

Skills Intensity: A Human Capital Approach to Understanding the Development of Regions

*Alexis Esposito, **Andrea Garing, ***Anne Langworthy,
and ***Rebecca Feldmann

*Our paper analyses the importance of the skill intensity of occupations as a key driver of economic development in regions. To this end, it uses the Occupational Information Network (O*NET) to evaluate and examine skill intensity for the Melbourne Statistical Division (MSD) and the Outer East of Melbourne (OEM). It analyses employment change in the region and uses hierarchical regression in order to determine and identify which sets of skills provide a larger economic premium in the labour market. The paper concludes that different skill levels contribute to earnings differences to some extent in both cases, although to a much lesser extent in the OEM.*

1. Introduction

Upskilling of the labour force is an important ingredient in the development of regions. Over the last decade, the Australian labour market (as in most OECD nations) has experienced persistent levels of skill mismatches between employees and jobs or employers, and persistent levels of skills shortages in many occupations and particular industries (OECD 2006, 2011; Australian Industry Group 2004). These have impacted heavily on regions around Australia. In trying to understand the impact that skills play in the development of regions, this paper pays particular attention to the Outer East of Melbourne (OEM), an area which is characterised by a significant population which tends to be homogenous, demonstrating negligible growth, ageing with pockets of socio-economic disadvantage; a dominance of small and micro business rather than large industry; and unemployment which is more marked in the outer areas of the region where youth unemployment is high (Langworthy et al. 2009). In trying to obtain a broad understanding of the impact of skills on regions, this paper analyses skill change and identifies the sets of skills which provide a larger economic premium in the labour market. The paper is divided into the following sections. Section 1 presents the literature review. Section 2 discusses the Occupational Informational Network (O*NET) and its application to the analysis. Section 3 explains the method used in the analysis and discusses findings related to the skill intensity analysis of both regions. Section 4 uses hierarchical regressions to identify the skill sets that provide a premium in the labour market. Section 5 provides a conclusion and presents policy options.

2. Literature Review

Despite the pervasiveness of skills shortages generally, skills needs vary across industries and equally across different areas of Victoria. The impact of skills shortages in regional and non-metropolitan areas has been significant and the body

* Swinburne University of Technology aesposito@swin.edu.au

** Swinburne University of Technology

*** University of Tasmania

*** Swinburne University of Technology

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of research concerned with the skill requirements and deficits in regional areas attests to this (Department for Victorian Communities 2006; Department of Transport and Regional Services & Bureau of Transport and Regional Economics 2003).

The prosperity of regions across Australia varies markedly and the factors which contribute to their economic health are complex. Overall, regional Victoria experienced substantial employment growth in recent years. Between October 1999 and June 2006 an additional 19% of the population in regional Victoria gained employment, making the level of overall

unemployment in some regions lower than in metropolitan Melbourne. However, as indicated in the Victorian Regional Skills Shortage Survey, there were significant recruitment difficulties in many industries. Across all industries in regional Victoria, an average of 77% of employers attempted to recruit in the previous 12 months and 12% of their vacancies remained unfilled. Again across all industries, 19% of employers had difficulty retaining workers. This points to the fact that skill deficits in regional areas cannot be entirely accounted for by an actual lack of appropriately skilled employees (Department for Victorian Communities 2006). In addition to actual shortages, regional employers often experience recruitment difficulties where appropriately qualified individuals may exist in the labour market but are not made available within a specific region.

Reasons for these difficulties are many and may include a lack of appropriate training available in regional areas, forcing residents to commute in order to undertake education and training. Regional economies may be dominated by industries that are seen as 'less desirable' either on account of their 'image' (young people may have a somewhat negative image of trade occupations including agriculture, for example), a lack of career structure ('dead-end' jobs) or a region may be dominated by industries that are considered to be unstable and seasonal.

2.1 Successful Regions

Human capital development, in the form of upskilling of the labour force, is a crucial component and ingredient for the successful development of regions. Local skills, local jobs and local knowledge are important to the sustainability of local communities. Regions with highly diverse economies exhibit more stable economies and are less subject to volatile growth patterns (Bureau of Transport and Regional Economics 2003). Other factors which influenced regional economic growth were the availability of facilities, remoteness, leadership and a strong skill base. Regionally, success breeds success, and thus regions where the 'requisite skill and knowledge capacity are in place are more likely to attract viable and dynamic industries' (National Institute of Economic and Industry Research 2004, cited in Langworthy & Brunt 2005).

The creation of local jobs and the retention of the local working population has significant advantages for local communities and regional economies, including fostering an increasing a sense of community.

The improvement of the skill and knowledge capacity of residents, whilst essential for the local economy, also has wider benefits. Many studies demonstrate the

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benefits of community members who have university education. For example, higher education fosters democratic participation (Harper, cited in Benson & Harkavy 2002; Kezar, Chambers & Burkhardt 2005). Graduates are more likely to participate and accept diversity in their communities and are over three times more likely to belong to a voluntary organisation than non-graduates (Purcell, Elias & Wilton 2004). They also experience better health and wellbeing (Hillman & McMillan 2005; King 1999; Kretzmann & McKnight 1993), are less likely to be involved in crime (Chapman et al. 2002) and are significantly more likely to hold positive attitudes towards race and gender equality (Purcell, Elias & Wilton 2004).

In addition, graduates live healthier lifestyles and are less likely to smoke, to be obese or to suffer from depression and more likely to report 'excellent' health (Wilberforce 2005). Higher education qualifications are also associated with less physical decline, depression, loneliness and social loss, and positively associated with continuous growth in ageing people (Steverink et al. 2001). The benefits are also intergenerational. Graduates are more likely to take an interest in their own children's education and to be involved with their school, factors which are predictors of schooling success (Purcell, Elias & Wilton 2004). The above discussion highlights the importance of skills in the continued development and wellbeing of communities, regions and nations. One way of achieving a good understanding of the skill needs of communities, a changing economy and labour market is through a skills change analysis using the Occupational Information Network (O*NET).

2.2 The O*NET: A Suggested Approach to Understanding the Regional Skill Levels

The O*NET is an extensive and comprehensive database that describes the attributes and characteristics of occupations and workers. Its first version was launched in 1998 and is known as O*NET 98. Considered to be the most comprehensive standard source of occupational information in the US, it offers statistical information that can be applied to the Australian context to analyse labour market change.

The O*NET was developed by a consortium led by the US Department of Labor to replace the Dictionary of Occupational Titles (DOT) which had been conceived in the 1930s and was last published in 1991. The DOT was developed in an industrial economy during a time that emphasised blue-collar occupations. It was updated periodically and proved very useful for more than six decades.

The occupational information in the O*NET is organised in a relational database which identifies, defines and describes the comprehensive elements of job performance. It contains hundreds of information items on job requirements, worker attributes and the content and context of work, capturing what people do in their day-to-day activities.

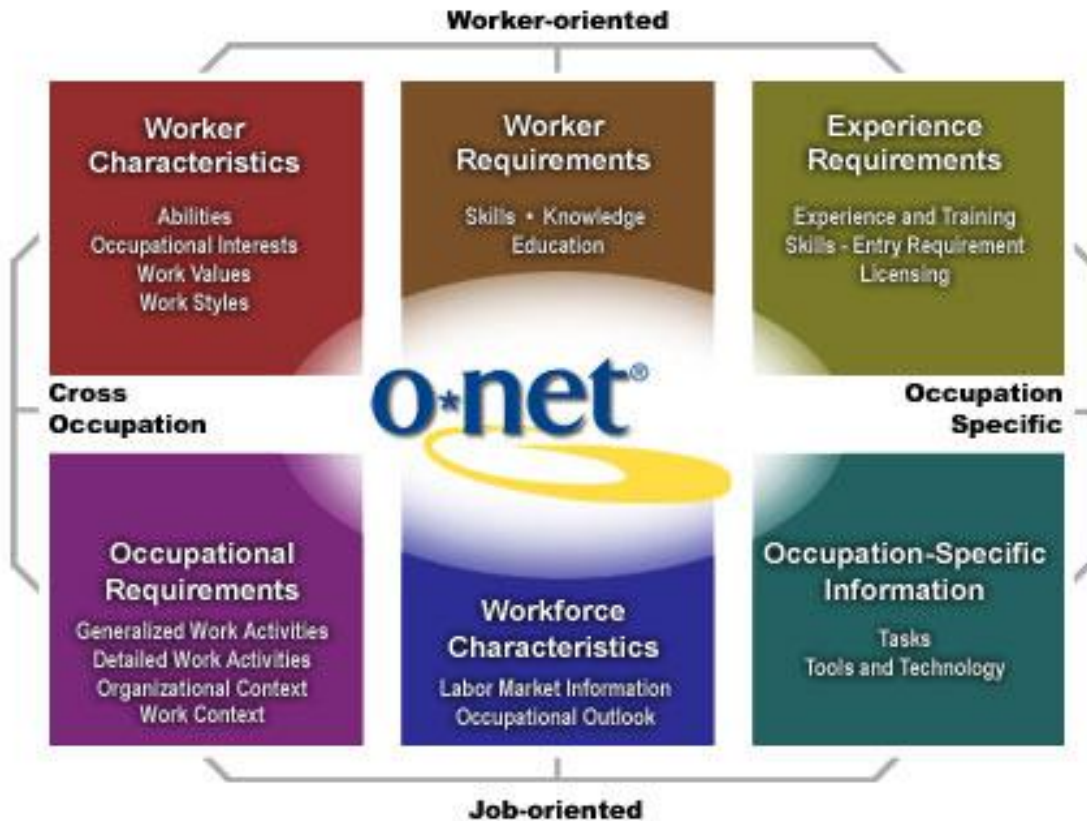
2.3 The O*NET Content Model

The Content Model is the conceptual foundation of the O*NET. It was developed by Mumford and Peterson (1999), using research on job and organisational analysis, and embodies a framework that reflects the character of occupations (i.e. using job-oriented descriptors) and people (i.e. using worker-oriented descriptors). The

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Content Model also allows occupational information to be applied across jobs, industry sectors (by using cross-occupational descriptors) and within occupations (using occupation-specific descriptors).

Figure 1: Six Domains of the O*NET Content Model



Source: O*NET Resource Centre (2012).

2.4 O*NET Skill Descriptors Used for This Analysis

The approach taken by O*NET to define skill is that of Mumford and Peterson (1999) who define it as a set of general procedures that underlie the effective acquisition and application of knowledge in different areas of endeavour. The implication of this definition is threefold. Firstly, skills are innately linked to knowledge, learning, practice, education and experience. For example, a person cannot acquire or apply skills without learning, practising, being exposed to education, experiencing or acquiring knowledge. Secondly, skills can be seen as general procedures that are necessary for the performance of multiple tasks. These tasks, however, must form part of a given domain of skills such as social skills, basic skills or problem solving skills. Finally, skills are not constant attributes of individuals that remain unchanged over time. They can be acquired (sometimes they can be lost) and developed as a result of new learning, experience or newly acquired knowledge. Thus the O*NET can provide a good description of human capital (the stock of productive skills and technical knowledge embodied in labour), although it has not been widely used in labour market research.

Given the above, Mumford and Peterson (1999) argue that skills are not one-dimensional and require a variety of taxonomies. They divide the taxonomy of skill into two broad categories. The first is referred to as basic skills, defined as the developed capacities that facilitate learning or the attainment of new knowledge. These are subdivided into two further categories: content and process skills, which are made up of six and four skill variables respectively, out of a total of 46 skills that comprise the complete O*NET skill taxonomy. Content skills can be broadly defined in terms of those capabilities that allow people to acquire information and convey it to others. They represent the structures required to work with and acquire other skills. This category includes skills such as reading, writing, listening, speaking, mathematics and science. These skills are also widely seen as fundamental in the provision of any sound educational system.

Process skills are seen as those that facilitate the acquisition of content across domains. The ability to think critically is thus part and parcel of such skills. This is closely related to a second kind of general learning skill, referred to as active learning. Another process-oriented skill takes the form of learning strategy. This uses a variety of approaches when learning new things. Finally, monitoring represents an ongoing appraisal of the success of an individual's efforts because it assists them in assessing how well they are learning something or doing a particular task. The second classification of skills is defined in the O*NET as the capacities that facilitate individuals to perform effectively in a variety of job settings. This skill definition is also known as Cross-Functional Skills and in the O*NET Content Model is based on the notion of socio-technical systems theory.

3. Methodology: The Skill Composition of Employment: MSD and OEM

In the analysis that follows, the O*NET measures of skill are applied to investigate changes to the composition of full-time and part-time employment for men and women. We explore the following questions:

- How have the occupational requirements of workers in the MSD and the OEM in terms of O*NET skill intensities changed between 1991 and 2010?
- What areas of skill are most important in terms of employment growth for both the MSD and the OEM?

3.1 The Skill and Knowledge Intensity of Occupations: MSD and OEM

This section considers the worker requirements of occupations by analysing the overall skill intensity change of occupations. To describe changes in the skill intensity of occupations, employment indices of skill intensity were created using the following equation:

$$SK_{ALL} = \frac{E_j \sum_{i=1}^n (I_{SK_i} \cdot L_{SK_i}) / n}{\sum_{j=1}^m E_j} \quad \text{Equation 1}$$

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The above index measures the intensity of skill in occupations across the whole of the labour market and allows us to compare changes to the composition of skill in terms of job types, e.g. female full-time employment. Hence, to say that on average the skill intensity in a given job type has increased is to say that on average the composition of employment in that job type has changed because of:

- Growth in occupations that require a higher level of skill intensity;
- A decline in the number of jobs that require lower levels of skill intensity;
- Both an increase in occupations that require higher levels of skill intensity and a decline in occupations that require lower levels of skill intensity.

3.2 Employment Change: Australia, MSD and OEM

Before delving into an analysis of the skill intensity changes in the labour force of both the MSD and the OEM, it is important to note the important role of part-time employment in Australia. The labour market has experienced a major transformation over the last three decades. A major feature of this change has been the increasing diversity in the nature of work and types of employment (VandenHeuvel and Wooden 2000). For example, up until the 1970s, most Australian workers were in permanent full-time employment. During the early 1970s, just over one in ten worked in part-time employment, defined by the ABS as less than 35 hours per week. By 2002 nearly one in three employees were employed on a part-time basis (ABS 2002). Furthermore, in the early 1980s, alternative work arrangements began to flourish, especially casual employment (Esposito 2008a, p. 84).

Two major factors have contributed towards a trend that promotes labour market change, namely, demand and supply factors, and institutional forces. The desire of many workers to combine responsibilities and personal interests with participation in the labour market has impacted the supply side. Such examples are the entry of many married women into the labour market who are willing to combine home and family duties with employment arrangements such as casual and/or part-time work. The opportunity for women to do so and for students to combine study and work can be seen as a positive outcome, in that it has improved both groups' social and economic wellbeing.

Table 1: Employment Change by Region, 1991-2010ⁱ

Region	Persons employed		Change 1991-2010
	1991	2010	
MSD	1,252,430	1,747,552	39.5
Outer East of Melbourne			
Knox	54,683	72,177	32.0
Maroondah	38,427	54,002	40.5
Yarra Ranges	53,798	74,117	37.8
Men Full-time			
Outer East of Melbourne			
MSD	597,370	708,048	18.5
Knox	27,096	32,058	18.3
Maroondah	18,441	22,104	19.9
Yarra Ranges	26,546	30,227	13.9
Men Part-time			
MSD	107,359	222,753	107.5
Outer East of Melbourne			
Knox	4,101	7,269	77.3
Maroondah	3,106	6,696	115.6
Yarra Ranges	4,457	9,355	109.9
Women Full-time			
MSD	319,414	409,023	28.1
Outer East of Melbourne			
Knox	12,733	15,797	24.1
Maroondah	9,224	11,416	23.8
Yarra Ranges	11,651	14,310	22.8
Women Part-time			
MSD	319,414	378,808	18.6
Outer East of Melbourne			
Knox	10,754	17,357	61.4
Maroondah	7,657	14,319	87.0
Yarra Ranges	11,145	21,082	89.2

Source: ABS Census, 1991, 1996, 2001 and 2006 and author's estimates. Not stated and inadequately described not included in estimates.

For both the MSD and OEM, these employment arrangements (the increase in part-time and casual workⁱⁱ) have taken a more prominent share of total employment. Table 1 indicates that the growth in part-time employment has clearly outstripped the growth in full-time employment in all categories, except women in the MSD. For

example, in the MSD total employment grew by 39.5% between 1991 and 2010, but full-time work grew by a smaller percentage. When compared to full-time work, part-time work for men grew more than fivefold. Women, on the other hand, experienced stronger growth in full-time work than in part-time work in the MSD. This pattern was not, however, replicated for Knox, Maroondah and Yarra Ranges. Men in employment in the OEM experienced similar trends to the MSD.

Table 1 reveals that the nature of employment creation changed considerably over the period, with a twofold shift characterised by slower growth in full-time employment creation and an acceleration in part-time employment creation.

3.3 Skill Intensity of Occupations in Full-Time Employment: MSD and OEM

The analysis that follows begins by examining the changes to the intensity of skill for total and full-time employment and then proceeds with the same analysis for part-time work. The comparisons are made between the changes of skill intensity and knowledge intensity of occupations in the MSD and OEM.

Table 2 shows changes in the skill intensity of occupations and growth in employment for the period 1991 to 2010, using Equation 1. For every year, for the total employed population and for men and women, the skill intensity index is higher for the MSD than the OEM. This indicates that the skill occupations in the MSD require higher skill levels. The skill intensity results show that for total employment job creation in the MSD, skilled occupations are favoured. The skill intensity of jobs grew by 6.61%, compared to a fall of 1.4% for the OEM.

In terms of full-time work, the trends are different for men and women, particularly in the OEM where the skill intensity of occupations increased for women, but fell for men. For the MSD, the skill intensity of occupations increased for both men and women, but the growth was much stronger for women, indicating the increasingly important role of women in full-time employment. These same trends are also found for the OEM but are of a lower magnitude. This demonstrates a trend similar to that of the Australian economy (Esposito 2008a, p. 166).

For overall employment, job creation in the OEM is favouring occupations which require lower skill levels compared to the MSD for total employment. When disaggregating the data in terms of job type (i.e. male and female full-time), the results show different trends. Employment creation in full-time work in the OEM shows trends of low skill intensive job creation. Conversely, for women the trends in the OEM show that job creation favours higher skilled occupations. These trends are similar to those found in the MSD, however, the magnitude of the increase in skill intensive employment in the MSD is stronger in terms of growth for both men and women.

Table 2: Skill Intensity Scores and Indices Change for Total Employment and for Male and Female Full-Time Employment, MSD and OEM, 1991-2010

Year	MSD	OEM	MSD	OEM	MSD	OEM
Skill Intensity Index						
	Total employment		Male full-time		Female full-time	
1991	6.52	6.43	7.3	7.28	6.23	6.04
1996	6.65	6.4	7.4	7.21	6.74	6.36
2001	6.77	6.38	7.52	7.15	7.08	6.55
2006	6.86	6.36	7.61	7.11	7.43	6.77
2010	6.95	6.34	7.70	7.07	7.80	7.00
Change	6.61	-1.40	5.49	-2.88	25.16	15.85

Source: ABS Census, 1991, 1996 and 2006. Authors' estimates for 2010. Not stated and inadequately described not included in calculations.

4. Identifying Skills that Provide a Premium in the Labour Market

This section estimates the relationship between skill, and wages and employment growth, using hierarchical regression analysis.

4.1 The Value of Marketable Skills

In order to categorise and identify the most marketable skills in the Melbourne Statistical Division (MSD) and Outer Eastern Region of Melbourne (OEM), this study takes as its conceptual framework the O*NET. The O*NET Content Model defines worker requirements, or skills, as the attributes that individuals develop or acquire in the context of their work performance, and divides them into two broad categories: Basic Skills, which are necessary in order to acquire and assimilate new knowledge; and Cross-Functional Skills, which relate to the activities that are undertaken across a range of occupations. Using this framework, comparisons of worker requirements can be made across a wide range of vocational fields and environments in the form of cross-occupational descriptors, thus allowing the identification of generalised skill requirements of a geographical region.

As the Basic Skills were foundational to the acquisition of the more complex Cross-Functional Skills, it would be expected that those skills would only influence earnings discrepancy through their effect on the Cross-Functional Skills and would not in and of themselves provide a premium in the labour market. This is illustrated in Figure 2.

Figure 2: Expected Link between Skills and Labour Market Premium



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Skills classified by the O*NET as Basic Skills are those six that are essential background structures that facilitate learning, called Content Skills, namely, reading comprehension, active learning, writing, speaking, mathematics and science; and the four Process Skills, which are procedural skills which contribute to rapid acquisition of skills, namely, learning strategies, critical thinking, active learning and monitoring. Together the Content and Process Skills form the basis upon which Cross-Functional Skills develop.

Cross-Functional Skills, on the other hand, are viewed as developed capacities that facilitate the performance of specific activities common to multiple jobs. There are 36 Cross-Functional Skills that form five clusters: complex problem solving skills, social skills, technical skills, systems skills and resource management skills. These clusters would be expected to be differentially valuable to the labour market dependent on, among other things, the dynamic forces present in the regional economy and the characteristics of that particular supply of labour.

4.2 Methodology

The hypothesised skill cluster model was tested using hierarchical regression analysis.ⁱⁱⁱ The use of regression analysis is appropriate when examining the relative importance of predictors, thus it is appropriate here as it enables conclusions to be drawn about the relative effects of individual skills on earnings discrepancies. The data met all assumptions for regression analysis. Tolerance figures indicated that bivariate correlations were not so strong as to render any particular variable redundant in a regression, although prevented the use of latent factors. Hierarchical regression allows for the testing of a mediation hypothesis, whereby there is a hypothesised chain of influence. In the skills cluster model, it was expected that the Basic Skills would have no direct influence on earnings discrepancy, but indirectly affect earnings discrepancy by facilitating the acquisition of skills which were considered valuable in the labour market. The Basic Skills cluster was entered in the first model, followed by the Cross-Functional Skills clusters in the subsequent model.^{iv}

4.3 Valuable Skills in the Labour Market: Aggregate Data

In the MSD, 18.4% of earnings discrepancy can be explained by skills. In stage one of the regression, the Basic Skills alone (six Content and four Process Skills) explain 12.1%. In stage two, the introduction of Cross-Functional Skills (social, problem solving, technical, systems and resource management) explain a further 6.3% of earnings discrepancy, but of these, only systems skills contribute significantly, while the Basic Skills no longer contribute to the model (see Figure 3). Overall this suggests, as expected, that the Basic Skills only influence earnings discrepancy through their effect on more complex skills. However, unexpectedly, the only skills cluster to contribute to earnings discrepancy is the systems skills cluster. That is, in the Melbourne metropolitan area, the acquisition of Basic Skills like reading and writing is only useful inasmuch as it allows greater acquisition of systems skills and thus greater earnings discrepancy.

Figure 3: Relationship between Skills and Labour Market Premium in Metropolitan Melbourne



The Systems Skills cluster comprises the Cross-Functional Skills that are utilised to understand, monitor and improve socio-technical systems. It encompasses the skills of Judgement and Decision-Making, which entails cost-benefit analysis of relative merits of potential actions and the choice of the most advantageous alternative; Systems Analysis, which involves determination of the most efficient methodology for a system and the effects on that system of both internal and external influences; and Systems Evaluation, comprising skills in identifying appropriate indicators of system performance and effective methods for improving performance relative to the goals of the system.

In metropolitan Melbourne, possession of the aforementioned systems skills provides a premium in the labour market, resulting in an extra 18% in earnings over and above that earned by individuals who do not possess such skills. Furthermore, the acquisition of social skills, problem solving skills, technical skills and resource management skills does not lead to a premium in the labour market.

Further analysis was undertaken to determine which of the individual skills provides the greatest earnings discrepancy. A hierarchical regression revealed that in metropolitan Melbourne, the most important of the Basic Skills is Critical Thinking, which alone accounts for 14.4% of the variation in earnings discrepancy. However, once again, this skill does not directly provide a premium in the labour market, instead being only influential in its ability to affect the acquisition of Judgement and Decision-Making skills which emerged as the most important of the Systems skills. Critical thinking is a Basic Process skill involving the use of logic and reasoning to identify strengths and weaknesses of alternative solutions, conclusions or approaches to problems, thus a direct precursor of the ability to make sound judgements. This relationship is therefore not unexpected. Perhaps surprising is that together these two skills account for 17.7% of the variation in earnings discrepancy, which is almost all of the variation accounted for by both the Basic and Systems clusters (18.4%). This suggests that in metropolitan Melbourne, individuals wishing to gain a premium in the labour market should focus their educational efforts on acquiring skills in critical thinking, in order to facilitate and build skills in judgement and decision-making.

4.4 Valuable Skills in the Labour Market: Regional Data

The results for the OEM region are very different to the overall Melbourne analysis, with skills explaining only 4.6% of earnings discrepancy. Furthermore, the only skills to result in this relatively small premium are the Basic Skills cluster. Cross-functional skill clusters fail to contribute any explanation over and above the Basic Skills (see Figure 4).

Figure 4: Relationship Between Skills and Labour Market Premium in the Region



This suggests that in the region, the acquisition of more complex, higher skills will not result in a greater premium in earnings. Furthermore, whatever earnings discrepancies do exist appear to be mostly due to factors other than skills.

In terms of the most important individual skills, Active Learning emerged as the most important of the Basic Skills, alone accounting for all the premium evident in the regional labour market. The other Basic Skills appear not to impact significantly on earnings discrepancy. Active Learning involves attending fully to information provided by others and ensuring comprehension by committing time or energy to understanding, or asking questions when appropriate. Of all basic and complex skills, this is the one skill that can provide a premium in earnings in the region.

5. Conclusion

The study found that, over the 1991-2010 period, the growth of jobs requiring higher level skill intensity was concentrated in the MSD. In contrast, the OEM was characterised by job creation requiring lower skill levels, perhaps indicating that people who live in the inner areas of Melbourne have access to occupations that require higher skill levels and as a result command a higher premium in the labour market.

Furthermore, a comparison of the MSD and the OEM suggests that skills contribute to earnings discrepancy to some extent in both cases, although to a much lesser extent in the OEM region. While overall in the MSD critical thinking will facilitate the acquisition of the systems skill of Judgement and Decision-Making and thus result in a clear premium (18.4%), no such premium exists in the OEM. The only skill to contribute to earnings discrepancy in the region is Active Learning which is only associated with a relatively small increase in wages (4.3%).

This, of course, presumes the continuation of the existing economic and social structure in the region. Given the levels of declining skill intensity identified in the occupations of regional residents in Table 2, it is likely that strategies to address regional industry structure and growth will be required.

Endnotes

ⁱ Estimates of employment growth for 2010 are obtained using a linear trend method matching the 1991, 1996, 2001 and 2006 census employment data to 2010. This was done by using the least squares methodology..

ⁱⁱ Unfortunately, it is not possible to comment on the rise of casual employment for both the MSD and OEM because the Australian census does not provide information on casual employment.

ⁱⁱⁱ It was initially intended for the hypothesised model to be tested by using structural equation modelling; however, a high degree of multicollinearity both with and between O*NET clusters prevented the use of latent factors.

^{iv} Almost all skill variables were moderately to severely positively skewed. Square root or logarithmic transformation was required to render all variables suitable for regression analysis.

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