WAGE INEQUALITY ACROSS AUSTRALIAN LABOUR MARKET REGIONS

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ABSTRACT: This paper considers the patterns of inequality in wage and salaries across labour markets in Australia. Using data sourced from the Australian Taxation Office and the Australian Bureau of Statistics, the paper develops several measures of wage and salary inequality and considers both the regional differences in, and the potential drivers of, inequality at the regional level. The research reported illustrates the uneven nature of the wage inequality issue across Australian regions, illustrating the regional winners and losers in terms of inequality outcomes, and suggests that a number of regional level factors may be important in understanding the differences in inequality outcomes reported.

KEY WORDS: Inequality; labour market regions; wage and salary; regional differences.

1. INTRODUCTION

Within regional studies, geography, and other spatially focused academic disciplines; there has been ongoing interest in the patterns and extent of wage inequality at various spatial levels. Often, these enquiries are structured along a particular theme; such as the impact of economic

restructuring, the changing nature of work, national policy changes, or economic shocks; or are considered in terms of the growing recognition that uneven spatial patterns of wage disparities can result in long term negative impacts on individuals (Saunders and Wong, 2014). While many of these studies are tied to understanding shifts and transitions in Australia's contemporary economic geography (Beer, 2012), the focus on the spatial nature of wage inequalities is important within discussions around appropriate policy directions. This is especially the case given the highlighted negative impacts of wage inequalities (Saunders and Wong, 2014) and the fact that in many cases regional economic policy has had unintended consequences that act against addressing wage inequality issues (Florida, 2017; Mudiriza, 2018). Importantly, a spatial or regional analysis of wage inequality moves discussion from a broad national analysis of inequality and allows for an understanding of the ways in which wage inequalities differ between localities. In addition, these analyses allow policy makers and service providers to develop evidence-based policies or programs. Moreover, by focusing on the extent to which wage inequalities differ between places, together with the determinants of wage inequalities, policy makers can engage in programs which better identify the people and place based characteristics of the policy mix (Melo, 2017; Rae, 2012).

This paper takes concerns around the geographical patterns of wage and income inequality and presents an analysis relating the extent of wage inequality across Australian labour market regions. Guided by the work of Lee *et al*. (2016) and others, and using a combination of data, it considers the broad patterns of wage inequality across Australian Bureau of Statistics SA4s and undertakes an analysis of the likely determinants of these deafferented patterns. As a secondary goal it also considers the ways in which outcomes differ according to the measure of inequality used.

2. WAGE AND INCOME INEQUALITIES AS A REGIONAL ISSUE

Despite the importance of understanding the regional nature of wage inequality, within the Australian context, there has been relatively little work conducted in this space. The early work by Maxwell *et al*. (1991) and Gregory and Hunter (1995) illustrated the spatial scope of the inequality issue. Maxwell *et al*. (1991) analysed the degree of income inequality across various levels of spatial aggregation and noted wide variation in the level of income inequality. Gregory and Hunter (1995), using spatially

disaggregated ABS census data, illustrated the highly polarised nature of household incomes across city neighbourhoods with "the poor increasingly living together in one set of neighbourhoods and the rich in another set" (p. 6) suggesting that "the economic gap is widening" (p. 6). In later work, Lloyd *et al*. (2000) showed that during the first half of the 1990s, a growing gap in income emerged between individuals living in Australian capital cities and those living elsewhere. However, the results were not uniform with different experiences being evident across different states as a result of particular social and economic characteristics. Some of the more recent research continues to show similar patterns. Miranti *et al*. (2013) used small area micro-simulation to investigate the extent of regional (Statistical Local Area) inequalities in disposable income and illustrate the mixture of characteristics that are associated with regions of the highest levels of inequality. Similarly, Fleming and Measham (2015) showed the extent to which income inequality has changed across a broad selection of Australian regions. An Australian Bureau of Statistics analysis of taxation data presents a broad regional overview of income distributions utilising standard income inequality measures. The report found some spatial variation in inequality measures with, for example, Sydney displaying the highest level of income inequality (a Gini coefficient of .495), while Darwin showed the lowest level of inequality (Gini coefficient of .401) (ABS, 2016).

Outside of Australia, the recent work by (Lee *et al*., 2016) is an illustration of the spatial focus on questions of income inequality. Focusing on wage inequality in British cities, the authors illustrate the spatial mosaic of wage inequality that has continued to develop as the United Kingdom has emerged from the global financial crisis. In an earlier study, Stewart (2011), analysed earnings data for a limited number of UK regions from 1997 to 2008, finding that inequality grew faster in London than in any other region, with the changes in regions outside of the immediate London/ South East and East Anglia zone having only a small impact on overall change. Looking at the spatial context of inequality within the broader mix between people and place Melo (2017) analysed earning differentials in Scotland noting the importance of spatial factors in explaining income differences between individuals located in large urban areas. In an early descriptive analysis of European context, Dunford (1994) provides a broad analysis of inter-regional income inequalities at a country level, illustrating the divergent nature of wage inequality across countries. More recently, Iammarino *et al*. (2018), discussing the contemporary situation across European regions, argue that globalisation and technological change have resulted significant changes in regional income inequality arguing that

> "The result is a finely grained, multi-scale territorial patchwork of diverging real incomes and rates of labour force participation: between states and regions; within regions, between core areas and peripheral areas; and between prosperous metropolitan regions and less-prosperous ones" (p. 2).

Across the Atlantic, North American researchers have followed similar research endeavours. Florida and Mellander (2016) analysing the geographical patterns of wage and income inequality across metropolitan regions in the United States identify significant clusters of regions with high income high-technology cities being the most unequal. With reference to Canadian data, Beckstead *et al*. (2010), note the large urban-rural earning differences with earnings increasing with the size of urban area, and between rural and urban areas, while Breau *et al*. (2014) show similar patterns noting the large urban-rural wage gap that characterises the Canadian settlement hierarchy and outlining the importance of larger cities in increasing inequality.

3. UNPACKING THE DETERMINANTS OF INEQUALITY

While this paper sets out a description of the broad spatial or regional patterns of wage inequality, it also considers the ways in which inequality measures are associated with a range of important 'drivers' of inequality in a regional setting. Theoretical and conceptual arguments surrounding space and income, or wage inequality, include debates around returns to human capital, the role of agglomeration economies, regional economic development and inequality and the role of industry effects on inequalities.

Links between inequality and human capital focus on the rewards associated with different skill levels, the impact of changes in demand for different skill levels and shifts in labour market polarisation (Acemoglu and Autor, 2011; Breau *et al*., 2014; Wheeler, 2005). Captured under the term skill-based technological change (SBTC), wage inequality is an outcome of a shift in technology that favours skilled, more educated workers over unskilled labour by increasing its relative productivity and relative demand. When translated to a regional level, the greater labour market polarisation associated with SBTC and represented by higher levels of human capital and formal education, are seen as being associated with a higher skill premium represented by higher levels of wage inequality (Antonczyk *et al*., 2018; Coelli and Borland, 2016). The empirical evidence surrounding the human capital -inequality link is to a large extent supportive of these arguments. Melo (2017) in her work on Scotland found

that the effects of returns to qualifications was significant in explaining wage differentials, while Lee *et al*. (2016) found that the skills of the population are an important factor in explaining wage inequality "with greater skills associated with higher wages and increased inequality" (p. 1724).

Somewhat associated with human capital arguments, some researchers have also considered the impact of migration and race on wage inequality. They argue that either migration or race can have a significant impact on the skills structure of a given region therefore changing the return to skills in that region, or that regional wage inequality can be associated with the links between concentration of particular racial groups and poverty levels. For example, while researchers such as Glaeser *et al*. (2009) have reported an association between diversity and higher inequality, with the presence of international migrants—especially those from Latin America—associated with higher levels of inequality in a given region, Lee and Rodríguez-Pose (2013) have found that there is no significant association between migration and inequality. Looking at the impact of race, Florida and Mellander (2016) reported a significant positive association between race (measured as the share of African-Americans in a metropolitan region) and wage inequality.

Following theories around economic development and inequality (Kuznets, 1955), many authors have considered the link between wage inequality and the level of development (Castells-Quintana, 2018). At a regional level, the Kuznets pattern would suggest that richer areas would tend to be more unequal (Glaeser *et al*., 2009). In their study the changing patterns of income inequality in the United States, Moller *et al*. (2009) found that increasing levels of median incomes at the county level (a measure of economic development) were associated with higher inequality. Lee *et al*. (2016), analysing British cities, also included a measure of median incomes in their analysis, reporting a positive association between median wage and inequality. Against these findings are those such as Bolton and Breau (2012) who, using Canadian data, report a negative association between median income and inequality, suggesting that economic development may have an equalising effect on wage inequality.

Another possible explanation for regional differences in wage inequality is linked to population size, with linkages being associated with the impacts of agglomeration/urban economies and Marshallian externalities (Glaeser, 1999; Glaeser and Gottlieb, 2009; Melo, 2017; Wheeler, 2004). At a regional level, the concentration of economic activities produces externalities for both firms and workers leading to among other things

wage premiums in large urban areas or regions (Glaeser, 1999). Testing these issues empirically, researchers such as Baum-Snow and Pavan (2013), Bolton and Breau (2012), Korpi (2007), Lee *et al*. (2016) and Glaeser (1999) have looked at wage inequality across cities of differing sizes illustrating a significant wage premium for larger urban areas. Baum-Snow and Pavan (2013) for instance, illustrate that for US cities, wage inequality has a strong positive association with city size, accounting for around 25 to 35 per cent of increases in inequality. In contrast, Bolton and Breau (2012) illustrate the impact that labour force population size has on inequality in Canadian cities. Lee *et al*. (2016) in their analysis of British cities found that city size, measured by the log of the number of employees, was positively associated with higher levels of inequality across a range of inequality measures. However, these differences failed to remain significant once median pay was included as a control variable.

Associated with discussions around skills is the link between industry and occupation and inequality. As regions develop particular industrial bases and levels of specialisation, it can be expected that differentials in industry, occupation and employment structures will have differing impacts on wage inequality. This may be through the wage regulating impact of public sector employment or the impact of less regulated labour markets (Fortin and Lemieux, 1997). Authors such as Zhong *et al*. (2007) have illustrated that the presence of producer service industries in US regions are linked to higher levels of income inequality, while Lee *et al*. (2016) showed mixed results with employment in the financial sector for their sample of UK regions. The research by Lee *et al*. (2016) also illustrated the potential impact that public sector employment can have on regional wage inequalities, with public sector employment regions being associated with lower levels of wage inequality. Importantly for the Australian context, Fleming and Measham (2015) analysed the impact of mining industries on regional wage inequalities in Australia, reporting that while mining regions as a whole were associated with smaller shifts in wage inequality, individual regions showed significant variation both in the overall level of inequality and in the extent of change.

4. METHODOLOGY

Data

The data used in this paper is drawn from the Australian Taxation Office (ATO) and the Australian Bureau of Statistics (ABS). The ATO releases a sample file of individual taxation returns on an annual basis. The two per

cent sample for the 2013 -14 financial year is used to develop the dependent variables analysed in the paper. The sample file contains data on individual wages and salaries, incomes from investments, government payments and other sources and, importantly, includes a spatial reference for each individual record. As discussed below, this allows for the calculation of inequality measures across defined spatial units.

As one of the goals of this paper is to consider the ways in which inequality measured at different points across the distribution, several variables are used to measure wage inequality. Following the work by Ma and Tang (2016), Lee *et al*. (2016) and others, this study accounts for wage inequality using four measures—a standard Gini coefficient and three wage ratios. The Gini coefficient is calculated using the standard formula and is interpreted in the usual way (i.e. higher coefficients indicate higher inequality). These wage and salary ratios aim to account for the dispersion of wages within any given region. The ratios used are:

- The 90/10 ratio: this is the ratio of the 90^{th} to the 10^{th} percentile in wage. This provides a measure of the way in which wages are spread and also an understanding of the scale of differences between high wage earners and low wage earners.
- The 90/50 ratio: this is the ratio of the 90^{th} to the 50^{th} percentile of wage distribution. This measure accounts for upper-tail inequality; that is how far the top of the wage distribution from the median.
- The 50/10 ratio: this is the ratio of the 50^{th} to the 10^{th} percentile of the wage distribution. This provides a measure for lower-tail inequality.

Once calculated for each region, the Gini coefficient, plus the three ratio measures, are included as dependent variables in the analysis.

In order to consider the potential drivers of inequality within regions, 2011 ABS Census data is used. The independent variables used were influenced by the available census data as well as the existing research (discussed above). Table 1 provides details of these independent variables. The variables account for the level of regional development (Median wage and salaries), returns to skills or human capital (% qualifications, % peak earners), the level of migration (% non-Australian born migrants), regional industry structure (% public sector employees, % mining sector

employees) and regional employment characteristics (Unemployment rate, % part time workers).

Table 1. Independent Variables Used in Analysis.

Variable name	Variable details
Size	log of the total number of persons employed in each SA4 region
Median wage and salaries	median wage/income – 50th percentile of ATO yearly wage/total income data divided by (52*35) to give an approximate hourly wage/income
Qualifications (%)	proportion of working population qualified to degree level or above (not working age population – only people who are employed)
Migration (%)	proportion of population not born in Australia (non-respondents excluded from denominator)
Peak Earners (%)	percentage of working population aged 35-49 (not working age population – only people who are employed)
Public sector (%)	share of employment in public administration and safety, education and training and health care and social assistance industries (non-respondents excluded from denominator)
Mining sector (%)	share of employment in mining industry (non-respondents excluded from denominator)
Regional unemployment rate (%)	unemployed over labour force (non-respondents excluded from denominator)
Part-time employment rate (%)	part-time employed over total employed (non-respondents excluded from denominator)

Source: the Authors

Labour Market Regions

An important decision, when developing the analysis undertaken in this paper, related to the most appropriate spatial units to adopt. As the main focus of the paper is understanding wage inequality across labour market regions, ABS SA4 regions are used. While this choice was partly due to convenience—the spatial identifier in the two per cent taxation data file was SA4 regions—the use of those regions also provides a close approximation to what might be considered journey-to-work regions

(ABS, 2010). The SA4 regions are used by the ABS for the collection and dissemination of geographically classified statistics, including the results from the monthly Labour Force Survey. There exists 87 SA4s covering the whole of Australia. Due to the small population in a particular SA4 in Tasmania, two SA4s are combined in the ATO data, to give a total of 86 labour force regions across Australia.

Modelling

As one of the purposes of this paper was to consider what may be the drivers of regional level wage inequality, a series of regression models were carried out. In this case the use of standard ordinary least squares regression was potentially problematic due to the existence of significant spatial autocorrelation between the labour market regions. A Moran's *I* test for spatial autocorrelation (table 2) suggested significant results for all four measures of inequality. This resulted in the need to run appropriate regression models accounting for the spatial autocorrelation effect (see below). In developing the modelling outlined in this paper, several techniques for dealing with spatial autocorrelation were employed. Following a comparison of output, the results from spatial auto-regressive (SAR) models with a spatially lagged dependent variable are presented (Anselin, 2013).

Table 2. Moran's *I* Results for Inequality Variables.

Measure	Gini	P9010	P9050	P5010
Moran's *I*	0.357***	0.261***	0.386***	0.172*
	(4.80)	(3.54)	(5.18)	(2.39)

Notes: ***p < 0.001; **p < 0.01; *p < 0.05; p < 0.1. Source: ATO sample unit record file 2013-14, authors' calculations

The modelling investigates the factors associated with wage inequality across Australia's labour market regions, using a series of simple regression models. Each model represents a given measure of wage inequality as a function of a range of independent variables.
The general model is of the form:

$$IE_i = \rho W IE_i + X_i\beta + \varepsilon \quad \textbf{1)}$$

estimated for region i. IE is one of the inequality measures being used, the Gini coefficient or one of the percentile ratios, for either wage and salary

of total wage. ρ is the spatial lag coefficient measuring the influence of the inequality measure in neighbouring regions on region *i*. The spatial weight matrix, *W*, is a row-standardised first order contiguity matrix. *X* is the matrix of control variables as described in table 1, with a vector of coefficients, β.

5. WAGE INEQUALITY ACROSS LABOUR MARKETS REGIONS

This section presents the findings from the analysis of wage inequality across Australia's spatially disaggregated labour markets. Table 3 presents information on the top and bottom 10 labour market regions ranked by the Gini coefficient for wages. It is evident that those labour market regions with the highest levels of inequality represent a group of places most often associated with advantage and affluence within the Australian space economy (Baum *et al*., 2005; Tanton *et al*., 2007). Inner-city labour markets in Sydney, Brisbane and Melbourne represent the most unequal labour markets in Australian cities. Interestingly, inner-city Perth recorded the highest level of wage inequality when measured using the Gini coefficient, likely an outcome of the mining boom in Western Australia. Other regions of affluence—including the western suburbs of Brisbane, Sydney's northern beaches, and northern and eastern suburbs, and near inner city labour markets in Melbourne—are also highly ranked on the Gini measure.

Contrasting these high inequality regions are the 10 localities with the lowest levels of inequality. Unlike the most unequal labour market regions, those at the bottom of the distribution are found in both metropolitan and non-metropolitan areas. A definite link with old industrial economies is evident (Baum *et al*., 2005) with labour markets in the north of Adelaide, western Melbourne, Logan and Toowoomba in South East Queensland, and some outer suburbs of Sydney. The most equal labour market region as measured by the Gini Coefficient was the remote New South Wales region of Far West and Orana.

Table 3. Most and Least Unequal Labour Markets, Gini Coefficient of Wage and Salary.

		Gini Coefficient
Rank	Labour Market region	Index
1	Perth – Inner	0.5166
2	Sydney – Eastern Suburbs	0.5075
3	Sydney – North Sydney and Hornsby	0.4818
4	Sydney – Northern Beaches	0.4798
5	Brisbane Inner City	0.4774
6	Sydney – City and Inner South	0.4733
7	Melbourne – Inner East	0.4728
8	Brisbane – West	0.4711
9	Melbourne – Inner South	0.4647
10	Melbourne – Inner	0.4472
77	Sydney - Blacktown	0.3726
78	Sydney - South West	0.3674
79	Sydney - Outer West and Blue Mountains	0.3672
80	Adelaide - North	0.3665
81	Riverina	0.3627
82	Sydney - Outer South West	0.3622
83	Logan - Beaudesert	0.3573
84	Toowoomba	0.3569
85	Melbourne - West	0.3527
86	Far West and Orana (NSW)	0.3513

Source: ATO sample unit record file 2013-14, authors' calculations.

The figures in table 4 relate to the labour market regions ranked according to the three wage ratios. The 90/10 ratio measure compares the upper and lower extremes of the distribution. Considering those labour market regions ranked in the top 10 most unequal, there is considerable overlap to the ranking by the Gini coefficient. More unequal labour market

regions tend to be those associated with inner or near inner city localities. Perth-inner tops the list with wage in the 90th percentile being around 20 times higher than those in the 10th percentile. The significant difference in listed regions is the inclusion of Bunbury and South Australia-Outback, both regions associated with employment in the mining industry. For those labour market regions in the bottom of the distribution ranked by the 90/10 ratio, the Sydney labour market regions of South-West, Blacktown and Outer West and Blue Mountains are the most equal with wages in the 90th percentile being only 7 times that of wages in the 10th percentile. Logan-Beaudesert, Adelaide-North and Riverina remain in the 10 most equal labour market regions when comparing to the distribution by Gini coefficient, while Ipswich and the non-Metropolitan labour markets of Bendigo, Shepparton and Central Coast are now added to the list of most equal localities.

The labour market regions with high upper-tail inequality (90/50 ratio) are largely similar to the overall measure of inequality with the exception of Mandurah, Mackay and Queensland Outback. The dominance of labour markets ties with the mining industry where wages are likely to be high relative to the median. As with the overall measure of inequality, inner-city or near inner-city labour markets in Sydney and Melbourne also record high levels of inequality.

The most unequal labour market regions measured on lower-tail inequality (50/10 ratio) in a number of cases represent different regions to those highly ranked on the other measures. Whilst regions such as Perth-Inner, and Sydney-City and Inner South are among the most unequal regions on this measure, other regions not necessarily noted for their economic advantage such as Coffs Harbour-Grafton, Darling Downs-Maranoa, New England and Northwest and Western Australia-Wheat Belt are listed as high inequality regions. Similarly, those regions with the lowest inequality based on the 50/10 ratio include a mix of regions, including some listed as low inequality labour markets on previous measures together with other regions such as Northern Territory-Outback.

Table 4. Most and Least Unequal Labour Markets, Wage and Salary Ratios.

	90/10 ratio (overall spread)		90/50 ratio (upper-tail inequality)		50/10 ratio (lower-tail inequality)	
Rank	Labour Market region	Ratio	Labour Market region	Ratio	Labour Market region	Ratio
1	Perth - Inner	20.37	Perth - Inner	3.178	Perth - Inner	6.41
2	Sydney - City and Inner South	15.53	Mandurah	2.854	Sydney - City and Inner South	5.86
3	Melbourne - Inner East	15.31	Sydney - Northern Beaches	2.812	Melbourne - Inner East	5.73
4	Sydney - Eastern Suburbs	14.76	Sydney - Eastern Suburbs	2.811	North West (Vic.)	5.49
5	Sydney - North Sydney and Hornsby	14.26	Mackay	2.807	Brisbane Inner City	5.45
6	Brisbane Inner City	13.87	Sydney - North Sydney and Hornsby	2.724	Brisbane - West	5.43
7	Bunbury	13.86	Melbourne - Inner East	2.672	Western Australia - Wheat Belt	5.41
8	South Australia - Outback	13.85	Sydney - City and Inner South	2.652	New England and North West	5.34
9	Brisbane - West	13.84	South Australia - Outback	2.64	Bunbury	5.26
10	Sydney - Northern Beaches	13.78	Queensland - Outback	2.638	Sydney - Eastern Suburbs	5.25
77	Central Coast	8.21	Melbourne - West	2.041	Logan - Beaudesert	3.88
78	Bendigo	7.98	Sydney - South West	2.027	Brisbane - East	3.85
79	Shepparton	7.88	Sydney - Outer West and Blue Mountains	2.021	Bendigo	3.84
80	Ipswich	7.85	Ipswich	2.019	Riverina	3.83
81	Adelaide - North	7.6	Australian Capital Territory	2.01	Adelaide - North	3.81
82	Logan - Beaudesert	7.58	Toowoomba	2.006	Shepparton	3.79
83	Riverina	7.58	Adelaide - North	1.992	Sydney - Outer West and Blue Mountains	3.74
84	Sydney - Outer West and Blue Mountains	7.56	Riverina	1.978	Sydney - Blacktown	3.73
85	Sydney - Blacktown	7.37	Sydney - Blacktown	1.975	Central Coast	3.61
86	Sydney - South West	7.25	Logan - Beaudesert	1.954	Sydney - South West	3.58

Source: ATO sample unit record file 2013-14, authors' calculations.

To begin understanding the relationships between the measures of inequality and the chosen socio-economic measures, table 5 presents simple correlation coefficients. The size of the labour market region, measured by the log of the total number of people employed, is insignificant and has mixed signs across the range of inequality measures—larger regions are associated with higher overall inequality but lower inequality when measured by the wage ratios. Having a higher level of median wages has a significant positive association with overall inequality as well as the 90/10 ratio and upper tail inequality (90/50 ratio). The measure of qualifications—people holding a degree or higher—is significantly associated with higher inequality across all the measures. A higher proportion of peak earners is associated with lower levels of inequality but only significantly so with the Lower tail and 90/10 ratio measures. Higher levels of migration are associated with higher inequality, especially the measure of overall inequality and inequality measured by upper tail inequality. The presence of public sector workers is associated with lower inequality (except in the case of lower-tail inequality) but none of these correlations are significant. Employment in the mining sector is associated with higher levels of inequality, especially when measured by the 90/10 ratio and the upper-tail (90/50) measure. A higher level of regional unemployment is negatively associated with inequality but is significant only across the first three measures. Finally, the level of part-time employment in a labour market has mixed correlations with none being significant.

We can now move on to consider the regression results between the four measures of inequality and the independent socio-economic variables. Table 6 presents a number of regressions relating to the overall measure of inequality (the Gini coefficient). The first three models present the results from regressing median wage, labour market size and qualifications with the Gini coefficient without the presence of other control variables. Without the presence of control variables, higher levels of median wages and qualifications are both significantly associated with higher inequality. The effect for qualifications remains when control variables are added (regressions 4 and 5), while the impact of median wages becomes insignificant. The measure of labour market size is insignificant when taken by itself, but becomes significant and appears to have a dampening effect on inequality once control variables are included. In the full models (regressions 4 and 5) employment in the public sector is associated with lower levels of overall inequality, while employment in the mining sector and the level of part-time employment in a region is positively associated with inequality.

Table 5. Correlations Between Inequality Measures and Independent Variables.

	Gini	90 / 50 ratio	90 / 10 ratio	50 / 10 ratio
Labour market region size	0.07	-0.07	-0.09	-0.1
Median wage and salary	0.43***	0.43***	0.28**	0.08
Qualifications (%)	0.66***	0.41***	0.52***	0.48***
Peak Earners (%)	-0.14	-0.09	-0.25*	-0.32**
Migration (%)	0.32**	0.23*	0.2	0.09
Public sector (%)	-0.07	-0.2	-0.05	0.09
Mining sector (%)	0.18	0.47***	0.3**	0.12
Regional unemployment rate (%)	-0.32**	-0.3**	-0.27*	-0.2
Part-time employment rate (%)	-0.03	-0.11	0.00	0.12

Notes: ***p < 0.001; **p < 0.01; *p < 0.05; p < 0.1. Source: ATO sample unit record file 2013-14, ABS Census of Population and Housing 2011, authors' calculations.

Table 6. Inequality of Wage and Salary, Gini Measure, Regression Analysis.

	(1) Gini Wage and salary	(2) Gini wage and salary	(3) Gini Wage and salary	(4) Gini Wage and salary	(5) Gini Wage and salary
Median income	0.003**				0.000
Size		-0.001		-0.01**	-0.01**
Qualifications			0.13***	0.23***	0.22***
Peak Earners				-0.02	-0.02
Migration				-0.04	-0.04
Public Sector				-0.11**	-0.11*
Mining employment				0.42***	0.42***
Unemployment rate				0.005	0.01
Part time employment				0.20***	0.20**
P	0.44***	0.56***	0.42***	0.40***	0.40***
LMerr	0.39	1.95	8.39**	0.28	0.27
AIC	-357.77	-348.77	-391.17	-445.20	-443.20

Notes: ***p < 0.001; **p < 0.01; *p < 0.05; p < 0.1. LMerr is the Lagrange Multiplier error test, AIC is the Akaike Information Criteria. Source: ATO sample unit record file 2013-14, ABS Census of Population and Housing 2011, authors' calculations.

Table 7 presents the results of the three ratio measures for inequality of wage and salary. As with previous outcomes, the size of a labour market region is significant for the overall spread of wage and salary and for upper-tail inequality regardless of whether median wage is controlled for, and for lower-tail inequality before controlling for median wage. In all cases as the size of the labour market region increases, the measure of inequality declines. Of the three models where we include the median wage variable (models 2, 4 and 6), only the model for lower-tail inequality produces a significant result for median wage and salary, with a negative coefficient. The variable measuring the relationship between qualifications and inequality once again yields a strongly positive coefficient in each of the models. The variable 'peak earners' is significant with a negative coefficient in the model for lower-tail inequality that excludes median wage and salary (model 5). The significance of this variable disappears once median wage and salary is controlled for (model 6). Employment in the public sector is negatively related to the overall spread of wage and salary only when median wage and salary is not included in the model (model 1). The same variable is negatively associated with upper-tail inequality of wages and salaries in both the model that excludes median wage and salary, and in the model where mean wage salaries is controlled for. Employment in the mining sector maintains its strong positive relationship in all of the ratio measurement models. The level of part-time employment is positively related to the overall spread of wages and salaries and upper-level inequality whether or not median wage is included. However, it is significant for lower-level inequality only where the median wage and salary is not controlled for.

Table 7. Inequality of Wage and Salary, Ratio Measures, Regression Analysis.

	(1) 90/10 ratio wage and salary	(2) 90/10 ratio wage and salary	(3) 90/50 wage and salary	(4) 90/50 wage and salary	(5) 50/10 ratio wage and salary	(6) 50/10 ratio wage and salary
Size	-1.32***	-1.19***	-0.13***	-0.14***	-0.27*	-0.20.
Median Income		-0.17		0.01		-0.10**
Qualifications	13.90***	14.92***	1.33***	1.28***	3.14***	3.74***
Peak Earners	-16.26	-8.89	0.50	0.14	-6.83*	-2.37
Migration	-1.03	-0.04	-0.08	-0.13	-0.55	0.10
Public Sector	-7.38*	-5.15	-1.05***	-1.17***	-0.82	0.49
Mining employment	34.10***	38.25***	4.20***	4.01***	5.92***	8.50***
Unemployment rate	3.46	-9.55	0.08	0.72	1.31	-6.67
Part time employment	16.07***	12.58**	1.53***	1.70***	3.99**	2.03
ρ	0.25**	0.27**	0.40***	0.39***	0.18	0.17
LMerr	0.55	0.11	0.04	0.00	0.44	0.01
AIC	298.54	297.64	-107.38	-106.15	100.87	92.67

Notes: ***p < 0.001; **p < 0.01; *p < 0.05; p < 0.1. LMerr is the Lagrange Multiplier error test, AIC is the Akaike Information Criteria. Source: ATO sample unit record file 2013-14, ABS Census of Population and Housing 2011, authors' calculations.

6. DISCUSSION AND CONCLUSIONS

Using data from the Australian Taxation Office, combined with Australian Bureau of Statistics Census data, this paper has presented an analysis of wage and salary inequality across Australia's labour market regions. A snap-shot of the findings presented here suggest that while there is some difference depending on the measure of inequality used, the most unequal labour market regions tend to be those associated with mining industry activities or those labour markets located in the major metropolitan regions. Labour markets exhibiting the most even wage and salary distributions tend to be associated with those places that have been among Australia's rust-belt / employment vulnerable labour markets (Baum *et al.*, 2005). The former includes the capital city labour market regions of Perth-Inner, Sydney-City and Inner South and Melbourne Inner-East, together with the non-metropolitan regions including South Australia-Outback and Mackay. The latter include metropolitan labour market regions such as Sydney-Blacktown, Adelaide-North, and

Melbourne-west and non-metropolitan regions of Toowoomba, Riverina and Shepparton.

When considering the associations between the various measures of inequality and a range of control variables, it is clear, given the consistent significant regression coefficients, that formal qualifications are significantly linked to higher levels of inequality, as is employment in particular industries (mining) and jobs (part-time employment). However, against this there are also dampening effects on inequality associated with labour market region size and employment in public sector industries.

The findings do provide insight into several conventional regional studies issues—the impact of the most recent period of mining expansion on inequality, the impact that underemployment and poor labour market performance has on wage and salary outcomes, and the policies to raise the human capital of local regions.

Within the regional science literature as well as more general social-science output, there has been concern around the high wages and salaries paid in the mining sector and the potential damaging effects in terms of rising local or regional inequalities and socio-economic issues (IIED, 2002; Richardson, 2009; Rolfe *et al*., 2008). These concerns are reflected in the findings here whereby regions with higher levels of mining employment are prone to higher levels of inequality in wages and salaries. This holds true when inequality is measured by the Gini coefficient, and also when ratio comparisons are made reflecting the overall spread of wages and salaries, upper tail inequality and lower tail inequality.

Along with concerns around inequality in mining intensive regions, there has also been concern around the potential polarising impact of poor labour market performance and in particular the rise in precarious employment (part-time and casual) and associated low levels of pay (Ozich *et al*., 2016). While at the individual level, the link between precarious employment and wage inequalities is a concern, this concern is amplified once a regional or spatial perspective is considered. The research in this paper has shown that in regional areas with higher levels of precarious (part-time) employment there is more likely to be higher levels of wage and salary inequality. While this holds true across all of the measures used, it is especially noticeable when the overall spread of wage is considered (illustrated by the 90:10 ratio).

Finally, there is the question of the need to expand levels of human capital in order to encourage regional expansion and the potential that such policies may be at odds with socially inclusive growth. Several studies have pointed to the importance of human capital to regional development. However, as recently pointed out by Florida (2017) there may be a

downside to regions pushing for higher levels of human capital, especially if it acts, as suggested here, to increase levels of inequality.

While the results presented in this paper provide an interesting analysis, they do need to be interpreted within the context of several limits. The data used to measure inequality was obtained from the Australian Taxation Office's two per cent sample of individual taxation returns. As such, the measure of inequality developed in the paper may be slightly skewed as the taxation data does not include information on very low wage earners who do not pay tax. In addition, the analysis has focused exclusively on market wages and wages and salaries and does not take into account the impact of household size. As Greenville *et al*. (2013, p. 9) suggest, what one has at the end of the day counts in practical terms: "while market income (at the individual level) describes the distribution of wage arising from individuals' interaction with the economy, ultimately equivalised final household wage has the greatest impact on an individual's consumption and material living standards". These issues aside, the paper does make an interesting contribution to the growing regional science literature that details the changing nature of regional socio-economic outcomes.

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