THE EFFECT OF INDUSTRIAL DIVERSIFICATION ON REGIONAL ECONOMIC PERFORMANCE

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ABSTRACT: The effect of economic diversification on regional economic performance has received considerable attention from regional scientists and a number of themes have emerged from this literature. In particular, it has frequently been suggested that a more diversified regional economy will experience greater economic growth and stability. Specifically, a number of relationships have been hypothesised including, a relationship between the level of regional diversification and a regions employment growth and the instability of this growth; regional diversity and the regional unemployment rate and the instability of this rate and finally, the diversity of a regional economy and the level and stability of regional income. In addition, regional performance may be spatially dependent, with regions sharing similar performance clustered together in geographic space. This paper tests these hypotheses using data from the Local Government Areas of Queensland. In general, the findings support the hypothesised relationship between regional diversification and economic performance, while spatial clusters of regions sharing similar economic performance are also identified.

1. INTRODUCTION

The role of economic diversity has received considerable attention from regional scientists. Within this literature a number of themes are frequently encountered, including the hypothesis that there is a relationship between the sectoral composition of regional employment and regional economic performance, particularly the growth and stability of the regional economy. In many cases it is implicitly assumed that a diverse regional economy will enjoy a higher level of stability in both the level of certain variables such as unemployment, and the growth of certain variables such as employment and per capita incomes. The regional diversity is hypothesised to act as shield, protecting the regional economy from fluctuations in the market for its products and services. Other researchers have been interested in the relationship between city/region size and industrial diversification (see, for example, Crowley 1973, Blair 1976 and Begovic 1992). These studies suggest that larger cities are more industrially diverse and tend to have more stable economies.

Support for these hypotheses are mixed with researchers such as Jackson (1984) and Attaran (1986) finding that instability is not related to regional industrial diversity, while other studies, such as Kort (1981), Brewer and Moomaw (1985) and Malizia and Shanzi Ke (1993), have found that increased

industrial diversification is associated with reduced regional instability. These studies have used cross-sectional techniques, comparing regions by looking at the correlation between regional instability and the measured diversity of the regional economy. Another stream of work, following Conroy (1974) employs the portfolio theoretic approach. While this approach has the advantage of allowing a regional efficiency frontier to be calculated, i.e. a series of points where regional growth is maximised for given levels of regional instability, it is not applicable for small regions where detailed time series of employment by industry is not available.

This current work can be seen as a preliminary attempt to clarify the underlying consequences of regional industrial diversification. The study explores the relationship between economic diversification and regional growth and instability using data from the Local Government Areas (LGA's) of Queensland. For this reason the results are applicable to a wider range of regions than are the results from a study using data confined to metropolitan areas or state economies as in much of the previous work.

The following section provides a review of some of the literature concerned with the consequences of industrial diversification. Section 3 provides an outline of the data used in this study, along with a description of the methodology used to derive the measures of industrial concentration and regional instability. In section 4 the analysis commences with the results obtained using simple descriptive statistics presented. Section 5 explores the spatial pattern of regional performance, while a brief conclusion is presented in section 6.

2. LITERATURE REVIEW

While the advantages of diversity have been argued and analysed for a considerable time, Malizia and Shanzi Ke (1993) note that the underlying theory explaining the influence of diversity on regional performance is not well developed. Generally, it is thought that regional performance, particularly the instability of a regional economy, is some positive function of the level of industrial concentration. For this reason, many early studies appear to have been more interested in measuring the relationship between regional instability and alternate measures of regional diversification than in determining the factors responsible for the cross sectional variation in regional instability.

Many of these studies used bivariate statistical techniques to investigate the diversity-instability relationship. Papers that have tested the relationship between industrial diversification and regional instability include Kort (1981), Jackson (1984), Brewer and Moomaw (1984), Brewer (1985) and Attaran (1986).

Kort (1981), using data from 106 Standard Metropolitan Statistical Areas (SMSA’s) of the U.S. was concerned with the possibility of hetroscedasticity in an equation explaining regional instability as a function of regional diversification with this hetroscedasticity related to city size. Kort (1981) used weighted least squares, multiplying both sides of the relationship by the square root of the SMSA’s population. He concluded that industrial diversification was found to vary with city size and the entropy index was found to perform better

than alternative measures of diversification, both in terms of its significance and its elasticity coefficient. This work was criticised by Brewer (1985) and Brewer and Moomaw (1986) for two reasons. The first criticism of these authors was that, after using weighted least squares on transformed data, Kort (1981) then preceded to compute the R^2 assuming a single explanatory variable, inflating the explanatory power of the regression from 0.075 to 0.64. Brewer and Moomaw (1986) also found that, when they performed a Goldfeld-Quandt test on the weighted regression of Kort (1981), the resulting F value was above the critical value, thus the transformation made by Kort (1981) did not correct the hetroscedasticity.

Like Kort (1981), Brewer (1985) was also concerned with the power of alternate measures of regional diversification in explaining regional employment instability. In this work, Brewer (1985) compares the portfolio measure to the ogive, national average and percent of employment in durable manufacturing and found that the portfolio theoretic measure of diversification, adjusted for population hetroscedasticity, outperforms other test measures by explaining over 50% of cross sectional variation in instability.

The conclusions of Jackson (1984) are much more circumspect than those of Kort (1981) and Brewer (1985). Like these authors, Jackson (1984) was concerned with the evaluation of alternate measures of regional industrial diversification and his work revealed a substantial amount of ambiguity among the results. On the basis of this work he concluded that the concept of industrial diversity as a policy framework suffers from both definitional ambiguity and a lack of empirical substantiation.

Attaran (1986) came to a similar conclusion in a study using ten years of annual data from the 50 states of the U.S. and the District of Columbia. Attaran (1986) looked at the correlations between several measures of instability, including unemployment and its growth, per capita income and its growth and the entropy measure of industrial diversification. As a result of this analysis, this author concluded that no strict relationship between economic diversity and the economic performance of a regional economy existed.

More recent studies have tended to use multivariate models to analyse the relationship between industrial diversity and regional economic performance. Authors employing this technique include Smith and Gibson (1988), Wundt (1992), Malizia and Shanzi Ke (1993) and, more recently, Izraeli and Murphy (2001).

Unlike many of the earlier authors, Smith and Gibson (1988) were concerned with the effect of regional industrial diversity on unemployment instability. Their study used data from 44 non-metropolitan counties in Idaho. The principal hypothesis being tested was that unemployment in a more diversified economy is more cyclically stable than in a less diversified economy. The framework used involved the estimation of several models using OLS. These models range from a simple regression of the measure of regional diversification on the measure of regional instability through to the estimation of models that incorporate a variety of industries as explanatory variables. Smith and Gibson (1988) found that, in the models incorporating disaggregated manufacturing and base service sectors,

the index of diversification is no longer significant in explaining regional instability. As a consequence, these authors concluded that stable industries are more influential on regional instability than is the overall industrial diversity of the region.

Wundt (1992) was concerned with the relationship between industrial diversity and regional economic instability over the business cycle. This author, like Brewer and Moomaw (1984) and Brewer (1985) concluded that the portfolio theoretic measure provided more accurate results. This author also included additional variables to capture differences in regional industrial structure and fluctuations in the national economy.

Malizia and Shanzi Ke (1993) incorporated a similar methodology to Smith and Gibson (1988) while investigating the relationship between regional diversity and both the unemployment rate and employment instability. The first step in their work was to develop a theoretical model that, in turn, was used to expand the relationship between diversity and regional economic performance through the inclusion of additional variables to control for the various factors affecting the regional economy. Malizia and Shanzi Ke (1993) also suggested that earlier attempts to establish the relationship between industrial diversification and regional instability produced inconsistent results because they incorporated the wrong spatial units. These authors suggested that only metropolitan areas should be included in the study because these areas more closely conform to the notion of a functional economic unit than does a state level economy that may consist of an agglomeration of independent or semi-independent labour markets.

The results of this study indicate that more diversity leads to lower unemployment rates and less employment instability in the areas included in the study. Diversity of the metropolitan economy appears to be a very influential factor in the metropolitan areas economic performance.

More recently, Izreali and Murphy (2003) have undertaken a study of U.S. States using pooled data techniques rather than a cross sectional database. These authors were also concerned with the effect of industrial concentration on state unemployment and income. Izreali and Murphy (2003) found a strong link between industrial diversification and reduced unemployment while the link between diversification and per capita income was found to be much weaker.

Another group of studies investigating the relationship between industrial concentration and regional instability has employed the portfolio theoretic approach. This methodology was introduced into regional economics by Conroy (1974). The portfolio selection framework permits the simultaneous consideration of the level of regional employment and the instability of the regional economy. In doing this, the framework allows the calculation of a regional efficiency frontier, i.e. a frontier where regional instability is minimised for given rates of employment growth. These boundary solutions take into consideration the interactions between different parts of the regional economy, so that while individual industries may be unstable, they are collectively stable. This is achieved by explicitly considering the variance of each industry's employment growth rate in addition to its covariance with other industries.

Jackson (1984) notes that this measure represents a departure from normative measures by accounting for intraregional-intersectoral employment relationships that may be attributed to regional factor endowments.

Studies employing the portfolio selection framework in a regional setting include Conroy (1974), St Louis (1980), Lande (1992), Wundt and Martin (1993), Hunt and Sheesley (1994) and in Australia, Trendle (1999). While in many respects the portfolio selection framework is superior to earlier methodologies, it has one significant limitation in that it requires a detailed time series of employment by industry for the regions being studied and is thus not possible to implement in many small regional economies. For this reason, this study has adopted a cross sectional approach to analyse variation in regional economic instability across the LGA's of Queensland.

3. DERIVATION OF THE DATA

The data used in this study is taken from the 1996 and 2001 Census of Population and Housing, conducted by the Australian Bureau of Statistics (ABS), in addition to the small area labour market data, provided by the Department of Employment and Workplace Relations (DEWSB)[1] and data available from the Australian Tax Office (ATO). The small area labour market data is used to derive the measure of regional instability following the method presented in equation (2), while the data provided by the ABS is used to derive regional unemployment rates and the measure of regional industrial diversification. The ATO data is used to derive average regional incomes.

In this study, the measure of regional diversification has been derived using the entropy index, derived as:

$$ENTROPY = \sum_{j=1}^{k} \left(E_{ij} / E_i\right) / \log_2 \left(E_i / E_{ij}\right) \quad (1)$$

In equation (1), *i* stands for the *ith* area and *j* is the *jth* industry, *k* is the total number of industries in the *ith* area, E_{ij} is employment in the *jth* industry in area *i* and E_i is total employment in area *i.*

As the purpose of this study is to provide an insight into the factors associated with regional instability rather than to explore the efficacy of alternate measures of regional diversity, alternate measures of diversity such as the ogive, national average and portfolio theoretic measures were not trailed in the analysis. Furthermore, the entropy index seems to offer a plausible measure, taking as its starting point the idea that a perfectly diversified economy as one in which industry employment is equal in all sectors. In this study, the second division Australian and New Zealand Standard Industrial Classification (ANZSIC) data have been used with the regional industrial base being disaggregated to 67 industrial sectors.

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1 See, for example, DEWSB 2002 and earlier publications

Regional instability has been derived using a measure developed by Siegel (1966) and is calculated as follows;

$$INSTAB = \sum_{t=1}^{T} \left[\left(E_{it} - E_{it}^{Tr} \right) / E_{it}^{Tr} \right]^2 / (T) \qquad (2)$$

Where $INSTAB$ is the index of regional instability, E_{it} is employment at time t in region i, E_{it}^{Tr} is the predicted level of employment at time t, region i predicted by a linear time trend equation and T is the time span over which the trend line is estimated.

This definition of regional economic instability is based on the idea that the economic time series is based on four components: random, seasonal, trend and cyclical. In this context, the purpose of the index of instability is to isolate and measure the cyclical component of this time series. The measure outlined in (2) does this using 6 steps: firstly, seasonal and random components are isolated from the original employment series; a linear approximation of the trend component is estimated; the trend component is then subtracted from the seasonally and randomly adjusted employment series to derive an approximation of the cyclical component; this difference, or residual, is then adjusted, by expressing the difference in percentage terms, i.e. dividing by E_{it}^{Tr} to account for differences in scale among regions; these percentage deviations from trend are then divided by T to adjust for degrees of freedom; finally, squared percentage deviations are summed over all quarters to derive an estimate of overall regional economic instability.

4. STATISTICAL ANALYSIS

From the literature review presented in section 2, it can be seen that a number of hypothesis have been postulated within the relevant literature. The aim of this section is to present the results of simple tests of some of these. Specifically, the intention is to determine whether diversity is statistically correlated with improved regional economic performance. In this paper, regional economic performance is assessed in terms of three variables namely employment, unemployment and regional per capita income, with this data allowing five hypotheses to be tested, being:

- Diversity and employment instability (EINSTAB) are negatively correlated.
- Diversity and employment growth (EGROWTH) are positively correlated.
- Diversity and the unemployment rate (UERATE) are negatively correlated.
- Diversity and the instability of the unemployment rate (UEINSTAB) are negatively correlated, and

- Diversity and per capita income (PERCAPY) are positively correlated.

Data limitations mean that it is impossible to test the hypothesis that instability in regional per capita income is negatively related to economic instability.

Table 1 presents simple and rank correlation coefficients between the measure of regional instability and the variables used to measure regional economic performance. The results presented in this table indicate that the measured level of diversity is significantly correlated with regional economic performance, with the simple correlation coefficients between the entropy index and the measures of regional performance being significant for all but regional per capita income, while the Spearman's rank correlation coefficient is significant for all variables.

Table 1. Correlation coefficient and significance of relationship

Variable	Correlation coefficient	Spearmans Rank Correlation coefficient
EINSTAB	-0.6615*	-0.8368*
EGROWTH	0.2612*	0.3334*
UERATE	0.5203*	0.6570*
UEINSTAB	-0.3450*	-0.4771*
PERCAPY	0.0569	0.1985*

Note: * indicates significance at the 5% level

An interesting result from Table 1 is the significant positive relationship between regional diversification and the regional unemployment rate. This suggests that regions with a narrower industrial base have experienced lower unemployment rates, a result counter to the idea that diversification may act to improve regional economic performance. A factor driving this result may be that many LGA's in central and western Queensland have small labour forces and narrow industrial bases with Trendle (2002) noting that many of these regions have historically had low unemployment rates. It may be that labour market adjustment in small isolated regions is predominantly through migration rather than changes in the unemployment rate. The narrow industrial base may mean that the chance of finding employment is increased through migration rather than remaining unemployed in the region.

The unexpected positive relationship for the correlation coefficient of the unemployment rate with the entropy index was further explored. Specifically the dataset was split between western regions and eastern regions, between the Brisbane-Moreton region and the balance of Queensland, and according to the size of the regional labour market. It was found that the results based on the regional labour force size indicated that the relationship between the regional unemployment rate and the entropy index of industrial diversification varies significantly, changing sign over the sample. In particular, for regions with a labour force above 10,000 persons (the largest 23 LGAs) the correlation

coefficient was negative (-0.53) while it was positive for the sample of LGA's below this point (0.45).

The significance of this change in sign was formally tested using the Chow test, performed within a simple linear regression incorporating a break point specified at a labour force size of 10,000. The results of this test are shown in Table 2.

Table 2. Chow test for structural break in the relationship between regional unemployment and regional diversity

Variable	Coefficient	Standard error	t-stat	2Prob(t)>T
const	-0.03	0.02	-1.89	0.06
ENTROPY	0.14	0.03	5.44	0.00
splitdum	0.66	0.35	1.88	0.06
sd_ENTRO	-0.80	0.43	-1.85	0.07
Mean of dependent variable = 0.07		Standard deviation of dep. var. = 0.04		
Sum of squared residuals = 0.13		Standard error of residuals = 0.03		
Unadjusted R-squared = 0.30		Adjusted R-squared = 0.28		
F-statistic (3, 121) = 17.34 (p-value < 0.00001)				
Chow test for structural break at observation 103: F (2, 121) = 2.59 with p-value 0.08				

While the authors acknowledge the limitations of this regression, the implications are apparent. The coefficient is positive for the sample of 125 LGA's and for the smallest 102 LGA's, but negative for the largest 23 regions. Furthermore, the Chow test indicates that this structural break is significant with the level of significance of 0.08 being between the 5% and 10% level, supporting the hypothesis that the relationship between regional unemployment rate and regional diversity varies, to the point of changing sign, according to region size.

Overall then, the results support the hypothesis that regional industrial diversification has a significant influence on regional economic performance. In particular, the relationship between diversity and regional instability, as measured by employment and the unemployment rate, and the relationship between diversity and regional employment growth is as hypothesised in the literature. However, the data does not support the hypothesis that regional industrial diversification has a significant influence on regional per capita income, while the relationship between the unemployment rate and industrial diversity seems more complex than that hypothesised in the literature, with evidence suggesting that it varies according to the size of the regional labour force.

5. SPATIAL PATTERN OF REGIONAL INSTABILITY

Many of the more recent studies, including Smith and Gibson (1988), Wundt (1992), Malizia and Shanzi Ke (1993) and Izreali and Murphy (2003) have used multivariate models to incorporate important control variables when studying the effect of regional diversity on economic performance. An important omission from this and earlier analysis has been regional location and the performance of neighbouring regions. It is possible that stable and unstable regions or fast and slow growing regions are not distributed randomly across geographic space, but that some form of spatial dependence exists. This spatial dependence may be due to some form of spatial process, whereby economic growth or instability is transferred from one region to the next or alternatively because the true spatial extent of the phenomena being studied does not conform to the spatial scale of the analysis.

Several approaches exist to study spatial dependence and it is useful to consider both global and local measures of spatial dependence. Global measures permit the testing of the existence of a spatial pattern over the whole study area, while local measures permit the examination of spatial clustering and the detection of outliers in the data.

At a global level, spatial dependence can be explored informally, or graphically, using Moran scatter diagrams and Figure 1 presents a Moran scatter plot for the instability of the regional unemployment rates. This figure plots each LGA's difference from the average measure of regional unemployment instability against their spatial lag, i.e., a weighted average of the unemployment rate instability of neighbouring regions. The four different quadrants of the Moran scatter plot identify four types of spatial association between a LGA and its neighbours: quadrant 1 shows low unemployment rate LGA's surrounded by high unemployment rate neighbours; in quadrant 2, high unemployment LGA's with high unemployment neighbours appear; quadrant 3 records low unemployment rate LGA's surrounded by low unemployment rate neighbours while quadrant 4 shows high unemployment rate LGA's with low unemployment rate neighbours.

Concentrations of observations in the top right hand corner and bottom left hand corner indicate that regions with similar characteristics (i.e. high or low employment or unemployment instability) tend to be clustered together in space. The trend line through the scatter diagrams suggests that this spatial clustering of regions sharing similar unemployment rates is significant, or that variations in regional unemployment do not occur randomly over Queensland's geographic space.

This conclusion is confirmed by the test results shown in Table 3, where the results of the Morans *I* test are presented. For all of the variables used in this analysis, including the Entropy index of regional diversification, it can be seen that a significant amount of spatial autocorrelation exists.

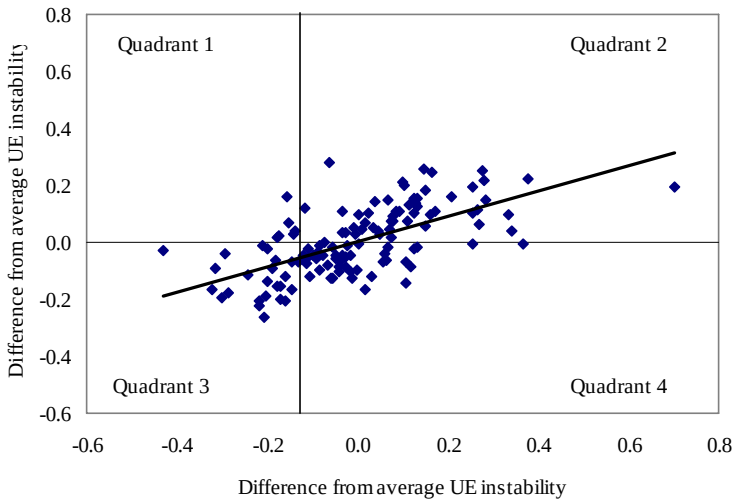

Figure 1. Moran Scatterplot – regional unemployment instability.

The Moran *I*-statistic takes the form;

$$I = \frac{n}{\sum_{i=1}^{n}\sum_{j=1}^{n}} \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2} \qquad (3)$$

where the w_{ij} are the elements in a spatial matrix and the x and $\bar{x}$ are the variable of interest and its mean value respectively. This statistic is tested using analytical expectations and variances based largely on the neighbourhood structure assumed in the spatial weighting matrix and are asymptotically distributed. The significance of the Moran *I* statistic is assessed by a standardized *z*-score that follows a normal distribution and is computed by subtracting the theoretical mean from *I* and dividing the remainder by the standard deviation. In the current study the spatial weight matrix is a first order contiguity matrix with cells taking a value of 1 if *i* and *j* are neighbours and zero otherwise. This matrix is row standardised before use.

The results of the Moran *I* tests presented in Table 3 suggests that we can reject the hypothesis of spatial independence due to the small marginal probabilities for the Moran *I* test and conclude that regional performance, as measured by the above variables, exhibits spatial dependence. This suggests that similar values of the variables tend to be clustered together in geographic space.

This may suggests that regional performance, as measured by these variables, is determined to some degree at least, by the performance of neighbouring regional economies.

Table 3. Moran I tests for Spatial Autocorrelation

Variable	Moran *I* statistic	p-value
ENTROPY	7.87	0.00
UEINSTAB	4.97	0.00
EINSTAB	7.67	0.00
UERATE	6.22	0.00
EGROWTH	4.36	0.00
INCOME	9.41	0.00

Further insight into spatial clustering can be gained through the use of the quintile map and local indicators of spatial association. These latter measures include the Ord and Getis (1995) *G*-stat and the Local Moran *I* Statistic (see Anselin, 1995). In this section the Local Moran *I* statistic is used to analyse the spatial clustering.

The quintile map for the regional unemployment rate is shown in Figure 2. In this figure, the unemployment rate is divided into five categories (as shown in the legend of the map). The data in Figure 2 indicate that there is some evidence of spatial clustering, i.e. there seems to be a cluster of high unemployment regions among the coastal regions of the Wide Bay-Burnett region, just north of Brisbane. In contrast, it can be seen that regions in western Queensland tend to have lower unemployment rates.

The significance of these spatial clusters can be formally tested using local indicators of spatial association and Figure 2 provides a significance map of the Local Moran I statistic.

The Local Moran *I* statistic is an extension of the Moran *I* statistic, and decomposes the global measure into contributions for each location, referred to as LISAs or Local Indicators of Spatial Association. This statistic can be represented as:

$$I_i = x_i \Sigma \; w_{ij} \, x_j \qquad (4)$$

Where x_j is the difference between the value of the variable under consideration for area *i* and the mean value for that variable. The relevant variables for this study are those examined earlier in this paper: unemployment, unemployment rate, income, employment, employment growth rate.

w_{ij} is a weight representing the strength of connection between areas *i* and *j*, developed from neighbour information.

The Local Moran *I* statistic is based on the gamma index, a general index of matrix association, and can be used to identify those "hot spots" where there is significant spatial clustering of similar values of each of these variables. The

values of I_j are positive when values at neighbouring locations are similar and negative if they are dissimilar.

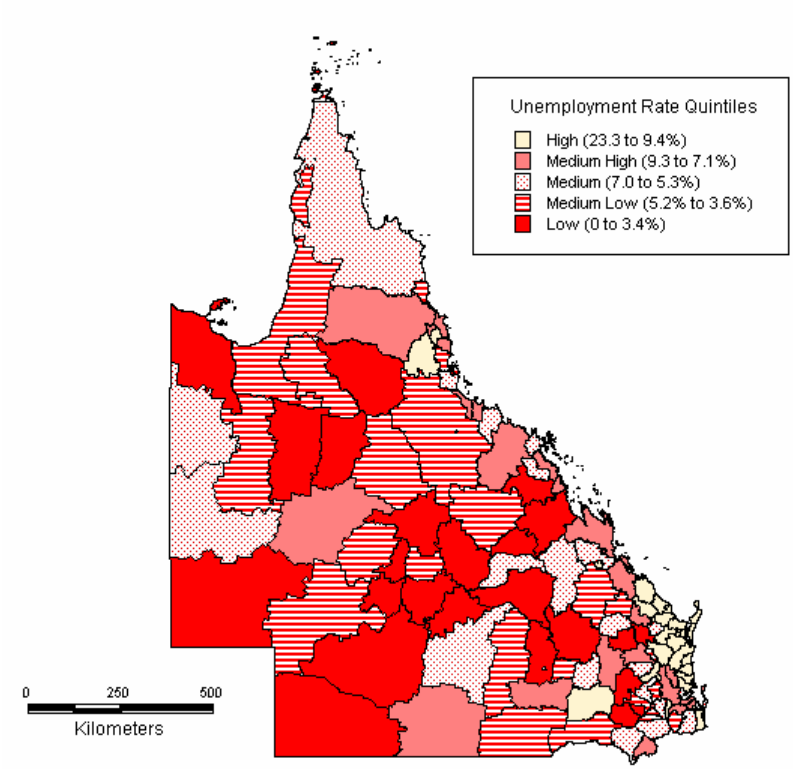

Figure 2. Quintile Map of Unemployment Rates by Queensland LGA's

In the significance map presented in Figure 3, it can be seen that the clustering of high unemployment rates in the Wide Bay-Burnett region (identified in the quintile map) is significant. Similarly, a significant clustering of low unemployment rate regions can be seen in the Central West and South West regions. Significance maps for the remaining variables used to gauge regional economic performance also reveal significant clustering.

The results of this analysis suggest that, for all the variables presented, the values are not randomly allocated across geographic space. Instead, the global indicators of spatial dependence suggest that there is a significant amount of spatial dependence while the local indicators identify the geographic units that contribute to this result. Overall, this suggests that geographic location cannot be ignored, as in much of the previous literature on the analysis of regional performance.

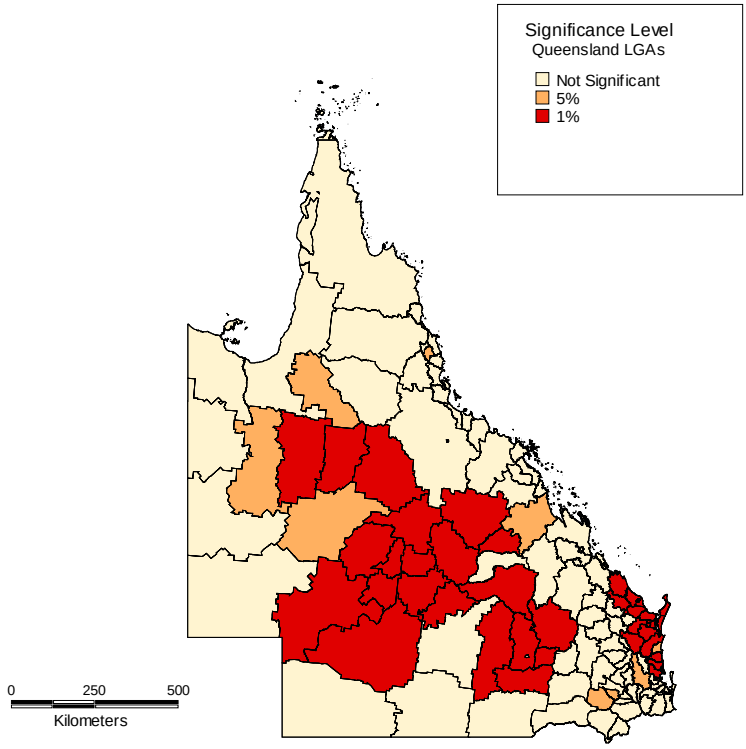

Figure 3. Significance Map of Unemployment Rates in Queensland LGAs

6. CONCLUSIONS

In this paper the relationship between economic diversification and regional economic performance has been explored. This study has used simple descriptive statistics to explore this relationship. In addition, a preliminary analysis of the spatial pattern of regional economic instability has been presented.

In terms of the relationship between economic performance and regional diversity, the results suggest that there is a statistically significant relationship between the entropy index of regional concentration and regional economic performance when performance is measured by the instability of regional unemployment rates, employment levels and the growth of employment. In contrast, regional diversity does not appear to be a significant determinant of the level of regional income, while the relationship between regional diversity and the rate of regional unemployment has been found to be the opposite to that hypothesised when the sample contains all regions.

It is unlikely that regional diversity is the sole determinant of regional economic performance and many of the more recent investigations into the effect of regional diversification on regional economic performance have used multivariate techniques. Examples of work incorporating these techniques include Smith and Gibson (1988), Malizia and Shanzi Ke (1992), Wundt (1992) and Izreali and Murphy (2003). These studies have suggested that, apart from regional diversity a range of variables have influenced economic performance, including industry structure, occupation structure, region size and the performance of the national economy.

In addition, it has been shown in section 5 that variations in regional economic performance, i.e. employment growth, instability, the unemployment rate etc, are not randomly distributed across geographic space, but that spatial clustering tends to occur. This finding may have implications for the determinants of regional economic performance if it is found that these variables are, to some degree at least, determined by the performance of neighbouring regions. Unfortunately, test procedures to determine if spatial clustering is due to a true spatial relationship or spatial heterogeneity are not well developed at the moment and this issue has been left unexplored in this analysis.

Furthermore, for the regional unemployment rate, it is suggested that the relationship with regional diversity varies according to region size; for smaller regions the data indicate a positive relationship while it is negative, as expected, for larger regions. Taken together, these results suggest a much more complex relationship between industrial diversity and regional performance than is suggested by much of the literature.

REFERENCES

Anselin, L. (1995) Local indicators of spatial association_LISA. *Geographical Analysis*, 27, pp. 93-115.

Attaran, M. (1986) Industrial diversity and economic performance in U.S. areas. *The Annals of Regional Science*, 20, pp. 44-54.

Begovic, B. (1992) Industrial diversification and city size: The case of Yugoslavia. *Urban Studies*, 29(1), pp. 77-88.

Blair, J. (1976) Population size and the extent of diversification: A comment. *Urban Studies*, 13(1), pp. 81-82.

Brewer, H.L. and Moomaw, R.L. (1984) A note on population size, industrial diversification and regional economic instability. *Urban Studies*, 22, pp. 349-354.

Brewer, H.L. (1985) Measures of diversification: Predictors of regional economic instability, *Journal of Regional Science*, 25(3), pp. 463-469.

Conroy, M. (1974) Alternative strategies for regional industrial diversification. *Journal of Regional Science*, 14, pp. 31-46.

Crowley, R. (1973) Reflections and further evidence on population size and industrial diversification. *Urban Studies*, 10 (1), pp. 91-94.

DEWR (2002) *Small area labour markets, Australia*, September. Economic Analysis Branch, Department of Employment and Workplace Relations, Canberra, ACT.

Hunt, G., and Sheesley, T. (1994) Specification and econometric improvements in regional portfolio diversification analysis. *Journal of Regional Science*, 34(2), pp. 217-235.

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.

Lande, M. (1992) Regional industrial structure and economic growth and stability. *Journal of Regional Science*, 34(3), pp. 343-360.

Malizia, E.E, and Shanzi Ke (1993) The influence of economic diversity on employment and stability. *Journal of Regional Science*, 3 (2), pp 221-235.

Ord, J. and Getis, A. (1995) Local spatial autocorrelation statistics: distributional issues and an application, *Geographical Analysis*, 27, pp. 286-306.

Siegel, R. (1966) Do regional business cycles exist? *Western Economic Journal*, 5(Dec), pp. 44-57.

Smith, S. and Gibson, C. (1988) Industrial diversification in non-metropolitan counties and its effect on economic stability. *Western Journal of Agricultural Economics*, 13(2), pp. 193-201.

St Louis, L. (1980) A measure of regional diversification and efficiency. *Annals of Regional Science*, 14, pp. 21-30.

Trendle, B. (1999) Measuring the implications of regional diversification: An application of the portfolio selection framework to Queensland data. *Australian Journal of Regional Studies*, 5(3), pp. 263-278.

Trendle, B. (2002) Regional variation in Queensland's unemployment rate. *Australasian Journal of Regional Studies*, 8(3), pp. 327-347.

Wundt, B. (1992) Re-evaluating alternative measures of industrial diversity as indicators of regional cyclical variations. *Review of Regional Studies*, 22(1), pp. 59-73.

Wundt, B., and Martin, L. (1993) Minimizing employment instability: A model of industrial expansion with input-output considerations. *Regional Science Perspectives*, 1, pp. 81-99.