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The Economic Boom, Population and Structural Change and the Market for Tradespersons

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Abstract

The economic boom concentrated attention on skill shortages in Australia and their role in preventing the economy from reaching its full potential level of output and putting pressure on inflation. This paper concentrates on the extent to which the supply of tradespersons has adjusted to changed economic conditions and the regional dimension of these supply changes. While there is much anecdotal evidence on the regional dimension of skill shortages this has mainly focused on flows of labour into the resource-rich states of Western Australia and Queensland but there is no comprehensive analysis of the extent of the regional distribution of skilled labour, such as tradespersons, or the extent of changes in the population of tradespersons between regions as the economy as a whole and particular regions have experienced significant economic growth. This study uses mainly data from the Censuses of Population and Housing. The main finding of this paper is while socio economic factors affect the decision of tradespersons as to where to live and work, these effects appear limited. And while ever the issue of labour shortages for tradespersons exists, targeted immigration will have a role to play in reducing these deficiencies.

JEL classification: J80; J21; J61

1. Introduction

Most labour market policy over the three decades since the mid 1970s has focussed on excess supply of labour – unemployment. This was to be expected given the huge rise in unemployment resulting from the massive macroeconomic shocks impacting on the world and significant structural change as a result of policy to reform the Australian economy. Successive ALP and Coalition governments have continued the microeconomic reform policies which began in the 1980s, including reduction in the rates of tariffs on imported goods, labour market reform, deregulation of the financial sector, the reform or privatisation of public monopolies, reducing anti-competitive behaviour of firms, and working with the states and territories to enhance competition.

However, in examining the labour market during recent years up to the

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'Global Financial Crisis', one of the biggest issues facing the Australian economy was perceived shortages of labour. This was reflected in the lowest unemployment rate in three decades and record net migration. However, it must be noted that there were still large numbers of under employed, marginally attached and of those relying primarily on social security for a living (Lewis, 2008). Although the concept of a 'shortage' has been used rather loosely (Richardson, 2007), shortages were reported in both the private and public sectors, ranging from skilled to unskilled labour. Occupations affected included medical practitioners, nurses, schoolteachers, pilots, economists, tradespersons and engineers through to agricultural workers and shop assistants (Lewis and Corliss, 2010). As an economy nears full-employment, bottlenecks in certain parts of the economy are to be expected, as economic growth and structural change are not evenly spread throughout the economy and some industries can adjust quicker than others.

One attempt to alleviate this was to increase the intake of migrants and temporary residents. In 2006 the net inflow of new migrants was 134,600, up 23 per cent from 2003 and further increased by 177,600 in 2007, accounting for 56 per cent of Australian population growth. There was also a net addition of over 200,000 long-stay arrivals over departures per year (ABS, 2008). Of the total permanent migration to Australia more than 45 per cent were skilled settler arrivals.

The economic boom concentrated attention on perceived skill shortages in Australia and their role in preventing the economy from reaching its full potential level of output and putting pressure on inflation (Stevens, 2006). With the apparent agreement of most economists, the economy is returning to low unemployment and attention is again focussing on skill shortages.

This paper concentrates on the extent to which the supply of tradespersons has adjusted to changed economic conditions. While there is much anecdotal evidence on the regional dimension of skill shortages this has mainly focused on flows of labour into the resource-rich states of Western Australia and Queensland. There is, however, no comprehensive analysis of the extent of the distribution of skilled labour, such as tradespersons, or the extent of changes in the population of tradespersons between regions as the economy as a whole, and particular regions, have experienced significant economic growth.

The Censuses of Population and Housing provide unique data covering different stages of the business cycle from 1991, the middle of a recession; 1996, the recovery; 2001, the boom; and 2006, labour shortages. This paper uses data from these four periods to examine issues of dispersion of skilled labour. The paper not only provides important factual information on the dimensions of skill shortages, and but is also the basis for more informed policy making.

The paper is structured as follows. The next section provides a background to the modelling of tradespersons' migration by providing an overview of the labour market for tradespersons in Australia. Although Census data are open to some criticism due to the self reporting nature of data collection, nevertheless, for an analysis of occupations, industries, regions etc at the level of aggregation required for this paper, the Census remains the only available data source. This is followed by a discussion of the model and its predecessors in the literature, the estimation issues and the results. The final section provides a summary and conclusion.

2. Employment of Tradespersons

The data used in this study are from the Australian Bureau of Statistics Census of Population and Housing. The spatial unit used in this paper ranges from national, state, region to is the Statistical Local Area (SLA) and working zones. The SLA is a spatial unit used by the ABS to collect and analyse statistics from other sources as well as those collected from the Censuses. In non-Census years, the SLA is the smallest unit defined in the Standard Geographical Classification (ASGC) Section of State Structure. There are over 1,300 SLAs and they cover the whole of Australia without gaps or overlaps. These data can be aggregated to any level including region, state or Australia as a whole; and can be cross tabulated for by variable, state and region.

The method of regional classification used here is that developed by the Australian Bureau of Agriculture and Resource Economics (ABARE, 2001). The regions are classified by SLA into five main regions (for further discussion see Garnett and Lewis, 2007):

- Capital Cities: Eight capital cities
- Other Metropolitan: SLAs other than in capital cities that contain whole or part of an urban centre with population of 100,000 or more
- Coastal: SLAs within 80km of the coastline
- Remote: Coded by road distance between populations and from the nearest urban centre, according to the ARIA[1]
- Inland: All remaining SLAs

Industry

There are only a few industries that are large employers of tradespersons. In 2006, the most significant employer of tradespersons was the construction industry, employing 330,000 tradespersons or nearly 30 per cent of all tradespersons. The manufacturing industry is the second biggest employer of tradespersons employing 242,384 tradespersons or 22 per cent of the total. The retail industry employs just under 14 per cent of the total number of tradespersons and personal and other services industry employs around seven per cent.

The percentage of all tradespersons employed who are in particular industries has seen significant changes over the last decade and a half as a result of structural change in the economy, as industry mix changes in response to both domestic and overseas demand (see Kelly and Lewis, 2006). The largest shift has been away from all other industries towards the construction industry, which in 2006 became the biggest single employer of tradespersons at around 30 per cent. While all other industries have had a steady decline over the period, from as much as 43 per cent in 1991 to just less than 28 per cent in 2006, the construction industry share of all tradespersons rose from 21 per cent in 1991 to 30 per cent in 2006. Another shift has been the decline occurring in the manufacturing industry from as much as 25 per cent in 1991 to a little under 22 per cent in 2006. The retail industry held steady at approximately

[1] The Accessibility/Remoteness Index of Australia (ARIA) was devised by the Department of Health and Aged Care (2001). This index classifies Statistical Local Areas according to their distance from a major centre. It has since been updated by the ABS to ARIA Plus.

14 per cent and after a significant decline from 10 per cent in the personal and other services industry occurring in 1991, the percentage of all tradespersons employed by this industry held steady at around seven per cent.

The percentage of workers within an industry employed as tradespersons has seen little dramatic change in the last fifteen years, although a small downward trend is discernible. Of all persons that work in each industry as many as 49 per cent employed in the construction industry in 1996 were tradespersons, falling to just below 47 per cent in 2006, making it by far the highest concentration of tradespersons of any industry. For the manufacturing industry and the electricity, gas and water supply industry, the workforce is made up of approximately one quarter of tradespersons, with less than two per cent variation over the 15 years. Personal and other services is the fourth largest industry of employment for tradespersons and the percentage of those employed who are tradespersons has remained fairly constant ant 22 to 23 per cent. In the mining industry 21 per cent of the workforce was a tradesperson in 2006. For all other industries the concentration of tradespersons is only seven per cent and declining. Of these other industries, retail is the largest employer of tradespersons but the percentage varied significantly over time from 14.4 per cent in 1996 to 11.7 per cent in 2006.

Table 1 - Distribution of Tradespersons by Industry of Employment, 2006

	Number	*Per Cent*
K Finance and Insurance	1667	0.2
N Education	10215	0.9
Not stated	10616	1.0
J Communication Services	13608	1.2
A Agriculture, Forestry and Fishing	15245	1.4
D Electricity, Gas and Water Supply	17751	1.6
R Non-Classifiable Economic Units	18235	1.7
O Health and Community Services	18472	1.7
P Cultural and Recreational Services	19446	1.8
I Transport and Storage	19625	1.8
B Mining	22384	2.0
M Government Administration and Defence	30592	2.8
H Accommodation, Cafes and Restaurants	33468	3.0
L Property and Business Services	33815	3.1
F Wholesale Trade	38521	3.5
Q Personal and Other Services	74298	6.7
G Retail Trade	152188	13.8
C Manufacturing	242384	22.0
E Construction	330000	29.9
Total employed persons	1102530	100.0

Source: Australian Bureau of Statistics, 2006 Census of Population and Housing, unpublished.

Change in skills mix within industries is generally attributable to technological change (Kelly and Lewis, 2006). Therefore the above data suggest that, with the exception of retailing, technological change has had little impact on the skills mix, at least in terms of tradespersons relative to other workers, in industries which are the main employers of tradespersons. Thus skills development will depend largely

on growth in total employment in particular industries. This is not to say that the skills required within trade occupations will not also need development as a result of technological change.

The above data suggest that the changes in skills mix in the economy are largely related to shifts in employment between industries, that is, structural change and this has significantly reduced the average demand for 'motor skills' in the economy (Kelly and Lewis, 2006).

Occupation

The number of tradespersons employed increased steadily over the period 1991 to 2006 up 144,061 jobs, but grew most in the period 2001 to 2006, 8.2 per cent compared with the period 1991 to 2001 growth of tradespersons of 6.3 per cent. While tradespersons observed significant steady employment growth over the period 1991 to 2006, the employment of the whole workforce grew by 29 per cent. Also, while the employment of tradespersons increased during the 2001 to 2006 period, where the number of tradespersons employed grew by 83,674 people, it was less than the growth experienced by the Australian workforce as a whole over 2001 to 2006 which grew by 9.7 per cent. Thus tradespersons have fallen as a proportion of the workforce, from 13.1 per cent in 1991 to 12.1 per cent in 2006. However, not all trade occupations have been affected in the same way. The trade occupations experiencing the biggest percentage growth have been construction, which has the largest percentage of its workforce who are tradespersons, rose by four per cent to 25 per cent of all tradespersons in 2006. A decline in the trade occupations mechanical, automotive and food tradespersons over the period 1991 to 2001 is evident as is the increase by 2006. Food tradespersons suffered a significant loss in employment between the period 1991 to 1996 losing 19,248 jobs, but gained somewhat in the latter period to maintain their relative share of eight per cent of the total tradesperson workforce. Falls in employment of people in the mechanical trade occupations, however, have been relatively steady over time. In summary, for most trades the number employed plateaued after the decline from 1991 but rose slightly by 2006. The exceptions were electrical and construction trades where employment has grown significantly concomitant with the growth in the construction sector of the economy.

Table 2 - Distribution of Tradesperson by Sub-group, Over Time

	1991		*1996*		*2001*		*2006*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
40 Tradespersons nfd	14,205	1	14,942	1	13,369	1	14,979	1
41 Mechanical	179,768	19	178,285	18	169,201	17	179,878	16
42 Automotive	116,547	12	120,723	12	115,599	11	116,368	11
43 Electrical	138,055	14	136,208	14	141,616	14	162,227	15
44 Construction	197,126	21	210,163	21	233,142	23	275,735	25
45 Food Tradespersons	102,474	11	83,226	8	85,037	8	90,334	8
46 Skilled Agricultural	44,428	5	64,085	6	70,195	7	72,222	7
49 Other Tradespersons	133,693	14	189,333	19	190,708	19	190,798	17
Total Tradespersons	958,480	100	996,965	100	1,018,867	100	1,102,541	100

Source: Australian Bureau of Statistics, 1991, 1996, 2001, 2006 Censuses of Population and Housing, unpublished.

Adjustment in the Tradespersons Labour Market

In order to examine the extent to which structural change has affected employment of tradespersons it is necessary to examine changes in employment of all workers by state, industry and region. These changes in employment by state, region and industry are summarised below in table 3.

Table 3 - Percentage Change in All Persons Employed by Industry, State and Region, 1996-2006

	Mining	*Manufacturing*	*Construction*	*Retail*
NSW	-6.9	-4.4	25.7	17.9
VIC	9.6	-3.5	41.5	23.2
QLD	31.4	23.5	46.9	29.7
SA	48.1	1.9	43.6	24.0
WA	34.3	18.2	42.7	24.0
TAS	-13.9	-2.4	22.0	19.3
NT	-48.6	30.3	9.1	13.6
ACT	-13.7	7.2	30.5	12.3
Capital Cities	47.9	2.8	36.4	23.1
Other Metro	0.4	-1.4	32.8	18.9
Coastal	48.5	-2.4	41.9	21.6
Inland	9.4	14.8	46.6	26.4
Remote	-10.2	19.9	12.4	6.6
Australia	20.9	3.4	37.2	22.6

Source: Australian Bureau of Statistics, 1996 and 2006 Censuses of Population and Housing, unpublished.

From the last row it can be seen that during the latest sustained period of economic growth in Australia, the period 1996 to 2006, industries that hire a significant percentage of tradespersons such as mining, construction and retail observed a dramatic increase in the number of all persons employed within those industries, increasing by 21 per cent, 37 per cent and 23 per cent respectively. Manufacturing on the on other hand saw only a slight increase of 3.4 per cent.

Of the growth in employment in the mining industry, Queensland, Western Australia and South Australia produced the lion's share of the new mining jobs and increased their percentage of all the mining jobs nationally. Of all the states that lost a percentage share in mining jobs nationally, New South Wales was the most significant falling by 6.1 per cent.

Regionally the shift in mining jobs has been away from remote, inland and other metropolitan areas towards capital cities and coastal regions. In fact capital cities increased their share of mining jobs by 8.5 per cent and coastal regions by four per cent over the period. Mining employment for capital cities and coastal regions grew by 47.9 per cent and 48.5 per cent respectively. This is an interesting finding and deserves future research. Among the issues which need to be examined are to what extent the pattern of jobs in the industry has changed with this regional shift and the implications for skills development.

Similarly, employment growth in the retail sector has been considerable, 22.6 per cent over the period 1996 to 2006. There has been little dramatic change to both the

regional distribution and in the states and territories distribution in retail employment over the period although there has been a decline in importance, relative to retailing in other states, in New South Wales, ACT and the Northern Territory. The most notable change in regional employment has been lower growth in other metropolitan and, particularly, remote areas and greater growth in inland regions and capital cities. This shift is also indicated by an increase in retail employment in inland regions and capital cities which has risen by 26.4 per cent and 23.1 per cent respectively and are both above the national average of 22.6 per cent.

The most notable growth in employment was in the number of construction jobs nationally, which was up 37.3 per cent during the period 1996 to 2006. The construction industry has the greatest percentage of tradespersons of any industry, just below 47 per cent in 2006. Hence nearly half of the growth in construction jobs over the period 1996 to 2006 has been in the employment of tradespersons. This has drastically increased the demand for qualified tradespersons over the period 1996 to 2006.

Although demand for construction workers has increased significantly generally, regionally there have been some notable shifts in the distribution of construction employment, with lower increases in capital cities, other metropolitan and, in particular, remote areas. Meanwhile, inland and coastal regions have increased their share of the national total. For the states and territories the most interesting shift has been a reduction in New South Wales's share and increasing shares for Queensland and Victoria.

The manufacturing industry, on the other hand, indicates strong evidence of structural change taking place over the period 1996 to 2006. While the Australian economy as a whole was in a boom and had significantly higher aggregate demand the Australian manufacturing industry only incurred employment growth of 3.4 per cent nationally. Regionally there has been a decline in coastal, capital cities and other metropolitan areas but rises in inland areas. For the states and territories while New South Wales, Victoria and Tasmania both experienced declines in their shares of national manufacturing employment, Queensland, Northern Territory and Western Australia increased their share substantially.

It was pointed out earlier in this paper that the percentage of tradespersons in total employment in the main industries that employ tradespersons has changed little over time. This suggests technological change has not significantly changed the employment mix with respect to tradespersons. The evidence on industries, states and regions points to structural change, arising from changes in relative demand for different goods and services over the business cycle. This has been the dominant factor determining the demand for tradespersons.

For instance, most demand for labour in industries employing tradespersons is in the capital cities so population migration to Brisbane and Perth (ABS, 2007b) can partly explain the relative growth of tradespersons in these cities and the corresponding falling shares in cities such as Sydney. In addition, the economic boom and resultant structural change in demand has increased demand for some industries which employ relatively high numbers of tradespersons, such as mining and construction in certain states and regions. Some other industries which also employ large percentages of tradespersons, such as manufacturing have been in relative decline. However, in manufacturing there has been increased employment in Queensland and Western Australia.

4. Migration of Tradespersons

Given the differential regional changes in demand for tradespersons this suggests that migration of tradespersons would be important in providing relatively efficient labour market adjustment. There are two possible ways in which this could have been facilitated. There could have been internal net migration or external net migration of tradespersons, or both. In either case this will be reflected in growth in the tradesperson population in some regions and decline in others.

In order to formulate a model of the growth of tradespersons in particular regions we essentially follow a framework determined by the migration literature. This is concerned mainly with variables such as earnings, demographics, industry mix, employment prospects, education, amenity and housing costs (Lewis, 1990; Tokle and Huffman, 1991; Lawson and Dwyer, 2002; Garnett and Lewis, 2007). Unfortunately, quantifying the relative effect a variable has on the migration of individuals is difficult and only a few studies have done so (Garnett and Lewis, 2007).

Garnaut *et al*. (2001) produced a small area analysis, analyzing population, employment, and income trends in non metropolitan Australia, using Census data from 1986 to 1996. For inland and remote regions, it was concluded that the highest rates of inward migration took place in SLAs in which the SLA was next to urban centers with a population of 20,000 or more. They suggest that this was due to greater employment opportunities created by a more diversified economy and greater service amenity. The authors go on to argue that a region experiencing simultaneously rapid employment and population growth caused by inward interregional migration could be due to a couple of reasons. First, any area that cannot meet its labour demand requirements locally will actively engage in recruitment of labour from other areas causing a net inflow of people to service those requirements. Second, an area experiencing rapid employment and population growth may be sending positive signals to entrepreneurs as a place worthy of the investment of labour and capital. For regions experiencing low employment opportunities, employment growth would lag behind population growth. This occurs as the costs of relocation make it cheaper to hire from the local area if the suitable skills and qualifications needed are available because there is no need to compensate workers for the costs of relocation. Alternatively, a region's population size can have negative effects upon employment opportunities. If the population size becomes too small and declines past the critical point necessary to sustain particular services some firms may have no alternative but to relocate causing a decline in the employment of the area in question (Productivity Commission, 1999).

A later study by Lawson and Dwyer (2002) used logit regression to attempt to determine and quantify factors causing employment growth and regional migration. Their results suggested that outward migration was caused by high unemployment rates and low access to markets. The authors suggest regions experiencing a relatively small amount of structural change had higher outward migration due to a lack of growth in new industries. Furthermore, they concluded that regions with a more diversified industry base had relatively higher population growth rates than did regions limited to just one main industry, such as agriculture or mining. Debelle and Vickery (1999) also used the unemployment rate of a particular region as a key indicator of the regions employment prospects and found regions with an initially high unemployment rate to have outward migration and regions with initially low unemployment rates to have inward migration.

More recently, Trendle (2005) sort to explain the determinants of interregional migration within Queensland, over the period 1996 to 2001. Trendle used a gravity type model in which the relative economic opportunities in both the origin and destination regions were of great importance. Trendle (2005) reported migration patterns from low unemployment regions towards high unemployment regions. This is contrary to previous research in which the unemployment rate has been a significant factory in steering migrants towards regions of low unemployment and away from region of high unemployment. He suggests that while the gravity model employed in the study explained over 80 per cent of the interregional migration, there are other factors separate from that included in his model which explain interregional migration.

Regions with higher levels of human capital are associated with greater employment growth over the long run and thus inward migration. This is due to regions with a higher skill base being more attractive to firms, being more equipped to take advantage of any economic opportunities, and may be enhanced by skill biased technical change (Bradley and Gans, 1998; NIEIR, 2001). Hunter (1996) and Karmel *et al*. (1993) explain that the majority of regional variation in unemployment is due to the attributes of the inhabitants.

Bell and Cooper (1995) found that domestic migration had a larger impact on inland and remote regions than did migrants from overseas, over the period 1986-1991. They suggested that Sydney and Melbourne receive the lion's share of overseas immigrants of which a proportion will later migrate to other regions. Garnaut *et al*. (2001) using employment rates of growth as an indicator of economic opportunity found that for the most part any economic opportunity occurring in inland and remote regions was insufficient to absorb the supply of labour from the natural increase in population and from the labour spillovers of declining industries. Net relocation away from inland and remote regions resulted.

Salt (1992) analyzed domestic migration by age group and observed a tendency for young people, i.e. people aged 15 to 24, to have an over representation in outward migration from rural areas and towards capital cities, over the period 1981 to 1986. Garnaut and Lim-Applegate (1998) concur with these findings reporting an underrepresentation in the farm population of 15 to 19 year olds. Its argued the migration of these young people from non-metropolitan to metropolitan regions is for the purpose of educational attainment or employment opportunities. Lawson and Dwyer (2002) found younger populations to be associated with higher outward regional migration.

Garnaut *et al*. (2001) suggest that service amenity and environmental amenity are significant determinants of regional migration, especially for older people, moving to coastal regions. Hugo and Bell (1998) support these claims observing that people aged 65 plus represented 17 per cent of inward coastal migration from the capital cities, over the period 1986 to 1991. They suggest that coastal regions are attractive to older age groups residing in inland and remote regions. It is argued that the reasons for the attractiveness are a combination of environmental amenity coupled with appropriate health services and other community services available in these locations. Salt (2001) agrees that amenity explains much of the inward coastal migration, as amenity attracts people to the region creating demand and stimulating employment growth. Lawson and Dwyer (2002) found regions with low regional amenity to be associated with higher levels of outward migration.

Here we use a model based on the above research to try to explain migration of tradespersons or more specifically the growth in the number of tradespersons by region. The units of measurement are the Bureau of Infrastructure, Transport and Regional Economics (BTRE, now BITRE), working zones (BTRE, 2003). BITRE working zones are based on SLA boundaries. Working zones reflect the area within which people are willing to commute from their place of residence to their place of employment. BITRE has defined 391 working zones based on commuting patterns reported in the 2006 Census.

The independent variables (table 4) employed in this study relate to the characteristics of the region with respect to a variety of socioeconomic variables contained in the literature and discussed above. In the case of dummy variables a category is always omitted and is indicated by an asterisk. Industry and occupation variables were transformed into proportions by dividing the total number employed in each individual industry and occupation type by the total number employed for every working zone. The variables for educational attainment are also proportions of the total number of persons with a respective qualification. The median income for each of the working zones did not require any such transformations. The jobless rate was calculated by summing the population between the ages of 15 and 65, subtracting the total number employed, and then dividing by the summed number of persons aged between 15 and 65 for each working zone. This gave the proportion of people in each working zone without a job.

Table 4 - Independent Variables

Industry	*States and Territories*
Primary*	dummies for each state and territory
Manufacturing	New South Wales*
Services	**Regions**
Utilities	Capital Cities*
Occupation Type	Other Metropolitan
Managers	Coastal
Professionals	Inland
Clerical	Remote
Production	**Demographics & Labour Market Conditions**
Labourers	Tradespersons Median Earnings
Tradespersons*	Unemployment Rate
Educational Attainment	Jobless Rate
University	Male to Female Ratio
Advanced Diploma	Hours Part-Time or Casual
Certificate	Hours Standard Working Week*
No Post School Qualification*	Hours Greater than 40
Qualified as a Tradespersons	Age Less Than 35
Not Qualified as a Tradesperson	Age 35-44*
Qualification not Relevant*	Age Greater Than 45
Migration	
Internal Migration*	
Recent Overseas Migrants	
Didn't Move	

Note: * next denotes omitted category.

The unemployment rate was calculated by taking the total labour force for each working zone subtracting the employed and dividing by the total labour force. The Male to Female ratio was calculated by dividing the male population for each working zone by the total population. Dummy variables were created for the states and territories and regional variables. Hours worked per week variables are as a proportion of the total number of persons employed in each working zone reporting hours of work in each category. The age variables were the proportion of the population in each age group. Finally, the variables to capture regions with, respectively, large external and internal migration, are the proportion of the population who lived outside Australia in 2001 and outside the zone but elsewhere in Australia in 2001.

The estimated coefficients of the variables in the model are shown in table 5. In these equations the coefficients of the dummy variables can be interpreted relative to the omitted category; 'Primary' for the industry group, 'tradespersons' for the occupation group, '35 to 44' for the age group, 'NSW' for the states and territories group, the 'standard week' for hours of work, 'trade qualification not relevant' for qualified tradesperson, 'internal migration' for usual address five years ago and lastly, 'Capital Cities' for the regional group.

Model Estimation

An issue effecting spatial research is the existence of spatial dependence. This is likely to be particularly problematic when using SLAs as the unit of measurement and Ordinary Least Squares (OLS) estimation. In general terms, spatial dependence is the effect that an area has on another area elsewhere (Anselin, 1998). We can separate spatial dependence into two specific issues measurement error and spatial interaction. Measurement error relates to the discrepancy between the spatial scope of the object being study and the demarcation of the spatial observations. This is likely to cause spillover across the limits of spatial units (Anselin, 1998). In this case, tradespersons are often not working and living in the same area. Using SLA level of aggregation presents a great deal of measurement error. Therefore we aggregate SLAs in to 'working' zones which are used as the spatial unit. This eliminates much of this error since a high percentage of residents work within the same work zone. It was not possible to completely remove all measurement error, but in using the working zones 90.5 per cent of the population work and live in the same work zone.

The second issue of spatial interaction deals with the multidirectional relationship two observations in space can have with each other. This spatial interaction is underpinned by the notion that distance matters, the closer observations are to one another in space the greater the influence they will have on each other (Anselin, 1998). A popular method for testing for spatial interaction is the Moran's I statistic (Chi and Zhu, 2008). The Moran's I statistic measures the extent of linear association between a characteristic (y) at its location and the weighted average of the characteristic at neighbouring locations (Wy) (Chi and Zhu, 2008). In the case of OLS estimation of the model the p value of the Moran's I statistics was significant at the five per cent level (0.018) indicating the existence of spatial interaction causing the OLS regression to yield biased results.

Two popular models used is place of the OLS regression are the spatial lag and spatial error model. The spatial lag model is specified as:

$$Y = X\beta + \rho WY + \varepsilon \quad (1)$$

Where Y denotes a vector of observations for the response variable, X denotes a matrix of observations for the explanatory variables, W denotes the spatial weights matrix, and ε denotes a vector of error terms that are independent but not necessarily identically distributed. Alternatively, the spatial error model is specified as:

$$Y = X\beta + \mu, \qquad \mu = \rho W\mu + \varepsilon \quad (2)$$

The spatial error model is defined in the same way as the spatial lag model above. The spatial lag model structures the spatial autocorrelation as a linear relationship between the response (Y) and the spatially lagged variable (Wy). The spatial error model structures the spatial autocorrelation in the error term (μ) and the associated spatially lagged error term (Wμ) (Anselin and Bera, 1998).

Model evaluation can be carried out by conducting the Likelihood ratio test, the Lagrange Multiplier and the Wald test (Chi and Zhu, 2008). The null hypothesis of the three tests is that there is no spatial autocorrelation and this is rejected if the test statistic exceeds 3.84 (at the five per cent level) and 6.635 (at the one per cent level) following a chi squared distribution (Anselin, 1988).

The diagnostic tests for spatial autocorrelation for each model are reported in table 6. The Moran's I test suggests the Ordinary Less Squares estimated is biased due to spatial dependence. However, there is not enough evidence to reject the null hypothesis for the spatial lag model and only the likelihood ratio test provides evidence against Ho for the spatial error model. Therefore spatial error is probably a bigger issue than spatial lag. However, when looking at the estimated models, there is not a great deal of difference between the estimated coefficients. In fact the estimated coefficients for each of the predictors are fairly consistent throughout. This suggests that the results are robust with respect to spatial autocorrelation.

Table 5 - Regression Coefficients for Model of Growth in Tradesperson Population, 2001-2006

	Spatial Lag Model		*Spatial Error Model*		*Ordinary Less Squares*	
	Coefficient	*P Value*	*Coefficient*	*P Value*	*Coefficient*	*P Value*
Industry/Occupation Mix						
Manufacturing	75.01	0.075*	86.56	0.038**	66.60	0.117
Utilities	52.51	0.289	48.72	0.324	52.46	0.315
Services	108.36	0.001***	104.98	0.001***	107.48	0.001***
Managers	230.20	0.004***	226.69	0.004***	225.34	0.007***
Professionals	70.53	0.611	43.49	0.754	74.58	0.610
Clerical	-24.43	0.828	-21.63	0.847	-21.78	0.855
Production	234.70	0.042**	232.00	0.043**	230.07	0.059*
Labourers	217.56	0.012**	198.09	0.022**	216.22	0.018**
Qualifications						
University	-22.44	0.862	-19.36	0.879	-36.79	0.784
Diploma	2.19	0.990	47.67	0.797	-0.02	1.000
Certificate	163.23	0.237	146.23	0.289	161.70	0.267
Qualified Tradespersons	-15.69	0.929	-11.16	0.949	-17.91	0.923
Unqualified Tradespersons	126.69	0.032**	114.83	0.053*	126.14	0.044**

Table 5 (continued) - Regression Coefficients for Model of Growth in Tradesperson Population, 2001-2006

	Spatial Lag Model		*Spatial Error Model*		*Ordinary Less Squares*	
	Coefficient	*P Value*	*Coefficient*	*P Value*	*Coefficient*	*P Value*
Demographics & Labour Market Conditions						
Male	-144.31	0.088*	-152.26	0.069*	-136.36	0.123
Young	142.56	0.092*	157.33	0.062*	137.77	0.122
Older	174.53	0.024**	187.71	0.015**	167.67	0.039**
Unemployment Rate	3.53	0.000***	3.41	0.001***	3.53	0.001***
Jobless Rate	-0.17	0.783	-0.27	0.670	-0.20	0.766
Earning Rent Ratio	0.40	0.212	0.39	0.222	0.40	0.235
Tradespersons Median Earnings	0.04	0.001***	0.04	0.001***	0.04	0.001***
Casual	69.97	0.098*	68.47	0.100	65.10	0.139
Overtime	28.42	0.537	28.85	0.527	24.55	0.610
Location						
Didn't Move	31.92	0.319	27.49	0.389	33.67	0.317
Recent Overseas Migrants	-392.99	0.047**	-419.45	0.034**	-380.25	0.068*
Victoria	0.25	0.960	1.28	0.800	0.73	0.891
Queensland	8.43	0.116	4.79	0.415	9.54	0.076
South Australia	1.31	0.836	-1.31	0.836	3.16	0.599
Western Australia	-1.37	0.840	-1.85	0.754	1.23	0.833
Tasmania	-2.57	0.756	-6.38	0.457	-1.13	0.894
Northern Territory	27.07	0.005***	22.09	0.028**	28.53	0.004***
Australian Capital Territory	24.71	0.354	28.36	0.287	24.83	0.377
Other Metropolitan	4.02	0.771	3.04	0.825	4.33	0.766
Coastal	-0.46	0.969	-1.68	0.885	-0.21	0.986
Inland	5.41	0.640	6.40	0.578	4.96	0.683
Remote	-4.71	0.695	-7.37	0.541	-4.33	0.732
Constant	-323.86	0.003***	-301.64	0.005***	-320.59	0.005***

Note: 1. *, **, *** denotes significance at 10%, 5%, and 1% respectively.

Table 6 - Diagnostic Tests for Spatial Autocorrelation

	Spatial Lag Model		*Spatial Error Model*		*Ordinary Less Squares*	
	Test Stastic	*P Value*	*Test Stastic*	*P Value*	*Test Stastic*	*P Value*
Moran's I					2.36	0.018**
Wald test	0.444	0.505	2.175	0.14		
Likelihood ratio test	0.444	0.505	2.935	0.087*		
Lagrange Multiplier test	0.228	0.633	0.49	0.484		

Note: 1. *, **, *** denotes significance at 10%, 5%, and 1% respectively.

Industry
When compared to primary industries, regions with a higher proportion of people employed in the service and manufacturing industries are associated with relatively higher inward flow of tradespersons, significant at the one and five per cent level respectively. The manufacturing industry although it has been in decline for a number of years is still a significant employer of tradespersons employing approximately one in every five tradespersons in Australia.

Occupation
When compared to tradespersons, regions with a higher proportion of managers, production workers and labourers were associated with higher inward flows of tradespersons, significant at the one per cent, five per cent and five per cent level respectively. These occupations may be seen as complementary occupations as they are used in conjunction with tradespersons in industries like manufacturing and construction.

Qualifications
When compared to trade qualified not relevant, regions with higher proportions of the workforce who are trade qualified are associated with higher inward flow of tradespersons, significant at the five per cent level. There is some evidence that the tradespersons labour market is working efficiently as tradespersons are more likely to move to areas where there is a greater need for tradespersons.

Age
When compared to the middle aged group, regions with a higher proportion of the population aged less than 34 and aged greater than 45 are associated with higher inflows of tradespersons, significant at the 10 per cent and five per cent respectively.

Hours
The average number of hours worked a week does not appear to make a significant difference to the inflow of tradespersons.

Tradespersons median earnings
Regions in which the tradespersons median earnings were higher are associated with a higher incidence of tradespersons inflows. This is further evidence of efficiency in the labour market for tradespersons with tradespersons locating to areas with higher pay.

Joblessness and unemployment
Regions in which the unemployment rates were higher is associated with a higher incidence of tradespersons inflows. This is contrary to expectation that people would locate to an area with decreased employment prospects and contrary to the bulk of literature on the matter. However, Trendle (2005) in his study of interregional migration in Queensland did find people moving from areas of low unemployment to areas of high unemployment which agrees in part with the results of this study. This may be due to cost of living being lower in high unemployment areas. It may also be indicative that high unemployment generally does not necessarily translate to high unemployment of tradespersons.

Gender
A higher proportion of males in a region is associated with a lower incidence of tradesperson inflows.

Migration
Regions with a higher proportion of recent migrants observed a lower inflow of tradespersons. That is tradespersons appear to be less mobile than other workers.

States and territories
When compared to New South Wales, the Northern Territory was associated with a higher incidence of inward tradespersons migration, significant at the five per cent level. There is no evidence of above average increase in the population of tradespersons to the resource boom states of Western Australia and Queensland.

Regions
There were no significant differences between regional classifications. There was no significant attraction of tradespersons to the remote regions, where the bulk of resource projects are.

5. Conclusion

In summary, the results suggest a number of factors are associated with the growth of tradespersons living and working in a particular zone, but it seems that working zones with larger manufacturing and service industries as a proportion of total industry, areas with a higher proportion of poorly qualified tradespersons, areas with a higher proportion of managers production workers and labourers, areas with better pay, areas with more old and young people as a proportion of the total, and areas with a higher unemployment rate, appear to attract tradespersons. However, tradespersons seem to avoid places with a high proportion of males and more recent migrants. When all the socioeconomic and demographic factors are accounted for the results suggest that the Northern Territory is associated with a higher incidence of tradespersons inflows.

These results suggest tradespersons seek out areas with less direct competition or areas with greater demand for their services. It also suggests tradespersons move to areas with higher proportions of complementary occupations such as labourers, production workers and managers. Overall, while the model suggests labour market factors play some part in affecting the decision of tradespersons as to where to live and work, these effects appear limited. The results suggest that where shortages for tradespersons exist, due for instance to a mining boom, targeted immigration will have a role to play in reducing these shortages.

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