THE DISPERSION AND PERSISTENCE OF QUEENSLAND REGIONAL UNEMPLOYMENT

Bernard Trendle[1]
Office of Economic and Statistical Research, Queensland Treasury, P.O. Box 37, Albert Street, Brisbane, Qld. 4002, Australia.

ABSTRACT This study explores the relationship between regional unemployment rates in Queensland over the period 1987(Q4) to 2000(Q3). A variety of techniques are used to investigate the extent and nature of the disparities in the regional unemployment rates. The disparities and persistence of the regional unemployment structure that is uncovered may be either a disequilibrium or equilibrium phenomenon. The aim of this paper is to attempt to determine which explanation is the more appropriate. It is suggested that the results tend to support a disequilibrium rather than equilibrium view. The implications that this may have for regional unemployment policy are discussed.

1. INTRODUCTION

The nature and persistence of regional unemployment disparities and the question of the cyclical responsiveness of regional unemployment to changes in the national rate has been widely investigated, with much research being carried out since the pioneering work of Thirlwall (1966) and Brechling (1967). Much of this analysis has indicated that regional unemployment rates rise and fall together but exhibit no tendency to converge on a common value.

Two broad theoretical views exist as to the causes of persistent unemployment disparities. These competing views can be considered the equilibrium and disequilibrium explanation of regional unemployment disparities. In the equilibrium explanation, the differences in regional unemployment rates are interpreted as an equilibrium phenomenon, in the sense that unemployment differentials have different underlying means across regions. Economic disturbances and shocks may move actual regional differentials away from their mean values and, hence, from their underlying long-run relationship to the National or State unemployment rate, but such disequilibriating movements are short lived and regional differentials converge back to their equilibrium means. Marston (1985), for example, states that geographical areas are in an equilibrium relationship with respect to one another, and the equilibrium unemployment rate in each area will be a function of the amenities and land endowment in the area. Because of variations in the endowments and infrastructures, equilibrium unemployment rates will differ between areas.

The second explanation for persistent regional differences in unemployment

[1] This paper does not necessarily reflect the opinions or views of Queensland Treasury or the Queensland Government. Any statement, opinion or advice expressed or implied in this report is made in good faith but no liability is taken for any damage or loss whatsoever which may occur in relation to its use.

rates is that they represent a disequilibrium phenomenon. According to this view, because labour market adjustment mechanisms are weak and slow, deviations of regional employment differentials from their means, caused by demand, structural, technological or other shocks, are very persistent. In this case the differences in regional unemployment rates are not stable or tend to zero, but may diverge further following a shock. Armstrong and Taylor (1993), for example, assume that the persistence of regional disparities is the net result of shocks and adjustment processes. Regional disparities arise because regions respond in different ways to exogenous shocks, and the adjustment mechanism is not instantaneous because of economic and social barriers.

Pehkonen and Tervo (1998) note that the empirical evidence of the relative importance of these theoretical explanations is scarce. This is because the equilibrium and disequilibrium views on long-term regional unemployment differences are not mutually exclusive. In particular, labour market disequilibrium phenomena, including exogenous shocks accompanied by sluggish adjustment, can lead to changes in the equilibrium unemployment rate via hyteresis effects. Consequently, the formulation of a model that allows the competing theoretical views to be tested against each other is a near impossible task.

Within Australia, work exploring the responsive to regional unemployment rates has been confined to state level data (see Industry Commission, 1993, Groenewold, 1997 and Dixon *et al.*, 2001). This paper seeks to provide an insight into the nature of unemployment disparities within Queensland and whether or not they are likely to persist in the long-run. Although the present study is unable to explicitly discriminate between the above equilibrium and disequilibrium hypotheses, the analysis aims to shed some light on the issue of whether unemployment differences reflect equilibrium or disequilibrium forces in the labour market.

The analysis commences in Section 2 with an outline of the dispersion and persistence of unemployment within the Queensland economy. This section also provides a preliminary outline of persistence within the Queensland regional system. In Section 3 the dynamics of persistence are analysed using time series techniques. These techniques comprise ARIMA modelling to examine the dynamics of persistence. The final section discusses the implications of these findings for the alternate explanations of the geographical dispersion of unemployment and possible implications that these findings may have for regional policy formulation.

2. THE DISPERSION AND PERSISTENCE OF REGIONAL UNEMPLOYMENT IN QUEENSLAND

A variety of descriptive statistics can be used to present regional unemployment data. In this section several of these techniques are used to highlight some of the characteristics of Queensland regional unemployment. These techniques range from a simple graphical presentation of the time series of

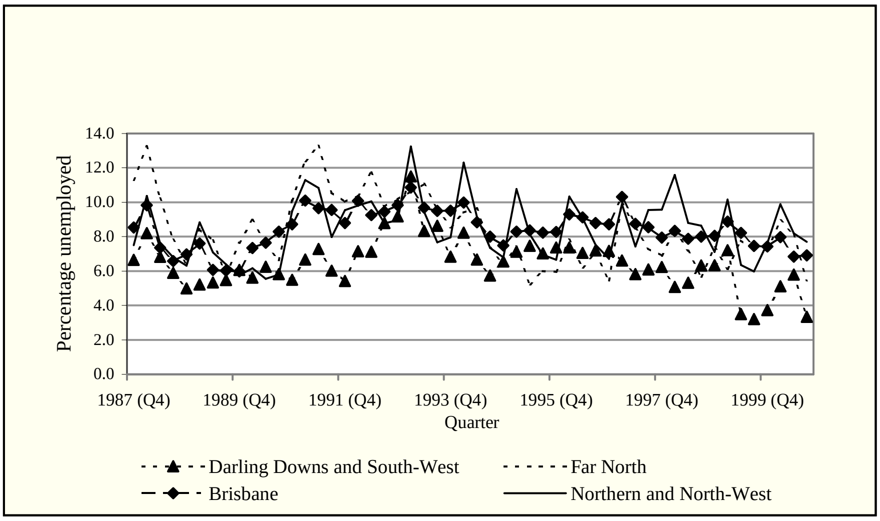

Figure 1: Unemployment Rates – Average Four Lowest Regions

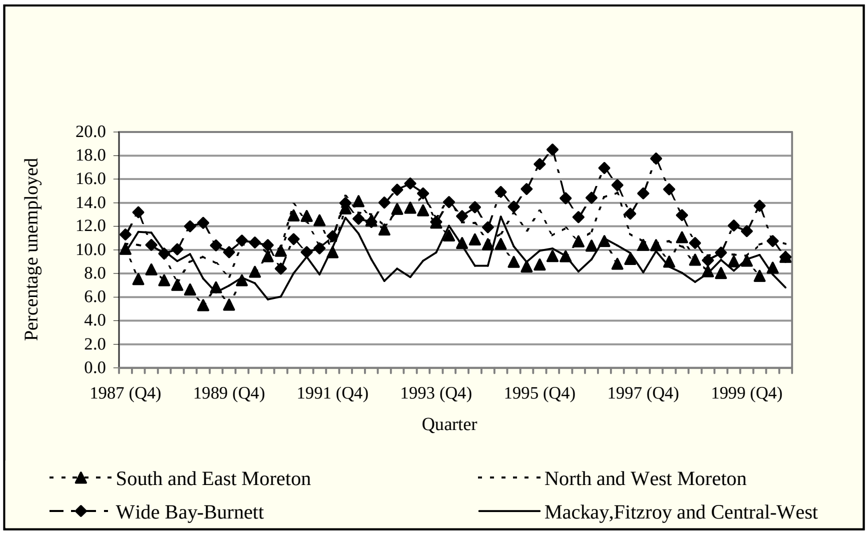

Figure 2: Unemployment Rates – Average Four Highest Regions

regional unemployment rates, to correlation analysis and measures of dispersion and interrelatedness. All of these are used in the remainder of this section to highlight the structure of Queensland's regional unemployment rates.

Figures 1 and 2 provide a time series of unemployment rates over the period 1987(Q4) to 2000(Q3). Figure 1 provides the time series of the regions that recorded the lowest (on average) unemployment rates while Figure 2 provides a

Table 1. Correlation Matrix of Regional Unemployment Rates

	Brisbane	SEM	NWM	WBB	DDSW	MFCW	NNW	FN
Brisbane	1.00							
South and East Moreton	0.94	1.00						
North and West Moreton	0.88	0.84	1.00					
Wide Bay-Burnett	0.39	0.27	0.60	1.00				
Darling Downs and South West	0.31	0.33	0.52	0.56	1.00			
Mackay, Fitzroy and Central West	0.75	0.68	0.76	0.46	0.14	1.00		
Northern and North West	0.79	0.85	0.63	0.38	0.29	0.52	1.00	
Far North	0.62	0.72	0.45	-0.24	-0.06	0.40	0.58	1.00

time series of the four regions with the highest average unemployment rates over the sample period. It is apparent from these two figures that the regional unemployment rate series have a strong seasonal pattern. This will affect the structure of statistical tests applied to the series, a factor that is discussed in Section 3.

An interesting feature of these two figures is the broad similarity between regional trends, with the exception of the Wide Bay-Burnett and North and West Moreton regions (both shown in Figure 2). These two figures suggest that regional unemployment paths do not appear to have traced out arbitrary or unrelated trajectories but, to a greater or lesser extent, have followed a common overall pattern. These figures suggest that the regions experienced a similar pattern of unemployment, rising and peaking in the period 1990 to 1993 and generally declining over the remainder of the sample period.

However, Figure 2 indicates that the Wide Bay-Burnett region and North and West Moreton region both experienced high rates of unemployment in the period 1996 through 1998 a period when the remaining regions were experiencing declining rates of unemployment. For these two regions, unemployment rates do not appear to show signs of a decline until after 1996 or 1997.

Table 1 presents the correlation matrix between the regional unemployment rates, and highlights the differences between the time paths of these rates. The first column of this table shows the correlation coefficients for Brisbane with the remaining regions. This column indicates that South and East Moreton and North and West Moreton recorded the two highest correlation coefficients with the Brisbane unemployment rate over the sample period. Although these regions border on Brisbane they are among the regions with the highest unemployment rates while Brisbane is among the regions with the lowest unemployment rates. Despite the difference in unemployment rates, the high correlation suggests that the regions are to some degree part of the same labour market, with a substantial amount of labour migrating on a daily basis from South and East Moreton and

North and West Moreton to Brisbane and to a lesser extent, *vice versa*.

The regions with the lowest correlation with Brisbane are the Darling Downs and South West and Wide Bay-Burnett labour force regions. The Darling Downs and South West region is a sparsely settled rural economy, while the Wide Bay-Burnett region experienced the highest average unemployment rate over the sample period.

An alternative way of looking at the relationship between spatial data, in this case regional unemployment rates, is through the concept of sigma (σ) convergence and Moran's *I* statistic.[2] The idea of σ convergence is to use the standard deviation or the coefficient of variation to measure the cross-sectional dispersion of the log of regional unemployment rates over time. A decrease in this measure over time could be interpreted as evidence of convergence, ie. of regional unemployment rates converging to some common level across regions. On the other hand, the Moran's *I* statistic can be used to determine the extent of spatial dependence. Increasing values of this statistic over time might be interpreted as suggesting increasing linkages between the regional economies being studied. In the context of this study, it would suggest that regional unemployment rates are becoming more closely related.

Figure 3 shows the mixed results provided by the application of these measures of dispersion and dependence to regional unemployment. For example, the standard deviation of regional unemployment rates tends to increase over most of the period, peaking at 3.81 in 1995 (Q4) before beginning to decline. This might be interpreted as providing weak evidence of divergence in regional unemployment rates for most of the sample period. Similarly, the Moran's *I* statistic shown in Figure 3 shows little evidence of a consistent upward or downward trend. An upward trend could be interpreted as increasing interdependence between the regions while a downward trend may suggest decreasing spatial interconnectedness in the economy. This finding seems to be consistent with the idea that the degree of regional integration has remained fairly stable over the sample period.

---

[2] The Moran's *I* statistic provides a measure of spatial dependence among geographic units, in this case the geographic units of Queensland, and can be expressed as:

$$I_t = \left(\frac{n}{s_0}\right) \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij} x_{it} x_{it}}{\sum_{i=1}^{n}\sum_{j=1}^{n} x_{it} x_{it}}$$

where w_{ij} is an element of the weight matrix W so that it is equal to 1 if i and j are neighbours and 0 otherwise; n is the number of spatial units (8 in this case); x_{it} is the log of the rate of unemployment of region i at time t; and s_0 is equal to the sum of the elements of W.

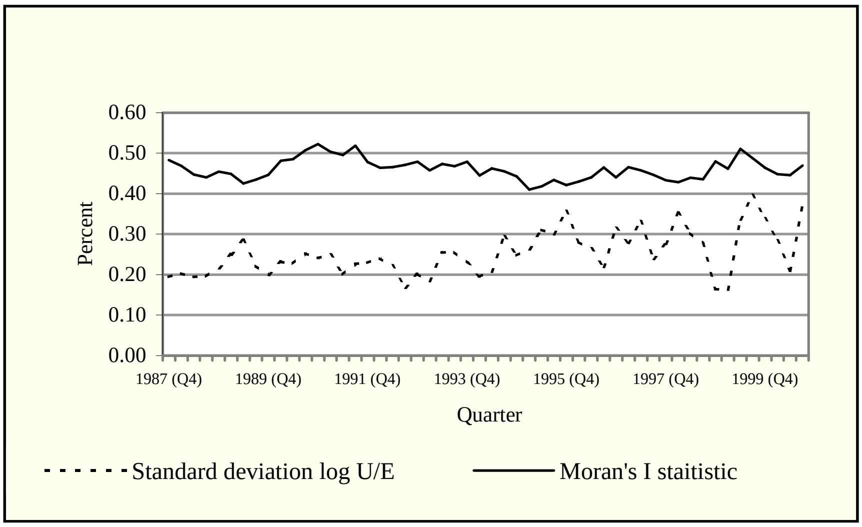

Figure 3: Coefficient of Dispersion and Moran's *I* Statistic

When looking at the actual differences in regional unemployment rates, there are two approaches that are frequently used. The first of these is to look at the regional percentage point differentials about the State unemployment rate, ie. $u_r - u_Q$ where u refers to the unemployment rate, r to the region and Q to Queensland. The second way of defining regional unemployment disparities is in terms of relativities, ie. u_r / u_Q. It is usual for the relativities and differentials to be inversely related (see, for example, Martin 1997 and Pehkonen and Tervo, 1998) with the differentials widening during periods when the State unemployment rate has risen and narrowing when the State unemployment rate falls. In contrast, the regional unemployment relativities tend to narrow during periods of high unemployment and widen as the national or State unemployment rate falls.

Figure 4 presents the results of applying the standard deviation of these two measures of the Queensland regional unemployment disparities to the regional unemployment rates. The standard deviations are presented because they provide a summary of the movements in the regional differentials and relativities. The usual relationship between the regional unemployment differentials and relativities does not seem to hold in the case of the Queensland regional economy where, as shown in Figure 4, both measures of regional unemployment disparities have tended to move together throughout much of the sample period.

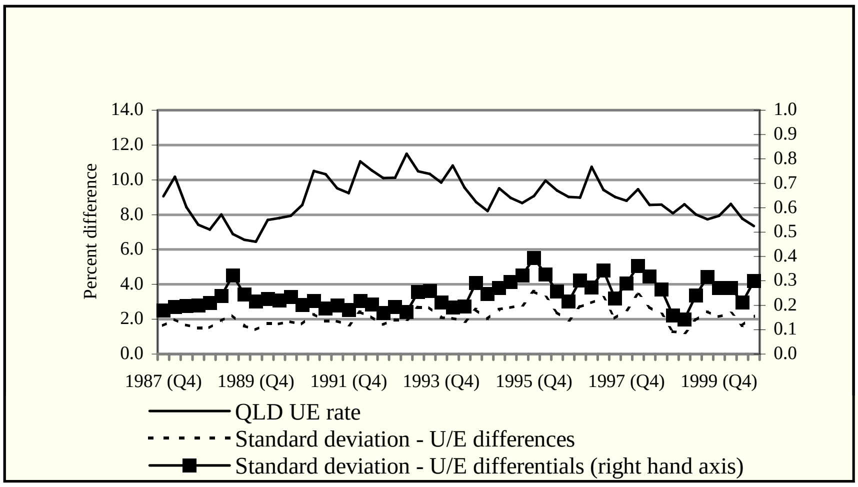

Figure 4: Aggregate Unemployment Rate and Regional Unemployment Disparities, Queensland

One factor apparent from Figure 4 is that the regional unemployment disparities have tended to increase from mid-1994 onwards as measured by the differentials and relativities. Recalculating these measures excluding the Wide Bay-Burnett region suggests that the growth in unemployment in this region during the mid to late 1990s has been the main cause of the increase in regional differences in unemployment rates. This fact, together with the relative stability of the Queensland unemployment rate during the latter half of the 1990s suggests that factors specific to that regional economy have been driving regional unemployment. One possible source of this difference in behaviour may be the large increase in population that occurred in this region. Over the study period the working age population[3] increased by 32.7% compared with 30.4% for Queensland. In contrast, the number employed increased by only 21.5% compared to 37.3% for Queensland during the period. Furthermore, data from other sources[4] indicates that the unemployment rate of interstate movers into this region was 31.8%, compared to a figure of 16.5% for Queensland. This suggests that migration to this region is driven by other factors beside the potential to gain employment.

Two important questions arise from Figure 4. These are, firstly, how persistent are the shocks to regional unemployment, and secondly, does the persistence of shocks differ across regions. Pehkonen and Tervo (1998) and Marston (1985) note that the examination of these issues is of special interest because the validity of the two main explanations of regional unemployment disparities are related to these issues.

---

[3] The population aged between 15 and 65 years.

[4] ABS Census of Population and Housing, 1996

Table 2: The Persistence of Regional Unemployment Differentials

	88-89	**89-90**	**90-91**	**91-92**	**92-93**	**93-94**	**94-95**	**95-96**	**96-97**	**97-98**	**98-99**	**99-00**
1988-89	1.00											
1989-90	0.95	1.00										
1990-91	0.70	0.87	1.00									
1991-92	0.75	0.88	0.98	1.00								
1992-93	0.73	0.89	0.99	0.97	1.00							
1993-94	0.80	0.93	0.98	0.98	0.99	1.00						
1994-95	0.85	0.95	0.93	0.95	0.96	0.99	1.00					
1995-96	0.97	0.97	0.75	0.78	0.80	0.86	0.91	1.00				
1996-97	0.94	0.99	0.87	0.89	0.90	0.95	0.97	0.97	1.00			
1997-98	0.97	0.98	0.80	0.82	0.83	0.88	0.92	0.98	0.97	1.00		
1998-99	0.76	0.90	0.97	0.98	0.99	0.99	0.98	0.82	0.92	0.85	1.00	
1999-00	0.98	0.98	0.81	0.84	0.83	0.88	0.92	0.97	0.97	0.99	0.85	1.00

An initial indication of the persistence of the pattern of regional unemployment disparities can be obtained by looking at the correlations between the map of regional unemployment differentials (or relativities) in any given time periods. The results of this procedure for differentials are shown in Table 2. The results in this table represent correlation coefficients between the unemployment differentials in 1988-89 and subsequent time periods. The significant and relatively high values of the correlation coefficients along with the apparent tendency to decline only slowly with increasing lags in time suggests a relatively stable structure among the unemployment differentials in the Queensland regional system.

Table 3 provides measures of the stability of the rank orderings of the regions by their unemployment differentials. The data in this table represent Spearman rank correlation tests between the unemployment differentials in 1988-89 and subsequent time periods. Again the results suggest that the regional unemployment structure has not changed dramatically from one period to the next, but instead has been characterised by a period of relative stability. In this respect, the Queensland regional system appears to behave in a similar way to that of the United Kingdom (see, for example, Martin 1997 and Industry Commission 1993) and Europe. This behaviour is in contrast to that observed in the United States where regional unemployment differences are much more variable and where one decade's high unemployment region can become the next decade's low unemployment region (see, for example, Partridge and Rickman, 1997).

Table 3. The Rank-order Stability of Regional Unemployment Rates, 1987-2000

89-90	**90-91**	**91-92**	**92-93**	**93-94**	**94-95**	**95-96**	**96-97**	**97-98**	**98-99**	**99-00**
0.83	0.24	0.36	0.36	0.64	0.55	0.64	0.62	0.62	0.52	0.81

3. THE DYNAMICS OF PERSISTENCE IN REGIONAL UNEMPLOYMENT RATES

As was noted in Section 1, the equilibrium explanation suggests that in equilibrium, disparities in regional unemployment rates exist because of differences in regional factor endowments and amenities. These differences cause the disparities in unemployment rates and any shocks to the system are quickly dissipated with a return to the equilibrium position. In contrast, in the disequilibrium explanation, disparities in regional unemployment rates are the result of shocks and slow or weak adjustment mechanisms.

Marston (1985) constructed a simple theoretical model consistent with both of these explanations. Of crucial importance for the validity of these competing theories in this model is the speed of adjustment of the regional unemployment rates following a shock. For the equilibrium explanation of regional unemployment disparities to be valid, adjustment must be relatively quick while the disequilibrium explanation emphasises slow or weak adjustment mechanisms. Acceptance of one or the other of these explanations has implications for the efficacy of regional unemployment policy.

Formal measures of the persistence, or speed of adjustment of a time series can be derived using several techniques. These range from the variance ratio measure (see Cochrane, 1988), to the impulse response measure (see, for example, Campbell and Mankiw, 1987 and 1988) and the use of unobserved components (UC) models such as that presented in Beveridge and Nelson (1981) or Mills (1993). Each of these approaches to estimating persistence has its advantages and drawbacks. The impulse response measure has the advantage of using ARMA modelling techniques that have a long history of use and development. Cochrane (1988), however, criticises the use of this methodology on the grounds that it is designed to capture short-run dynamics, rather than long-run correlations that are the main concern when measuring persistence. The UC models have also been criticised by Cochrane (1988) on similar grounds, in that the identifying restrictions required to estimate long-run behaviour are themselves based on short-run dynamics. Furthermore, such models rule out highly persistent processes a priori, and Nelson (1988) has provided evidence to suggest that they also have a tendency to incorrectly indicate that a series consists of cyclical variations around a smooth trend when the data are actually generated by a random walk. Consequently, the UC methodology tends to bias the estimate of persistence downwards. In addition, the variance ratio measure of persistence proposed by Cochrane (1988) is a non-parametric measure and provides only an approximate measure of persistence and is accompanied by large standard errors, the number of lags (or the window size in spectral analysis) used to estimate the measure can also be difficult to determine.

In this paper, the impulse response measure of persistence developed by Campbell and Mankiw (1987 and 1988) is used to derive estimates of persistence. This methodology was chosen for a number of reasons, including, relative ease of implementation and the nature of the dataset which has large standard errors and possible breaks suggesting limited gains from the application of more complicated techniques.

In applying the impulse response measure, the modelling strategy adopted will depend on whether the original series being modelled is stationary or requires differencing. For series that do not require differencing to induce stationarity, simple autoregressive models can be used to measure the persistence of the time series. In such a model, shocks to the series eventually die out, with the speed of this decline being determined by the size of the estimated autoregressive parameters. This is consistent with the observation that series that do not have a unit root or require differencing to induce stationarity do not have any permanent component.

In cases where testing suggests that the series contain a unit root, differencing is required to induce stationarity. Mixed ARIMA models may be used to model the time series and derive a measure of persistence. Series that contain a unit root contain a transitory and permanent component. The transitory component dies out over time and is captured by the autoregressive components of the model. On the other hand, the permanent component implies that shocks to the series have some permanent effect. This is captured by the moving average components of the model. In the case of non-stationary series, the methodology assumes that the regional unemployment rate u_r contains a unit root but is first difference stationary. The series can then be represented, using the familiar Wold decomposition, as:

$$\nabla u_t = \mu + \psi(B)a_t = \mu + \sum_{j=0}^{\infty} \psi_j a_{t-j} \qquad (1)$$

where:

μ = the mean of the series ∇u_t ,

ψ = the coefficients of the linear filter of the series ∇u_t ,

B = a backshift operator so that $(B)a_t = a_{t-1}$., and

a_t = a sequence of uncorrelated random variables, often known as innovations, drawn from a fixed distribution with the expected value of the series, $E(a_t) = 0$, and variance equal to $V(a_t) = E(a_t^2) = \sigma^2$, where $\sigma^2 < \infty$.

From equation (1), the impact of a shock in period *t*, a_t, on the change in u_t (∇u_t) in period *t+k*, ie. ∇u_{t+k} is ψ_k . The impact of the shock on the level of *u* in period *t+k*, u_{t+k} , is therefore $1 + \psi_1 + \psi_2 + ...\psi_k$. The ultimate impact of the shock on the level of *u* is then the infinite sum of these moving average coefficients, defined as:

$$\Psi(1) = 1 + \psi_1 + \psi_2 + ... = \mu + \sum_{j=0}^{\infty} \psi_j \tag{2}$$

The value $\Psi(1) = \sum_0^{\infty} \psi_j$ can then be taken as a measure of how persistent shocks to u are. For example, $\Psi(1) = 0$ for any trend stationary process, since $\Psi(B)$ must contain a factor (*1-B*), whereas $\Psi(1) = 1$ for a random walk, since $\psi(1) = 0$ for $j > 0$.

Difficulties arise in estimating $\Psi(1)$ because it is an infinite sum, thus requiring the estimation of an infinite number of coefficients. Campbell and Mankiw (1987 and 1988) offer a measure of $\Psi(1)$ based on approximating $\Psi(B)$ by a ratio of finite order polynomials. This is possible because, since it is assumed that ∇u_t is a linear stationary process, it follows that it has an ARMA(*p*,*q*) representation:

$$\phi(B)\nabla u_t = \theta_0 + \theta(B)a_t, \tag{3}$$

where $\phi(b) = 1 - \phi_1 B - ... - \phi_p B^p$ and $\theta(B) = 1 - \theta_1 B - ... - \theta_q B^q$. Equation (3) is interpreted as the moving average representation, or impulse response function of ∇u_t:

$$\nabla u_t = \phi(1)^{-1}\theta_0 + \phi(B)^{-1}\theta(B)a_t. \tag{4}$$

From the equality $\Psi(B) = \phi(B)^{-1}\theta(B)$, the measure $\Psi(1)$ can then be calculated directly as $\Psi(1) = \theta(1)\phi(1)$.

Before constructing ARIMA models of the regional unemployment rate series several steps were required. Because the data used are quarterly and are not trended or seasonally adjusted, seasonality is also a concern. An initial test, conducted by regressing four seasonal dummy variables against the first difference of each series suggested that seasonality was present in each series. There are several methods of dealing with seasonality, none of them entirely satisfactory. However, since the concern of this modelling exercise is to measure persistence, a long-run phenomenon, following Watson (1986) the series were seasonally adjusted to remove any short-run seasonal patterns. The log values of the series were then taken and all further testing and modelling was carried out on the logged, seasonally adjusted series.

The next step involved determining the order of integration of the individual regional unemployment rate series. This is an important process that has implications for the competing explanations of regional unemployment disparities. A series that is I(1) or contains a unit root has both a transitory and a permanent component and any shock to such a series will have both a transitory and permanent effect. This finding would immediately cast doubt on the equilibrium explanation of regional unemployment disparities which assumes that unemployment disparities are simply due to different long-run equilibrium unemployment rates. In this explanation, following a shock to the regional unemployment rate it will quickly adjust back to its equilibrium level. Geographical areas will be in an equilibrium relationship with one another and the unemployment rate in each area may differ being a function of regional factor endowments, amenities etc. In this sort of relationship, it would be expected that there exists some long-run cointegrating relationship between the series. This will not exist if some series have a unit root (ie. are I(1)) and other series are level stationary (ie. are I(0)).

Initial tests for stationarity were conducted using the Augmented Dickey-Fuller (ADF) test. In all cases, the null hypothesis of the series being I(1) cannot be rejected. These tests are known to be sensitive to breaks or large jumps in the series (see Peron, 1989 or Holden and Perman, 1994) and several of the regional unemployment rate series seem to have structural breaks, especially around the time of the 1990 recession. For this reason, additional tests for unit roots in the presence of structural breaks were conducted.

The testing procedure adopted followed that of Holden and Perman (1994). Initial testing starts with the estimation of the relationship $\nabla u_t = \alpha + \phi u_{t-1}$ where ∇u_t is the first difference of the unemployment rate, u_{t-1} is the lagged value of the regional unemployment rate and α and ϕ are parameters to be estimated. This relationship is estimated using recursive least squares and plots of the recursive estimates of ϕ are examined to determine if the estimates contain any instability. The presence of instability or large changes in the value of the estimated coefficients is taken as an indication of a break in the series.

Holden and Perman (1994) present a methodology to test for the presence of a unit root if instability or a break in the series is found. This procedure requires the estimation of the relationship:

$$\nabla u_t = \alpha + \theta DU_t + \beta t + \gamma DT_t + dD(TB)_t + \rho u_{t-1} + \sum_{i=1}^{i=k} c_i \nabla u_{t-i} + e_t \tag{5}$$

where:

DT_t = t if $t >$ the time break in the series (TB) and 0 otherwise
DU_t = 1 if $t > TB$ and 0 otherwise,
$D(TB)_t$ = 1 at TB+1 and 0 otherwise, and;
$\alpha, \theta, \beta, \gamma, d$ and ρ are parameters to be estimated.

To conduct the test the t value for ρ is compared to the critical values presented in Table VI.B in Peron (1989). A test statistic larger (in absolute size) than the critical value from Peron (1989) results in the rejection of the null hypothesis and it is concluded that the series does not contain a unit root. Table 4 contains the estimated results of this test for all series, along with the estimated breakpoint, test statistic and critical values at the 5% and 10% level of significance.

Table 4. Peron Test for Unit Roots in the Presence of Structural Breaks[5]

Region	Series Break	%	Critical Value 5%	Critical Value 10%	Test Statistic
Brisbane	1990Q1	0.17	-3.92	-3.60	-4.17
South and East Moreton	1990Q1	0.17	-3.92	-3.60	-4.93
North and West Moreton	1990Q1	0.17	-3.92	-3.60	-3.99
Wide Bay-Burnett	1991Q3	0.31	-4.18	-3.88	-3.13*
Darling Downs and South West	1992Q2	0.36	-4.20	-3.92	-4.71
Mackay, Fitzroy and Central West	1989Q3	0.15	-3.87	-3.56	-2.55*
Far North	1990Q3	0.23	-4.04	-3.72	-4.43
Northern and North West	1990Q3	0.23	-4.04	-3.72	-6.17
Queensland	1990Q1	0.17	-3.92	-3.60	-3.43*

Table 5. Autoregressive Estimates of Persistence[6]

Statistical Division	Series Break	Persistence				
		AR1	AR2	SUM	R^2	F
Brisbane	1990Q1	0.96	-0.18	0.78	0.86	102.41
South East Moreton	1990Q1	0.64		0.64	0.71	61.8
North West Moreton	1990Q4	0.67		0.67	0.60	39.45
Wide Bay-Burnett	1991Q3	0.71		0.71	0.64	44.81
Darling Downs and South West	1992Q2	0.33		0.33	0.60	26.22
Mackay, Fitzroy and Central West	1989Q3	0.75		0.75	0.54	60.54
Far North	1990Q3	0.39	0.43	0.81	0.57	22.3
North and North West	1990Q3	0.20		0.20	0.55	16.55
Queensland	1990Q1	1.26	-0.37	0.88	0.90	141.64

[5] Asterisks indicate a significant test statistic and evidence of a unit root in the regional unemployment series.

[6] Table 5 includes estimates of persistence for the Wide Bay-Burnett region, the Mackay, Fitzroy and Central West region and Queensland. The validity of these estimates depends on the acceptance of the tests for unit roots in the presence of structural breaks. The tests themselves suggest that a unit root is present in each of these series and so the estimation of persistence should be carried out on the first differences of the series. The results of this exercise are presented in Table 6.

The results presented in Table 4 lead to the conclusion that only three of the series are I(1) i.e. the Wide Bay-Burnett region, the Mackay, Fitzroy and Central West region and Queensland contain a unit root or require first differencing to induce stationarity. The remaining series are I(0).

To model the stationary series, the ARIMA methodology can be applied directly to the log values of the seasonally adjusted series in a methodology similar to that of Pehkonen and Tervo (1998) or outlined in Campbell and Mankiw (1988) for series stationary in levels. Using this methodology, the measure of persistence is derived as the sum of the autoregressive coefficients in the estimated equation and impulse response functions can be derived using these terms. Table 5 presents these measures of persistence.

The results presented in Table 5 show a wide range of estimates of the persistence of regional unemployment with estimates ranging from 0.20 for the Northern and North West labour force region to 0.81 for the Far North region. Broadly, the measures of persistence can be split into three categories. Firstly, those regions where adjustment is quick and where less than 10% of an initial shock to the regional unemployment rate remains after four quarters or one year, these being the Darling Downs and South West and North and North West regions. Secondly, regions with a moderate adjustment speed where it takes around 10 quarters or 2 ½ years for the initial shock to dissipate to a level where less than 10% remains, the regions falling into this category are the South and East and North and West Moreton regions. Finally, regions where adjustment is slow, taking between 15 and 24 quarters or four to six years for a shock to the regional unemployment rate to fall to less than 10% of the initial impact. These regions consist of Brisbane and the Mackay, Fitzroy and Central West region where the estimated impulse response function takes 17 and 18 quarters respectively or about 4 ½ years, for less than 10% of the initial impact to remain in the series, and the Far North region, where the estimated impulse response function indicates that a shock to the unemployment rate takes around 24 quarters or 6 years to return to within 10% of the initial pre-shock unemployment rate.

The tests for stationarity outlined earlier noted that there are concerns that some of the series contain a unit root or are nonstationary in levels. In this situation, formal measures of persistence proceed after taking the first difference of the series and testing again to ensure stationarity. This was done for the Mackay, Fitzroy and Central West, Wide Bay-Burnett and Queensland employment series. All these series were found to be difference stationary or I(1) using the ADF tests, this result suggests that the series contain a permanent and transitory component.

Estimation of persistence commences with the construction of ARIMA models to represent the regional unemployment rate series. The procedure to select the appropriate lag length for the autocorrelation and moving average terms involved selecting the model for which the Akaike Information criteria (AIC) and Schwartz-Baysian criteria (SBC) was maximised. For the Mackay, Fitzroy and Central West series, the model selection criteria indicated that the regional unemployment series is best represented as a random walk with 0 drift.

Table 6. Impulse Response Measures of Persistence

Region	ARMA	Estimate of Persistence	Standard Error	*T*-ratio
Wide Bay-Burnett	ARIMA(0,1,1)	0.63	0.16	3.98
Mackay, Fitzroy and Central West	ARIMA(0,1,0)	1.00	0.00	0.00
Queensland	ARIMA(0,1,1)	1.33	0.13	10.08

In this case, Ψ, the measure of persistence is equal to 1, so that any change to the unemployment rate has a permanent effect on the series with no tendency to die down or increase.

In contrast, for both the Wide Bay-Burnett and Queensland series both the SBC and AIC criteria were maximised using a simple first order moving average (MA) representation of the series, which can be written as:

$$\nabla u_t = \mu + \varepsilon_t + \theta\varepsilon_{t-1} \tag{6}$$

where:

μ_t = the mean of the first difference of the unemployment rate,

ε_t = the error term, and

θ = the coefficient of the moving average component.

Using the methodology developed by Campbell and Mankiw, the long-run measure of the persistence of the series is calculated as $1+\theta$, these estimates of persistence of the regional unemployment series are presented in Table 6.

Table 6 shows that the estimate of persistence for the Wide Bay-Burnett region and Queensland is 0.63 and 1.33 respectively. This means that in the long-run a 1% change in the rate of unemployment in the Wide Bay-Burnett region will have a permanent effect of 0.63%. For Queensland a 1% change in the unemployment rate will have a permanent effect of 1.33%. The result for Queensland is surprising and seems to indicate that the effect of a 1% shock is greater than unity. This is confirmed by the estimated standard error of 0.13 and means that the lower bound of the 95% confidence interval still places the estimate of persistence for the Queensland unemployment series above unity.

From this analysis, it seems likely that the estimate of persistence may not be independent of the size and the type of the region being studied. For example, both the Darling Downs and South West and the Northern and North West regions are relatively isolated regions and have low estimated measures of persistence (0.33 and 0.20 respectively). Typically, industrially diverse regions are more likely to adjust (see for example Kort, 1981, Jackson, 1984, and Malizia and Shanzi Ke, 1993). However, both of these regions are heavily dependent on agriculture and mining. Additionally, both regions have small populations averaging 7.0% and 7.3% of the total Queensland population over the sample period. It could be that the small population, relative isolation and limited job prospects result in out-migration or adjustment in regional labour participation rates following increases in the regional unemployment rate.

The high estimated persistence of Queensland unemployment, suggesting a permanent effect of 1.33% following a 1% shock is also worth consideration. One possible explanation is that the regional estimates of persistence are smaller than the State estimate because, following an increase in regional unemployment rates, labour is perhaps more likely to migrate from the region to another region within the State than it is to migrate outside Queensland. Both of these observations, i.e. that the size and location of a region may play an important role in determining the speed of labour market adjustment, and secondly, that the spatial scale of a region may affect the measure of persistence, are topics outside the scope of this research but worthy of further consideration.

4. IMPLICATIONS

In Section 1, it was noted that, broadly speaking, there are two competing explanations of the observed disparities in regional unemployment rates. These two views can be considered the equilibrium and disequilibrium explanations of regional unemployment disparities. The equilibrium explanation emphasises the speedy adjustment of regional unemployment rates following a shock. Differences are interpreted as an equilibrium phenomenon, and occur because the regions have different underlying levels of mean unemployment in equilibrium. Economic disturbances and shocks may move actual regional differentials away from their mean values, and hence from their underlying long-run relationship to the National or State unemployment rate, but such disequilibriating movements are short lived, and regional differentials converge back to their equilibrium means.

In contrast, the disequilibrium explanation of persistent regional differences in unemployment rates emphasises the slow adjustment that occurs in the labour market following an exogenous shock. According to this view, because labour market adjustment mechanisms are weak and slow, deviations of regional employment differentials from their means, caused by demand, structural, technological or other shocks, are very persistent. In this case, regional unemployment differentials will not exhibit stable means but instead follow non-stationary paths.

As far as the two main competing views exist, the results presented in this paper for the labour force regions of Queensland have provided mixed results but seem, in general, more supportive of the disequilibrium explanation of the observed regional unemployment disparities. However, this conclusion is by no means unanimous, depending on the type of analysis undertaken and the region being considered. For example, the results presented in Section 2 may be interpreted as supportive of the equilibrium explanation of regional unemployment disparities. Figures 1 and 2 in this section suggest that, with the exception of the North and West Moreton and Wide Bay-Burnett regions, regional unemployment rates have followed a similar path over the sample period. Further, regional unemployment rate differentials have been remarkably persistent as shown in Figure 4 and Tables 2 and 3, suggesting that high unemployment rate regions have remained high over the sample period and the regions with low unemployment rates have experienced low unemployment rates over the sample period. These results lend support to the equilibrium explanation of regional unemployment differentials (see, for example, Martin, 1997). In addition, the results presented in Table 5 provide estimates of persistence for the Northern and North West, Darling Downs and South West, North and West Moreton and South and East Moreton. These estimates suggest that it requires only 1 to 2 ½ years for a series to return to within 10% of their initial value following a shock. This is also supportive of an equilibrium explanation of regional unemployment disparities.

However, overall the results presented in Section 3 tend to lend support to a disequilibrium explanation of regional unemployment disparities. The autoregressive estimates of persistence for the Brisbane and Far North regions suggest that it requires 4½ to 6 years for a series to return to within 10% of its initial value following a shock. Consequently, for these regions, it appears that the 'slow adjustment' explanation is appropriate. This is generally thought consistent with the disequilibrium explanation in which weak and slow adjustment mechanisms are the underlying cause of regional disparities in unemployment rates.

The tests for stationarity also indicate that some of the series require differencing to induce stationarity. A long-run equilibrium relationship cannot exist between variables that are I(0) and I(1) respectively. Series that require differencing to induce stationarity have both a transitory and permanent component. The existence of this permanent component means that the series will not return to some trend level after a shock. The results presented in Section 3 indicate that the Wide Bay-Burnett, Mackay, Fitzroy and Central West and Queensland unemployment rate series have a permanent component and it appears then, that there is no equilibrium relationship among the regional unemployment rates. In saying this, however, an important caveat needs to be considered: the data that are being used are subject to structural breaks and also have large standard errors. It might be suggested that these factors are contributing to the high estimates of persistence uncovered in this study. However, it should also be considered that these conclusions, based on an examination of regional data are consistent with the findings of the Industry Commission (1993) and Groenewold (1997) in which State data were the subject of investigation.

The apparent inconsistency in the conclusions derived from the data presented in Sections 2 and 3 can be attributed to the behaviour of the data over the sample period. The high rank-order stability of regional unemployment rates, presented in Table 3, is due to the fact that regions with high unemployment rates have, for the most part, experienced high unemployment rates throughout the sample period. In contrast, regions with relatively low unemployment rates have maintained their low unemployment rates throughout the sample period. There is little evidence that high unemployment rate regions have become low unemployment rate regions and vice versa. While this is consistent with the equilibrium explanation of regional unemployment disparities, it is not inconsistent with the disequilibrium explanation. Specifically, regional economies can consistently experience high or low unemployment rates while the unemployment rate series is non-stationary or displays a high degree of persistence. It is not necessary for a region's unemployment rate to pass from a low level to a high level, or vice versa, for the unemployment rate to be non-stationary or highly persistent.

The acceptance of one or the other of these explanations of regional unemployment disparities has important implications for regional policy. For example, in the equilibrium explanation of regional unemployment disparities, geographic areas may be in equilibrium with respect to one another. Workers will migrate until there is no further incentive to move. In this situation, regionally targeted employment policy will merely attract more unemployed workers to the area where jobs are being created. This will occur until any temporary reductions in regional unemployment have been offset.

A more appropriate response in situations where the disparities are the result of equilibrium factors would be the implementation of policies aimed at impacting on factors that affect equilibrium unemployment rate disparities across regions. These factors consist, in particular, of the different levels of regional amenities. Regional amenities take a variety of forms, ranging from factors which government has no control of, such as climate, house and land costs, etc through to factors such as regional infrastructure ranging from road and port facilities through to the availability and quality of educational and health care institutions etc. Thus, the equilibrium explanation carries with it the implication that policy should be directed at changing the amenity value of regions, specifically those which government policy can control such as provision of regional infrastructure and the availability of health and educational facilities.

A further policy tool, of significance in the Australian setting, is microeconomic reform (for a discussion of the implications of this policy see Tonts, 1999). This policy has remained on the agenda of successive federal governments and continues to shape national policies, including policies on regional development. The Industry Commission (1993) suggested that minimum wage levels, cross subsidised transport infrastructure, public housing and other public services are impediments to regional adjustment. This report also suggested that high welfare payments are a disincentive to accept full-time employment, and that lower social security payments would encourage unemployed persons to migrate to regions with better employment prospects. Such policies seem aimed at speeding up the adjustment process and in this regard might be considered in line with the idea that disparities are a disequilibrium phenomenon.

Another policy, consistent with the finding of disparities due to disequilibrium factors, is regionally targeted employment programs. When unemployment disparities are due to disequilibrium factors such as slow or weak adjustment mechanisms there may be a role for regionally targeted employment policy. This is because the factors that act to equalise regional unemployment disparities are weak or nonexistent. As a consequence, government policy can have a long-term or permanent effect on the regional unemployment rate and differentials that exist in regional unemployment rates. This seems especially relevant given the finding that some of the unemployment rate series appear to have a permanent component. In such a series a shock will have a long-run or permanent effect. In this situation a policy which decreases unemployment in the short-run will decrease unemployment in the long-run or permanently.

5. CONCLUSIONS

This study has attempted to uncover the nature of the observed regional unemployment disparities in Queensland. While the results are mixed there seems to be enough evidence to suggest that for some regions at least, the disequilibrium explanation appears relevant. This is because, for some regions the measured persistence is high or the series are non-stationary implying slow adjustment or a permanent response to an exogenous shock.

Both microeconomic reform aimed at speeding up the adjustment process, and intervention, in the form of regionally targeted employment programs are responses consistent with the findings. While the modelling conducted in this study is unable to discriminate between the efficacy of these two alternatives it is suggested that in cases where adjustment is slow or non-existent, regionally targeted employment policy needs to be considered. This is because microeconomic reform has been associated with widening regional unemployment disparities (see, for example, Dixon *et al*., 2001), while other authors have criticised the ideas behind the Industry Commission (1993) with Tonts (1999) suggesting that the analysis overlooks the economic and social constraints associated with migration from declining rural areas. In addition, microeconomic reform seems unable to address problems of regional decline. In contrast, regionally targeted employment policy may be appropriate in situations where regions are facing declining populations and the disparities in regional unemployment rates are due to disequilibrium factors.

To complicate the issue for policy makers has been the finding that some regions also adjust relatively quickly, a result consistent with the equilibrium view of regional unemployment disparities. While the finding of quick adjustment fits nicely with the intentions of the microeconomic reform agenda, it is necessary to determine what factors have are driving this result. For example, it may be that these regions lack any amenity value and once a job is lost there is no or little incentive to remain. Clearly this is not an appropriate way in which to ensure quick labour market adjustment. For this reason, these results suggest that a greater understanding is needed of the processes determining regional disparities in both unemployment and growth, in order for policy to have the intended outcomes.

REFERENCES

Armstrong, H. and Taylor, J. (1993) *Regional Economics and Policy.* Harvester Wheatsheaf; Hemel Hempstead.

Beveridge, S. and Nelson, C. (1981) A new approach to decomposition of economic time series into permanent and transitory components with particular attention to the measurement of the ‘Business cycle’. *Journal of Monetary Economics*, 7, pp. 151-174.

Brechling, F. (1967) Trends and cycles in British regional unemployment. *Oxford Economic Papers*, 19, pp. 1-21.

Campbell, J.Y. and Mankiw N.G. (1987) Permanent and transitory components in macroeconomic fluctuations. *American Economic Review, Papers and Proceedings*, 77; pp. 111-117.

Campbell, J.Y. and Mankiw N.G. (1988) Are output fluctuations transitory? *Quarterly Journal of Economics*, 102, pp. 875-880.

Cochrane, J.H. (1988) How big is the random walk in GNP. *Journal of Political Economy*, 96, pp. 893-920.

Dixon, R., Shepherd, D. and Thomson, J. (2001) Regional unemployment disparities in Australia. *Regional Studies*, 35(2), pp. 91-102.

Groenewold, N. (1997) Does migration equalise regional unemployment rates? Evidence from Australia. *Papers in Regional Science*, 76(1), pp. 1-20.

Holden, D. and Perman, R. (1994) Unit roots and cointegration for the economist. In B.B. Rao *(ed), Cointegration for the Applied Economist*, Macmillian Press; London.

Industry Commission (1993) *Impediments to Regional Industry Adjustment.* Report No. 35, AGPS, Canberra.

Jackson, R. (1984) An evaluation of alternative measures of regional industrial diversification. *Regional Studies*, 18, pp. 103-112.

Kort, J. (1981) Regional economic instability and industrial diversification in the U.S. *Land Economics*, 57, pp. 596-608.

Martin, R. (1997) Regional unemployment disparities and their dynamics. *Regional Studies*, 31 (3), pp. 237-252.

Malizia, E.E, and Shanzi Ke (1993) The influence of economic diversity on employment and stability. *Journal of Regional Science*, 33 (2), pp. 221-235.

Marston, S.T. (1985) Two views of the geographical distribution of unemployment. *Quarterly Journal of Economics*, 100, pp. 57-79.

Mills, T. (1993) *The Economic Modelling of Financial Time Series*, Cambridge University Press; United Kingdom.

Nelson, C. (1988) Spurious trend and cycle in the state space decomposition of a time series with a unit root, *Journal of Economic Dynamics and Control*, 12, pp. 476-488.

Partridge, M.D. and Rickman, D.S. (1997) The dispersion of US state employment rates: The role of market and non-market equilibrium factors. *Regional Studies*, 31(6), pp. 593-606.

Pehkonen, J. and Tervo, H. (1998) Persistence and turnover in regional unemployment disparities. *Regional Studies*, 32(5), pp. 445-458.

Peron, P. (1989) The great crash, the oil price shock, and the unit root hypothesis. *Econometrica*, 57(6), pp. 1361-1401.

Thirlwall, A.P. (1966) Regional unemployment as a cyclical phenomenon. *Scottish Journal of Political Economy*, 13, pp. 205-219.

Tonts, M. (1999) Some recent trends in Australian regional economic development policy. *Regional Studies*, 33(6), pp. 581-586.

Watson, M. (1986) Univariate detrending methods with stochastic trends. *Journal of Monetary Economics*, 18, pp. 49-76.