of labour and capital in the regions in producing those commodities in which they are competitive and market these commodities effectively (see Table 2.3). At the same time, diversification of the regional economy to strengthen the linkages between the agricultural sector and other industry sectors, both within and between
regions, and with export markets, is desirable. McKenzie (1994) suggests that the lack of linkages in a region’s economy can create a situation of ‘sectoral disarticulation’, where there is little integration with the local economy. She argues that to a certain extent, the national economy overall exhibits a degree of non-integration because of its export orientation and lack of diversification.

Ovens-Murray is an example of a region where an economic development strategy based on increasing competitiveness and local economic linkages can be successful. The manufacturing base of the region has been in decline following major economic reform (see Section 2.2.2), but the region has weathered the major economic shocks to the Victorian economy, and maintained its per capita income level, by re-structuring to concentrate on its strengths in horticulture, the wine industry and tourism (Bright, 1996). Economic growth in Ovens-Murray has been enhanced by the diversity of the economy, which includes the wine making industry, food processing, timber and tourism, as well as more traditional agricultural enterprises, with access to interstate transport routes.

The agricultural sector in Australia is also responding to adjustment pressures through the increased utilisation of off-farm income to supplement farm income, and by effectively utilising the available skills of women, both of which has been well documented by ABARE (1996). This is also occurring in the United States, where Gardner (1993) maintains that the main contributions to long-term income gains by farmers are migration of excess farm operator labour to non-farm employment; improved education and skills of farm people; increased non-farm work by members of farm households; larger farms with economies of size; lower costs through technical progress and federal farm programs. Gardner (1993, p 23) argues that:
improved off-farm opportunities and improved farmer skills have combined with new technology and economies of scale to permit farm households to make far better use of their economic resources, whether they specialise in farming or not.

Whilst subsidisation through mechanisms such as the United States Farm Bill would be an expensive and retrograde step, there is an opportunity for appropriate public policy to support similar progress to diversification of farming. At present in Australia, these changes are viewed as ‘coping strategies’, rather than as part of a long-term, considered response to adjustment in the agricultural sector (Lawrence and Gray, 2000). (Lawrence and Gray 2000)

Part-time farming leads to greater integration between the agricultural sector and other sectors in the regional economy. However, for small farms and part-time farming to be profitable requires new forms of cooperation, new enterprises and appropriate technology. At the other end of the spectrum, the Rural Industries Research and Development Corporation (1997) argues that impediments to large scale capital investment in agriculture must be removed if agriculture is to be attractive to corporate investors. These impediments include:

- lack of separation between management and ownership;
- the cash economy of farming;
- lack of transparency in management performance;
- poor investment performance;
- insufficient critical investment mass
- lack of prudential control over investment
- structural aspects such as non-financial returns and overpriced assets; and
- illiquidity of the investment.
An important arena for potential economic and environmental gains is water reform. Given the essential nature of water to agricultural production, and the importance of agriculture to the Victorian economy, there is enormous scope for improving water use practices to enhance productivity and ameliorate the impact of adverse climatic conditions on agricultural supply. This requires regulatory and water pricing reforms for economic efficiency in water allocation, investment in public and private infrastructure for water control and delivery and improved water use efficiency for productivity and environmental sustainability of farms and river systems.

Employment growth to reduce unemployment rates is also essential for regional income growth. Some reduction in employment disparities may be achieved through labour movement, of which there is evidence from regional population changes. However, writing about the United States, Bartik (1991, p 211) cautions that:

> there is no necessary contradiction between the argument for helping distressed places and the argument that geographic mobility has great benefits. We should not elevate the virtues of geographic mobility so much that we forget the needs of those who have strong and valuable ties to their homes.

Fincher and Wulff (2001) present evidence from Australian case studies that demonstrate the adverse social outcomes and the breakdown of community from extensive population mobility. These outcomes reinforce the contradiction between government rhetoric on ‘family values’ and community development on one side, and the push for labour market deregulation and social security reform on the other. When people leave a region for employment elsewhere, there is a concomitant reduction in consumer demand, which can lead to further decline and the withdrawal of services. Labour market programs and integrated strategies aimed at economic development in regional areas may be
complementary and more socially cohesive than relying on labour mobility alone to reduce regional employment inequalities.

Taylor (2000) argues that appropriate regional policy is beneficial in addressing some of the equity and efficiency concerns arising from persistent regional disparities, and to facilitate regional adjustment. Howard and Buultjens (2000) argue that a clear definition of regional success is required before regional development theory can progress, and this should be ‘a measure of human capacity and choices,’ linked to regional economic performance. A set of mutually agreed objectives is required for a coherent regional policy that seeks to reconcile the economic, social and environmental needs of regional areas and the national interest.

The Victorian Farmers Federation (2000) have called for a strategy to ‘revitalise rural Victoria’, which embodies the main elements of the above discussion, namely:

- government investment in rural infrastructure;
- promoting growth in rural areas through technology and innovation in agriculture and the food industries;
- investing in natural resource management; and
- improving the rural community’s capacity to manage change and pursue growth.

Regional policy requires a broad focus that encompasses agriculture and agribusiness, education and training, health and services, and complements sound macroeconomic policy and promotion of the outward orientation of the regional and national economies. In the longer term, efforts to realise the potential of technology and human resources to increase
output, such as investment in education, research and development and improvements in infrastructure are required.

8.7 Avenues for Further Research

The 2001 Census presents an opportunity to extend the analysis of gross personal income disparities across the regions and to further estimate regional Gini coefficients to assess income distribution within the regions. In addition, another two years of Taxation Statistics will soon be available for comparison with the present series.

Public debate on the issue of regional unemployment has been sparked by comments from the Federal Treasurer that lower regional wages may be desirable to stimulate jobs growth in regional areas, and by the Federal Employment Minister that the unemployed are ‘too fussy’ about the jobs they are prepared to take. To fully investigate the relationships between labour mobility, wages and employment differentials at the regional level in Victoria would require appropriate data to estimate a model similar to Blanchard and Katz (1992) and Debelle and Vickery (1999).

The panel data used to estimate the regional growth model was constructed to avoid short-term fluctuations in the business cycle. Petrakos and Saratsis (2000) report conflicting evidence from other countries on the impact of the business cycle on income disparities so further investigation of the relationship between the business cycle and income and employment indicators would be fruitful. Daly and Royer (2000) report that the business cycle and demography explained much of the disparities in income between California and
the rest of the United States following the 1990s recession, which suggests that
these factors are worthy of further study. This could be incorporated with the comparison of
the data from the 2001 Census with earlier Census figures.

The Ovens-Murray region has been pinpointed as the only Victorian region, other
than Melbourne, to maintain its population and per capita income between 1980 and 1998.
The Gippsland region was shown to be in severe decline with little evidence of regional
adjustment. Both these regions would be worthy case studies of regional adjustment to
ascertain why one region had the capability to adjust to adverse economic conditions, while
the other appears to have a persistent adjustment problem.
CHAPTER 9. CONCLUSIONS

The aim of the research reported in this thesis was to assess whether the process of economic change in Victoria has resulted in increased regional income disparities. The empirical evidence supports the proposition that there is an increased economic divide between Melbourne and the rest of Victoria. This is based on the finding that the dispersion of regional taxable incomes relative to the state mean increased over the period 1980 to 1998. Melbourne had the highest per capita taxable income, which increased further above the state mean during this period, whilst the majority of the regions moved further below the state mean. Taxable per capita incomes in the majority of the non-metropolitan regions converged between regions, but towards income levels that were persistently lower than the state mean.

The various statistical measures used to assess dispersion in the literature are often not clearly specified, and this causes confusion about what they are measuring and their comparability. The standard deviation of the log of per capita income is useful in assessing whether incomes within a cross-section are converging towards each other and therefore whether the distribution of income between units is becoming more equal. However, it does not elucidate whether overall incomes are decreasing or increasing, where individual regions are positioned within the distribution, or the dispersion of income on a population-weighted basis. These features of the income distribution between regions need to be assessed by various other measures, which include the weighted coefficient of variation and the weighted mean absolute coefficient of variation.
The distribution of income within the Victorian regions, as measured by the decrease in the calculated Gini coefficients, became more equal over the period 1981 to 1996. The position of the regions relative to each other in terms of income distribution did not change significantly, which suggests that the changes in regional incomes and the persistent income disparities did not have a detrimental effect on income distribution within the regions. Lower Gini coefficients are a feature of low income regions, where incomes received are in a narrow range and high income earners are less prevalent.

Terms of trade and supply shocks were determined to be important sources of aggregate fluctuations in the Victorian economy. At the state level, a long-run increase in output and a decrease in unemployment result from an improvement in the terms of trade (and to a lesser extent, a positive supply shock) and these translate to income growth at the regional level. However, the influence of the terms of trade and supply factors makes regions vulnerable to these types of exogenous shocks, so that continual improvement in competitiveness is required to strengthen the ability of regions to withstand these shocks.

From the regional growth model, the finding of conditional β-convergence confirms the prediction of the neoclassical model. The estimated rate of β-convergence is rapid at approximately 22 per cent, which is faster than most empirical estimates of β-convergence. This implies that the Victorian regions are close to their steady state growth rates and that the share of capital in the production function is below one-third. The initial level of income is a significant determinant of subsequent growth rates. This confirms the prediction of the neoclassical model that the growth rate of an economy will be positively related to the distance that separates it from its own steady state and shows that the poorer regions are growing faster than the wealthier regions. However, the significance of the
conditioning variables in the model indicates that the regions are converging to different steady states growth rates. As the regions are close to their steady states but have markedly different income levels, this implies that the steady state income levels are also different, contrary to the prior assumption of similar steady state income levels.

The different structural characteristics of the regions account for the differences in the steady state growth rates. These different structural characteristics determine the extent to which each region is vulnerable to different shocks, such as those to the terms of trade, the agricultural sector and employment. The terms of trade, the unemployment rate and the extent of reliance on agriculture are significant in determining regional income growth. Whilst the extent of reliance on production agriculture in a region was shown to have a negative influence on regional income, this does not necessarily imply that these regions should abandon agriculture. The agriculturally based regions are constrained in their choice of alternative industries by location and capital fixity. Nevertheless, these regions may have an absolute advantage in the production of certain commodities. In addition, the linkages between production agriculture and other sectors are important, and the economic activity in the sectors that are linked to agriculture will also influence regional income growth.

The existence of long-standing disparities in per capita income and unemployment rates and increasing dispersion in per capita income and unemployment rates between Victorian regions, when viewed through the neoclassical economic framework, indicates that constraints to factor mobility are present and inhibiting the adjustment process that leads to the convergence of regional incomes in the long run. These constraints include low capital mobility as a result of capital fixity in agriculture
and other industry sectors, the extent of natural resource endowments, social barriers to labour mobility and rigidities in the labour market.

Nevertheless, Victorian regions have adjusted to economic shocks in a manner consistent with neoclassical theory. For example, population movements in response to economic shocks and to secular re-structuring are evidence of the mechanism of labour mobility in regional adjustment. With the exception of Gippsland and East Gippsland, unemployment rates and income growth in the regions have returned to approximately the same levels by 1999 as before the recession commencing in 1990. In addition, economic shocks to the Victorian economy have been regular and relatively severe, so that regions are still in an adjustment phase when hit by the next shock. The regional economies have contended with region-specific structural adjustments and localised shocks such as droughts, in addition to weathering the exogenous shocks to their economies.

It is apparent that long term sectoral changes and other influences affect economic growth and welfare in Victorian regions and that economic shocks and impediments to adjustment will always occur. Regional per capita income levels are likely to remain disparate, because of the high degree of capital fixity, labour market characteristics and continual adjustment pressures. The persistent economic disparities have implications for the economic and social welfare of people in the low-income regions, as well as for aggregate economic growth in Victoria. Regional policy that seeks to improve the competitiveness of regional industry, the skills and flexibility of the labour force and the provision of relevant infrastructure can help address the issue of regional inequality in growth and income.
The research reported in this thesis has a spatial dimension, making comparisons across the regions as to where change is occurring, as well as an industry focus on the role of agriculture in regional areas. The study has a practical application as a descriptive empirical analysis of economic growth in Victorian regions. In addition, a theoretical contribution was made by the application of the neoclassical theory of regional economic growth to small regional economies. It is hoped that this research contributes to an enhanced understanding of the process of regional economic growth, which is essential for governments if they are to develop appropriate public policy for regional Australia.
BIBLIOGRAPHY


— (1997b) Income Distribution, Australia. AGPS, Canberra


Bartik, T. (1991) *Who benefits from state and local economic policies?* W.E. Upjohn Institute, Kalamazoo, Michigan,


Bright, M. (1996). North East Agribusiness Forum Regional Profile


Department of Infrastructure, Victoria (1998) *Regional Victoria in Fact*. Department of Infrastructure, Melbourne


Ferry, N. (1991) Regional income levels and living standards in Australia, Economic Planning and Advisory Council, Canberra


Productivity Commission, Australia. (1998) *Aspects of Structural Change in Australia.* AGPS, Canberra


Appendices
Appendix 1  Population Figures for Victorian Statistical Division, Number of Persons, 1980 to 1999

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Note: The table above provides the population figures for Victorian Statistical Division from 1980 to 1999. Each row represents a different Statistical Division, and the columns represent the years 1980 to 1989.
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Appendix 7 Construction of Panel Data Variables

The data used in Chapter 7 are annual observations for the period 1980-1998. Data for this period is then divided into four subperiods (1980-84, 1985-89, 1990-94 and 1995-98). Some of the variables are calculated for the initial years of the subperiod and others for the average of the subperiod as indicated.

Growth in per capita income — log of per capita income at time \( t \) minus log of per capita income at time \( t-r \).

Log of per capita taxable income at the beginning of the subperiod — Australian Taxation Office annual data at the postcode level, aggregated to 1996 ABS Statistical Divisions, adjusted by the national GDP deflator (taken from ABS on-line time series) to 1996 dollars and calculated per capita using ABS population data: 1980-1998. Individual taxable income is the amount to which the tax rate is applied, which is the amount remaining after deducting from assessable income all deductions allowed under the Act.

Change in the Australian terms of trade index average/initial — (base 1989/90=100); ABS on-line time series; defined as the ratio of the implicit price deflator for exports of goods and services over the implicit price deflator for imports of goods and services; 1980-1999.

Change in population — based on ABS population figures for each SD, average and initial; 1980-1999.

Participation rate, average — percentage of population over 15 years of age engaged in the labour force - Department of Employment, Workplace Relations and Small Business (DEWRSB, formerly DEET) and the ABS: Local Government Area (LGA) statistics, aggregated to ABS Statistical Divisions; May statistics for 1984-1986 and June quarters 1987-1999.

Unemployment rate average — source and compilation as above for participation rate; 1984-1999.


Rainfall deciles average and initial — Bureau of Meteorology data on annual rainfall deciles for a ‘typical’ weather station in each Statistical Division; 1 being lowest ten per cent of rain on record and 10 being highest ten per cent of rain on record; 1980-1999.

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Variable legend: 1 = Growth in per capita income; 2 = Log of initial per capita income; 3 = Change in terms of trade (average); 4 = Change in terms of trade (initial); 5 = Rainfall (average); 6 = Rainfall (initial); 7 = Unemployment rate (average); 8 = Participation rate (average); 9 = Land used for agriculture (average); 10 = Change in population (average); 11 = Change in population (initial); 12 = Gross value of agricultural production per capita.
Table 2.2 Age Structure of the Victorian Statistical Divisions in 1996

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Figure 5.4 Average Annual Per Capita Taxable Income for the Victorian Statistical Divisions, 1980 to 1998
Figure 5.2 Average Annual Growth Rate in Per Capita Income, Per Cent, for the Statistical Divisions of Victoria

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Author/s:
O'Hagan, Rowan Jane

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