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ABSTRACT

Public-Private Sector Wage Differentials in Australia[1]

This paper examines wage differentials between public sector and private sector workers in Australia. After controlling for observed characteristics and individual fixed effects, we show that on average workers in the public sector earn about 5.1% percent more hourly wages than those in the private sector. The wage premium is slightly higher for females than males. Using a panel data quantile regression model with fixed effects, we show that the positive wage effects of public sector employment are heterogeneous, with comparatively larger impact at the lower end of the wage distribution than at other parts. We also find evidence of heterogeneity in the public sector wage premiums by qualification, time period, occupation and state/territory.

JEL Classification: J31, J45
Keywords: public sector, private sector, wage gap

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1. Introduction

The public-private sector pay gap has been researched for many years, with a history that goes back to at least the early 1970s in America (Ehrenbergh and Smith, 1986). The topic has captured rising attention from researchers elsewhere during the last two decades (Poterba and Rueben, 1994; Borland *et al.*, 1998; Mueller, 1998; Blackaby et al., 1999; Melly, 2005; Lucifora and Meurs, 2006; Elliott et al.,2007; Christopoulou and Monastiriotis, 2013; Lausev, 2014; Nikolic, 2014). Four main findings show up regularly in prior studies: on average, public sector workers receive higher pay than private sector workers; this pay gap is larger for women than for men; the distribution of pay among public sector workers is more compressed than for the private sector and hence the pay gap in favour of public sector workers is highest for those lower down the pay distribution; the pay gap varies by geographical regions within nations.

These findings are all descriptive, but they are more than just empirical curiosities. Systematic differences between the public and private sectors in the remuneration of similarly productive people, potentially has both efficiency and equity consequences. If the public sector pays more, then its workers are receiving rents at the expense of the taxpayer. Alternatively, the higher public sector pay might attract employees who have higher unmeasured quality. This would be good for the provision of high standard public services, but it would make it harder for private firms to recruit and retain these high quality workers. This effect has been referred to as the public sector 'crowding out' private sector activities (Elliot et al., 2007). If the reverse is true, so that the constant quality pay gap favours the private sector, then the quality of public services is likely to suffer.

A number of studies find regional differences in the pay gap, such that it is higher in poorer parts of a country and lower or non-existent in richer areas. In unitary states in particular, public sector pay tends to be more uniform across geographical areas than private sector pay as the forces of pay equity within the public sector make their presence felt. Elliot et al., 2007 mention this effect, citing several examples of research on countries with large geographic differences (Garcia-Perez and Jimeno, 2007 for Spain, Heitmueller and Mavromaras, 2007 for Germany, and Dell'Aringa et al., 2007 for Italy). These regional differences in pay gap can aggravate regional economic divergence: private employers find it harder to recruit good employees in poorer regions where they face a large pay gap in favour of public sector work. In contrast, in the prosperous regions, there is little or a negative pay gap and the public sector can struggle to retain the quality of workforce that they seek. A propensity for public sector pay equality across sub-national regions will be at one level a force for more regional equality, both directly and through its influence on private sector pay. But it may also cause more unequal patterns of growth in output and employment and in that way contribute to both less efficiency and less equality. It is relevant when assessing any equity and efficiency implications across regions to note that the pay gap in favour the public sector is most pronounced for lower paid workers and for women. It is likely that this reflects both a greater union influence on public sector pay together with more effective adherence to rules that prohibit discrimination on the basis of sex. Ehrenbergh and Schwarz, 1986, among others, make this point.

These considerations are particularly important in the case of Australia, where a large proportion of the revenue from the Goods and Services Tax is redistributed annually by the Commonwealth Grants Commission, in order to enable comparable levels of public services for a comparable revenue-raising effort between the States and Territories.

A number of studies examine the public-private pay gap in Australia (Borland *et al.*,1998; Vella, 1993; Birch, 2006; Cai and Liu, 2011; Siminski, 2013). For the most part the findings of the Australian studies are similar to those above. However, there remain some contested facts. Borland *et al.*, 1998 find that full-time employees in the public sector earn about 10-15% (male) and 20-25% (female) more weekly earnings than their counterparts in the private sector. The later analysis by Siminski, 2013 concludes that the average premium is a much smaller 6% for women and statistically insignificant (4%) for men. Thus, even the existence and size of an average pay gap is not yet agreed for Australia. Several studies test whether any wage premium is explained by

the observed productivity characteristics of the different workforces, or the nature of the work that they do. Borland et al, 1998, conclude that the mean public-private earnings differentials can be fully explained by differences in individual characteristics and job characteristics between the two sectors, indicating that there is no public sector earnings premium in Australia. In contrast, Vella (1993) and Cai and Liu, 2011 find that a significant wage premium remains for women, but men have no (Vella 1993) or a negative (Cai and Liu, 2011) public sector premium once observable productivity characteristics are taken into account.

Several studies use quantile regression methods to see whether the public sector premium varies across the wage distribution, as has been found in other countries (i.e., is higher for lower paid workers). Birch, 2006 and Cai and Liu, 2011 both find this pattern and that it applies to both genders. However, they also find that higher paid men experience a public sector wage penalty compared with men with similar productivity characteristics who are employed in the private sector. Using a different approach, and one that focuses on skills rather than pay, Siminski, 2013 finds no evidence that the public sector wage premium varies with skill.

It is clear that for Australia, there are a number of interesting issues that are yet to be resolved about the public-private sector wage gap. These include some resolution of the conflicting findings that are reported in the existing literature, as set out above. In summary, these are a) what is the size of the raw wage gap; b) what is the size of the gap once the characteristics of the two different workforces are accounted for; c) at what point in the wage distribution does the public sector premium disappear and even become negative. We note that all the studies consider the male and female workforces separately and find significant gender differences.

This paper uses the best available data (HILDA) and the most contemporary econometric methods to offer a thoughtful resolution of the different findings of the prior literature. It is almost inevitable that studies that range from 1993 to 2013 will use different data and methods and conflicting findings will emerge because of this. The progress that has been made in econometric methods and in the availability of quality panel data for Australia means that it should be possible to produce more robust findings today than it was 20 or even 10 years ago.

Different conclusions about the key empirical questions can arise not just from different data and econometric method, but also from the way that many necessary practical data decisions are handled. One example is how pay is measured. Is it annual or hourly earnings (the latter needing to be estimated from weekly hours and earnings data)? Is it confined just to full-time permanent workers, or does it include people on contract or casual terms? Are systematic differences in job security, superannuation, leave entitlements and so on taken into account? In our analysis we make careful judgements about how best to measure the variables that we use, given the data possibilities. But we acknowledge that other reasonable decisions could be made in some cases, and that these might affect the results.

Using data from the 14 waves (2001-2014) of the longitudinal Household, Income and Labour Dynamics in Australia (HILDA) Survey, this paper investigates empirically the wage differentials between the public sector and the private sector in Australia. This paper is similar to Birch, 2006 and Cai and Liu, 2011 in the sense that we all focus on the sectoral wage effects over the full wage distribution. However, unlike Birch, 2006 and Cai and Liu, 2011, we utilise the panel aspects of the HILDA data, which allows us to deal with the correlation between sector choice and unobserved heterogeneity by controlling for individual fixed effects. This aspect of our contribution is important particularly as it enhances our ability to provide our results with a causal interpretation. Specifically, we employ both the widely used fixed effects (FE) panel approach and a panel data quantile regression model with fixed effects (QR-FE) recently developed by Canay, 2011.

Our OLS estimates indicate that on average public sector employees earn 7.4% more hourly wages than those in the private sector. FE estimates also show that working in the public sector confers a wage premium, which is smaller than the OLS estimates in terms of magnitude, especially for women. This suggests that ignoring unobserved heterogeneity overstates the public sector wage premium. On average, FE panel estimation shows that public sector employment

offers a wage premium in the magnitude of 5.1%. Women employed in the public sector earn 5.5% more wages than their counterparts in the private sector, which is slightly higher than the rate for males (4.6%).

We also estimate the sectoral wage effects using conventional quantile regression (QR) and quantile regression with fixed effects (QR-FE). As opposed to the average case, the QR-FE estimates show that the positive wage effects of public sector employment are heterogeneous, with a larger impact at the lower end of the wage distribution. For example, working in the public sector has over double the positive impact at the 10th percentile of the wage distribution than at the 90th. Similar to Birch, 2006 and Cai and Liu, 2011, the QR results at the 90th percentile also show that employment in the public sector has a negative impact on the wages of high-paid male workers. However, after accounting for the individual unobserved fixed effects, the QR-FE estimates show that public sector employment has a positive effect at the 90th percentile of the male workers' wage distribution. The comparison between the QR and QR-FE estimates for males at the 90th percentile indicates that highly-paid employees in the private sector have better unobserved characteristics, such as, for example, individual ability that is not recorded in the data, than their counterparts in the public sector. This is an aspect that has not been taken into account in the cross sectional modelling by Birch, 2006 and Cai and Liu, 2011. In addition, the extent of heterogeneity in public sector premiums seems larger for males than for females. We also find evidence of heterogeneity in public sector wage premiums by qualification, occupation, time period and state/territory.

The remaining paper is organised as follows. Section 2 describes the data and presents summary statistics. Section 3 discusses the empirical approach. Section 4 presents the estimation results and Section 5 concludes.

2. Data and descriptive statistics

2.1. Data and variables

HILDA is the first and only large-scale, nationally representative household panel survey in Australia. Starting from 2001, HILDA annually collects rich information on people's demographics, labour market outcome, life event, health and well-being. In this study, we use the 14 waves of HILDA from 2001 to 2014.

Individuals reported to work for six different types of employers in HILDA: (i) private sector "for profit" organisation; (ii) government business enterprise or commercial statutory authority; (iii) other commercial; (iv) private sector "not-for-profit" organisation; (v) other government organisation, such as a public service department, local councils, schools and universities; (vi) other non-commercial. We consider (i) and (iv) as the private sector, and (ii) and (v) as the public sector. Those reporting employers to be (iii) or (vi), which only account for around 0.6% of observations, are dropped due to the insufficient information to make the distinction between the public and private sectors. We focus on employees aged between 21 and 65, and we drop observations with missing information on core variables (summarised in Table 1). Our final sample consists of 88,610 observations for 16,624 persons.

Descriptive statistics by sector are reported in Table 1. Among the 88,610 observations, 28% (=24,911/88,610) are public sector employees and 72% (=63,699/88,610) are working in the private sector. Wages are obtained through dividing weekly earnings by weekly working hours. To enhance their comparability across waves, wages are converted to 2014 Australian dollars using national consumer price indexes. Table 1 shows that public sector workers earn about 18% (=3.47-3.29) more hourly wages than those working in the private sector. When compared with private sector workers, public sector workers are older and less likely to be a male. They are also better educated. For example, 49% of public sector workers have a university degree while the rate is only 24% in the private sector. In addition, public sector employees are six percentage points more likely to be legally married or in a de facto relationship.

Table 1: Summary statistics

	All		Public		Private	
	Mean	SD	Mean	SD	Mean	SD
Hourly wage (in 2014 AUD)	31.54	21.83	35.01	19.19	30.18	22.63
Log hourly wage	3.34	0.46	3.47	0.41	3.29	0.47
Age	39.56	11.62	42.20	11.05	38.53	11.68
Male	0.50	0.50	0.41	0.49	0.54	0.50
Education						
Year 12 or below	0.36	0.48	0.23	0.42	0.41	0.49
Certificate/diploma	0.33	0.47	0.28	0.45	0.35	0.48
University degree	0.31	0.46	0.49	0.50	0.24	0.43
Married	0.70	0.46	0.74	0.44	0.68	0.47
Long-term health condition	0.16	0.36	0.17	0.37	0.15	0.36
Born overseas	0.21	0.40	0.18	0.39	0.21	0.41
Living in a major city	0.66	0.47	0.64	0.48	0.67	0.47
Occupation						
Managers	0.11	0.32	0.09	0.28	0.13	0.33
Professionals	0.26	0.44	0.46	0.50	0.19	0.39
Technicians and trades workers	0.12	0.33	0.06	0.24	0.15	0.35
Community and personal service work	0.11	0.31	0.15	0.36	0.09	0.28
Clerical and administrative workers	0.17	0.37	0.17	0.38	0.17	0.37
Sales workers	0.07	0.26	0.01	0.09	0.10	0.30
Machinery operators and drivers	0.07	0.25	0.02	0.16	0.08	0.28
Labourers	0.09	0.28	0.04	0.19	0.10	0.31
State of residence						
New South Wales (NSW)	0.29	0.46	0.29	0.45	0.29	0.46
Victoria (VIC)	0.25	0.43	0.23	0.42	0.26	0.44
Queensland (QLD)	0.21	0.41	0.20	0.40	0.22	0.41
South Australia (SA)	0.09	0.28	0.09	0.28	0.09	0.28
Western Australia (WA)	0.09	0.29	0.08	0.28	0.09	0.29
Tasmania (TAS)	0.03	0.17	0.03	0.18	0.03	0.17
Northern Territory (NT)	0.01	0.10	0.02	0.13	0.01	0.09
Australian Capital Territory (ACT)	0.02	0.15	0.05	0.22	0.01	0.11
Observations	*88,610*		*24,911*		*63,699*	

Note: Data Source: HILDA 2001–2014.

Table 2 reports the public-private sector log wage gap by gender and state/territory. On average, males earn about 17% more hourly wages in the public sector than in the private sector, while women earn 23% more in the public sector. In terms of states/territories, the public-private sector wage differentials are much higher in Tasmania, Northern Territory and the Australian Capital Territory than in New South Wales, Queensland and South Australia. Victoria and Western Australia have the lowest public-private sector wage gaps among the eight Australian states/territories.

Table 2: Public-private sector log wage gap by gender and state/territory

	Australia	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
All	0.18	0.19	0.13	0.18	0.19	0.15	0.27	0.28	0.25
Male	0.17	0.15	0.12	0.17	0.18	0.13	0.26	0.33	0.24
Female	0.23	0.26	0.18	0.23	0.23	0.22	0.30	0.27	0.27

2.2. Raw distributional wage differential between the public sector and the private sector

Table 1 shows that the average wage gap is 18% between the public sector and the private sector. To describe the distributional differences in sectoral wage distributions, we present the kernel density estimates of logarithmic hourly wages by gender in Figure 1, which allow us to contrast wage distributions between the two sectors. The two-sample Kolmogorov-Smirnov test strongly rejects the null hypothesis at conventional significance levels that the log hourly wages in the two sectors come from the same distribution for each gender.

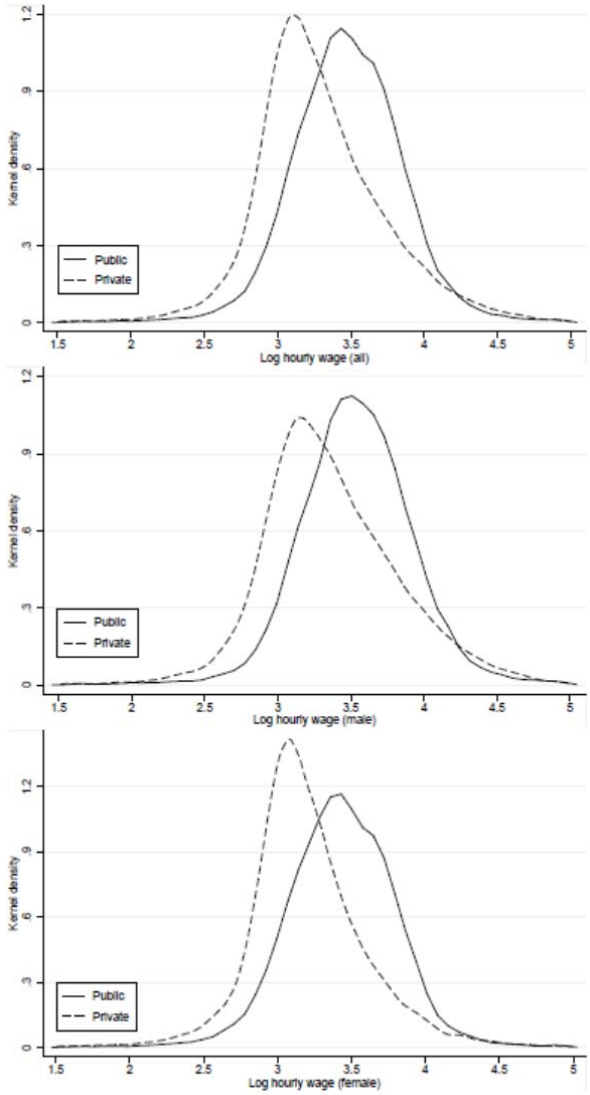

Figure 1: Kernel density estimates of log hourly wages

To give a clearer picture of distributional wage gaps between the two sectors, we plot the raw log wage differential at each percentile in Figure 2. For example, at the 10th percentile, we see a log wage gap of 0.200, which means that the wage at the 10th percentile of the distribution in the public sector is 20% higher than that at the same percentile of wage distribution in the private sector. The log wage gap between the public sector and the private sector is found to be uneven throughout the wage distribution. It increases slowly from the bottom end to the 40th percentile, and then remains relatively stable between the 40th and 60th percentile. The wage gap declines rapidly from the 60th percentile to the top end. Comparing distributional patterns between males

and females, we find that the public-private sector wage gaps are higher for males than for females before the 40th percentile. However, from the 40th to the top percentiles, the sectoral wage gaps are much larger for females. These observations indicate the gender differences in distributional sectoral wage differentials in Australia[2].

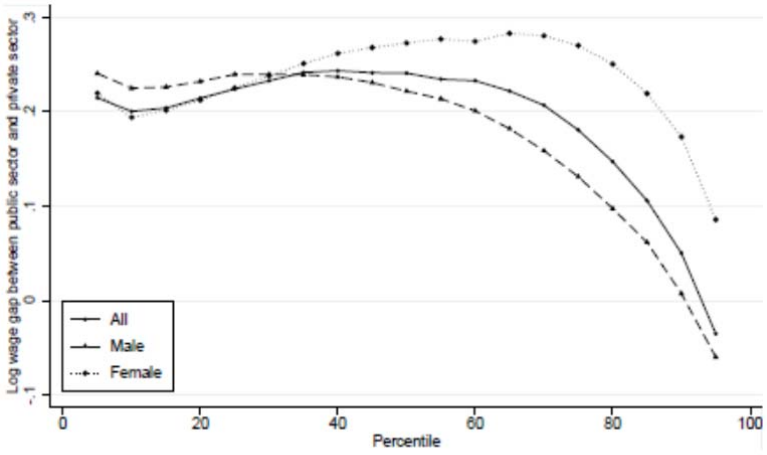

Figure 2: Public–private sector log hourly wage gap by percentile

3. Empirical approach

We assume that wages can be described by the following equation

$$Logwage_{it} = Public_{it}\beta + X_{it}^{'}\gamma + u_i + \varepsilon_{it} \quad (1)$$

where $Logwage_{it}$ denotes logarithmic hourly wages. $Public_{it}$ is the core variable of interest, which is a binary variable equal to one if an individual is employed in the public sector and zero otherwise. X_{it} is a vector of control variables. u_i denotes the unobserved individual heterogeneity, and ε_{it} is the idiosyncratic error term. The coefficient of $Public_{it}$, β, measures the average effect of working in the public sector on hourly wages. We estimate equation (1) using fixed effects (FE) panel estimation, which has an advantage over OLS estimation in dealing with the bias due to unobserved heterogeneity u_i.

To investigate the heterogeneity in the impact of working in the public sector on the full wage distribution, we utilise the panel data quantile regression model with fixed effects (QR-FE) developed by Canay, 2011. The approach considers and models individual fixed effects as location shift variables. Canay, 2011 shows that the QR-FE approach can be implemented using the following two-stage estimation method.

First, estimate equation (1) with FE panel regression to obtain consistent estimates of coefficients, and then calculate the unobserved fixed effect for each individual as

$$\hat{u}_i = \frac{1}{T}\sum_{t=1}^{T}\left(Logwage_{it} - Public_{it}\hat{\beta} - X_{it}^{'}\hat{\gamma}\right) \quad (2)$$

Second, estimate the conditional quantile regression model of Koenker and Bassett (1978), using $\widehat{Logwage}_{it} = Logwage_{it} - \hat{u}_i$ as the dependent variable. Namely, we solve the following minimization problem:

[2] In the next section, we discuss a panel data quantile regression model with fixed effects, which allows us to examine the impact of public sector employment on the conditional quantiles of the wage distribution. We note that Figure 2 only shows the unconditional distributional wage gaps between the two sectors, and is only used by the paper to motivate the subsequent investigation of the public sector wage premiums across the conditional wage distribution.

$$\left(\hat{\beta}_\tau, \hat{\gamma}_\tau\right) = \underset{\left(\hat{\beta}_\tau, \hat{\gamma}_\tau\right)}{\operatorname{argmin}} \frac{1}{NT} \sum_{i=1}^{N} \sum_{t=1}^{T} \left(\rho_\tau \left(\widehat{Logwage}_{it} - Public_{it}\beta_\tau - X_{it}^{'}\gamma_\tau \right) \right) \tag{3}$$

where $\rho_\tau(u) = u\left[\tau - I(u<0)\right]$ and I is an indicator function. The estimated coefficient $\hat{\beta}_\tau$ measures the effect of public sector employment on the τ^{th} percentile of the hourly wage distribution.

The conventional approach to tackling this optimisation problem is to use mean or quantile decomposition methods to disentangle the raw public-private sector wage gaps into its two components. These are first, the composition component attributed to the differences in observed characteristics between the two sectors; and second, the coefficient component attributed to the differential returns to observed characteristics (see for example, Cai and Liu 2011). This paper uses a computationally simpler method proposed by Fortin (2008) to reach the same decomposition outcome. Fortin (2008) explains that the coefficient of the public sector dummy in a wage regression using the pooled (public and private) sample, is equivalent to the coefficient effect in a mean decomposition which uses the estimates from the pooled regression as the reference wage structure.

In addition, our paper notes that decomposition methods have in the past ignored the endogeneity of sector selection and wage gaps that are due to unobservables such as individual ability, which then would be (mistakenly) attributed to the coefficient effect. Thus the FE and QR-FE estimations in this paper, do not only offer the coefficient of the public sector dummy as an estimate that is equivalent to the coefficient effect in a decomposition analysis, but they also control for the endogeneity due to time-invariant unobservables, such as differences in ability and tastes.[3]

We note that the conventional quantile regression (QR) approach and the quantile regression model with fixed effects (QR-FE) only allow us to examine the effects of public sector employment on the conditional wage distribution. Namely, all quantile estimates obtained are conditional on the control variables used. Ideally, one would rather be able to produce estimates on the unconditional distribution of wages. However, the present state-of-the-art econometric toolkit does not provide a method that can conduct fixed effects estimation on the unconditional distribution of the dependent variable. Our paper uses the best possible alternative approach developed by Canay, 2011. The approach of Canay, 2011 has been used in severalrecent studies investigating between-group wage gaps. Campos and Centeno, 2012 examined the public-private wage gaps using data from the European Community Household Panel that covers EU-15 countries. They found evidence of a positive wage gap among low wage earners in several countries, mostly arising from a positive selection effect. At the higher end of the wage distribution, they showed a significant decrease in the premium and, in several cases, penalties associated with public employment. Similar findings were reported in Hospido and Moral-Benito, 2016, who also employ Canay's 2011 method to examine the public sector wage premium in Spain, using longitudinal administrative data. This study finds substantial variation in the public premium along the wage distribution once observed characteristics are accounted for. After controlling for unobserved individual heterogeneity, this study observes positive selection into the public sector at the bottom of the wage distribution and negative selection at the top end.

Bargain and Kwenda, 2014 used Canay's 2011 method to estimate the informal-formal sector pay gap throughout the conditional wage distribution using panel data from Brazil, Mexico, and South Africa, controlling for time-invariant unobservables. They found consistent results for all

[3] We note that the empirical approach we assume does not address fully and directly any remaining sector or similar type of sample selection issues. Accounting fully for sample selection in the present context, would require finding an appropriate exclusion restriction that affects labour force participation decisions but not wages. It is generally difficult to find such a variable in labour market data, and we are of the view that a satisfactory exclusion restriction cannot be found in our data. This is a view that has also been argued elsewhere in the literature (see for example Siminski 2013). Further, to the best of our knowledge, there is no econometric method available that would allow us to estimate a fixed effects quantile regression model, which also address the sample selection problem.

three countries, that the wage penalty from being in the informal sector is larger in the lower part of the conditional distribution and tends to disappear at the top. Furthermore, Nordman et al., 2016 also focussed on the earnings gaps between formal and informal sector workers, using panel data from Madagascar. Their study found a systematic premium at all points of the distribution of formal self-employed workers over their informal counterparts, with comparatively larger premia at the lower end.[4] These contributions show that in spite of a potential cost in terms of interpretability of the results due to the reliance on conditional estimates, it is crucial that our methodology allows adequate control of individual unobserved heterogeneity. As it stands, the Canay, 2011 method is the most contemporary technique compatible with this aim in our effort to provide estimates along the wage distribution.

4. Results

4.1. Mean regression results

Table 3 reports the pooled OLS and FE panel estimates of β in equation (1), with standard errors clustered at the individual level.[5] Consistently with the literature, we include the following control variables: age, age squared, education dummies (year 12 or below, certificate/diploma, university degree), a marital status dummy, a binary variable indicating the presence of a long-term health condition, whether born overseas, a dummy variable indicating whether living in a major city or not and a set of occupation dummies (summarised in Table 1). State of residence dummies and year dummies are also included.

Table 3: Mean public sector wage premiums

	All	Male	Female
OLS	0.074***	0.047***	0.098***
	(0.006)	(0.011)	(0.007)
FE	0.051***	0.046***	0.055***
	(0.007)	(0.011)	(0.008)
Observations	*88,610*	*44,482*	*44,128*

Note: Standard errors clustered at the individual level are reported in parentheses. *** $p<0.01$.

OLS estimates indicate that on average public sector employees earn 7.4% higher hourly wages than those in the private sector, which accounts for about 41% (=0.074/0.18) of the raw wage gap between the public sector and the private sector in Australia.[6] Consistent with Borland and Gregory (1999), the public sector wage premium appears higher among females than among males (9.8% against 4.7%). FE estimates continue to show that working in the public sector confers a wage premium, however, of a smaller magnitude than OLS estimates, especially for the pooled sample and for women. This suggests that ignoring unobserved heterogeneity overstates the public sector wage premium. On average, women with the same measured productivity characteristics earn 5.5% higher wages in the public sector than women in the private sector, and this difference is slightly higher than the difference we find for males (4.6%).

[4] Canay, (2011) method has been applied with success more widely in the economics literature. It was used to examine the impact of the Teach for America Program on the distribution of student achievement by Antecol et al., 2013, the heterogeneous effects on subjective well-being of unemployment by Binder and Coad, 2015, crime victimisation by Mahuteau and Zhu, 2016, and working in non-profit organisations by Binder, 2016.

[5] Full regression results are available upon request.

[6] When explanatory variables are not controlled for, the OLS estimates are 0.183, 0.167 and 0.232 for all, men and women, respectively. The FE estimates when not using control variables are 0.078, 0.079 and 0.078, respectively. These estimates are all statistically significant at the 1% level.

4.2. Quantile regression results

Table 4 displays the results obtained using conventional quantile regression (QR) for cross sectional data (which does not control for unobserved individual heterogeneity) and the results obtained using quantile regression with fixed effects (QR-FE) at the 10th, 25th, 50th, 75th and 90th percentiles of the hourly wage distribution. Comparing the QR results and the QR-FE results, we find that ignoring the unobserved individual fixed effects overstates the public sector positive wage premium at the lower half of the wage distribution.

Table 4: Public sector wage premiums across the wage distribution

	QR			QR–FE		
	All	Male	Female	All	Male	Female
Q10	0.136***	0.142***	0.132***	0.069***	0.080***	0.060***
	(0.008)	(0.012)	(0.009)	(0.004)	(0.006)	(0.006)
Q25	0.129***	0.124***	0.134***	0.064***	0.067***	0.063***
	(0.005)	(0.009)	(0.007)	(0.002)	(0.004)	(0.003)
Q50	0.104***	0.083***	0.115***	0.053***	0.053***	0.053***
	(0.005)	(0.009)	(0.006)	(0.001)	(0.002)	(0.001)
Q75	0.050***	–0.006	0.087***	0.045***	0.042***	0.047***
	(0.007)	(0.011)	(0.008)	(0.002)	(0.004)	(0.003)
Q90	–0.009	–0.090***	0.050***	0.024***	0.018***	0.032***
	(0.009)	(0.017)	(0.011)	(0.004)	(0.006)	(0.005)
Observations	*88,610*	*44,482*	*44,128*	*88,610*	*44,482*	*44,128*

Note: Standard errors clustered at the individual level are reported in parentheses. *** $p<0.01$.

When contrasted with the FE model that estimates the average premium over the whole wage distribution, the QR-FE estimates show that the positive public sector wage premium varies across the wage distribution, with a larger premium at the lower end of the wage distribution and a hardly discernible premium at the higher end of the wage distribution.[7] Clearly, public sector employment most strongly benefits the lower wage earners.

Our results suggest that a focus on the average public sector premium conceals a sizeable distributional heterogeneity. More specifically, we show that the heterogeneity in public sector premiums is larger for males than for females, when using *Q90-Q10* as our measure. Similar to Birch, 2006 and Cai and Liu, 2011, our QR results at the 90th percentile show that employment in the public sector attracts a negative wage premium for the highest paid male workers. However, after accounting for individual unobserved fixed effects, the QR-FE estimates show that public sector employment attracts a positive wage premium at the 90th percentile of the male workers wage distribution. A comparison between the QR and the QR-FE estimates at the 90th percentile indicates that highly-paid employees in the private sector have better unobserved characteristics than their public sector counterparts.

4.3. Subgroup analyses

4.3.1. By qualification

Table 5 displays the public sector wage premium by three categories of highest achieved qualification (year 12 or below, certificate/diploma, university degree). The average premium is at its highest among those with a certificate or diploma qualification, and at its lowest among those with a university degree. On average, women with certificates and diplomas benefit more than men from working in the public sector, presumably because of their higher paid jobs in the female dominated health sector is compared with the lower paid male jobs in the trades.

[7] We note that the interpretation of the Fixed Effects estimates is reliant on the identification that has been achieved through those who switched sectors within the given sampling frame.

Table 5: Public sector wage premiums by qualification (FE and QR–FE estimates)

	Year 12 or below			Certificate/diploma			University degree		
	All	Male	Female	All	Male	Female	All	Male	Female
Mean	0.053***	0.052**	0.054***	0.068***	0.058***	0.075***	0.028***	0.025	0.031**
	(0.012)	(0.021)	(0.014)	(0.012)	(0.016)	(0.017)	(0.011)	(0.018)	(0.013)
Q10	0.058***	0.063***	0.063***	0.078***	0.089***	0.062***	0.071***	0.081***	0.057***
	(0.009)	(0.017)	(0.009)	(0.008)	(0.009)	(0.011)	(0.007)	(0.011)	(0.009)
Q25	0.060***	0.059***	0.062***	0.070***	0.069***	0.071***	0.064***	0.066***	0.061***
	(0.004)	(0.006)	(0.005)	(0.004)	(0.005)	(0.006)	(0.004)	(0.006)	(0.005)
Q50	0.055***	0.054***	0.057***	0.054***	0.054***	0.054***	0.048***	0.044***	0.050***
	(0.002)	(0.004)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.004)	(0.003)
Q75	0.052***	0.049***	0.054***	0.049***	0.046***	0.055***	0.031***	0.026***	0.037***
	(0.004)	(0.007)	(0.005)	(0.004)	(0.005)	(0.006)	(0.004)	(0.006)	(0.004)
Q90	0.032***	0.019**	0.041**	0.036***	0.030***	0.047***	0.007	0.006	0.014*
	(0.007)	(0.010)	(0.009)	(0.008)	(0.011)	(0.011)	(0.007)	(0.013)	(0.008)
Observations	*31,699*	*15,218*	*16,481*	*29,490*	*17,216*	*12,274*	*27,421*	*12,048*	*15,373*

Note: Standard errors clustered at the individual level are reported in parentheses. * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Quantile regression estimates suggest that, at the lower end of the wage distribution, males with post-school qualifications benefit more from public sector employment than their female counterparts. In contrast, at the higher end of the wage distribution it is females with post school education who benefit more than their male counterparts. This is an interesting picture where low paid public sector jobs appear to be favouring post-school educated men and high paid public sector jobs appear to be favouring women in general.

4.3.2. By time period

An examination of pay during the period covered by this paper (2001-2014) would be incomplete without looking at the potential role of the 2008 global financial crisis (GFC) in shaping pay changes in the private and public sector. Public sector wages can be expected to respond to change in the national economic conditions slower than private sector wages. Without entering the contested interpretation of the causal impacts of the Australian policy response to the GFC, we note that Australia implemented a robust and early financial stimulus, experienced a sharp drop of the exchange rate of the AU$ against the US$, left national minimum wages unchanged for a period of two years and experienced an economic slow-down but not a recession.

Table 6: Public sector wage premiums by time period (QR and QR–FE estimates)

	2001–2007			2008–2014		
	All	Male	Female	All	Male	Female
Mean	0.039***	0.050***	0.032***	0.055***	0.058***	0.053***
	(0.010)	(0.017)	(0.012)	(0.010)	(0.016)	(0.012)
Q10	0.059***	0.068***	0.049***	0.072***	0.085***	0.067***
	(0.007)	(0.011)	(0.009)	(0.006)	(0.008)	(0.008)
Q25	0.060***	0.068***	0.052***	0.065***	0.062***	0.070***
	(0.004)	(0.006)	(0.005)	(0.003)	(0.004)	(0.005)
Q50	0.050***	0.051***	0.046***	0.057***	0.051***	0.061***
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Q75	0.040***	0.040***	0.037***	0.048***	0.044***	0.052***
	(0.003)	(0.005)	(0.005)	(0.003)	(0.004)	(0.004)
Q90	0.023***	0.028***	0.019**	0.028***	0.017**	0.039***
	(0.005)	(0.008)	(0.008)	(0.006)	(0.008)	(0.007)
Observations	*39,095*	*19,721*	*19,314*	*49,575*	*24,761*	*24,814*

Note: Standard errors clustered at the individual level are reported in parentheses. ** $p<0.05$; *** $p<0.01$.

Table 6 shows the estimation results for the two periods with distinctly different macroeconomic circumstances, the pre-GFC 2001-2007 and the GFC and post-GFC 2008-2014. We conducted separate regressions for HILDA waves 1-7 and 8-14. We find that the public sector wage premium was higher in 2008-2014 than in 2001-2007, more so for women. We speculate that the GFC influenced pay more severely in the private sector, thus giving the public sector an additional wage advantage during 2008-2014. The wage premium estimates remain heterogeneous in both time periods, with a relatively larger premium increase in 2008-2014 among all low wage earners and also a large premium increase in 2008-2014 for female high wage earners set against a decrease for male high wage earners. This result builds on the earlier observation (see discussion of Table 5) of gender differences at the higher end of the wage distribution in favour of female public sector employees.

4.3.3. By occupation

Table 7 reports the public sector wage premiums for different types of work. According to the Australian and New Zealand Standard Classification of Occupations (ANZSCO), there are eight one-digit level occupations in the HILDA data: (i) managers; (ii) professionals; (iii) technicians and trades workers; (iv) community and personal service workers; (v) clerical and administrative workers; (vi) sales workers; (vii) machinery operators and drivers; and (viii) labourers. FE estimates and QR-FE estimates at the 10th, 50th and 90th percentiles of the wage distribution are reported for each occupation.

Table 7: Public sector wage premiums by occupation (FE and QR–FE estimates)

		(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
All	Mean	0.025	0.038***	0.005	0.057***	0.048**	0.096**	–0.047	0.053*
		(0.030)	(0.012)	(0.022)	(0.018)	(0.013)	(0.042)	(0.043)	(0.031)
	Q10	0.092***	0.066***	0.054***	0.078***	0.075***	0.095***	0.024	0.086***
		(0.014)	(0.008)	(0.004)	(0.014)	(0.009)	(0.028)	(0.027)	(0.020)
	Q50	0.058***	0.049***	0.053***	0.054***	0.058***	0.083***	0.034***	0.042***
		(0.005)	(0.002)	(0.004)	(0.003)	(0.003)	(0.011)	(0.007)	(0.006)
	Q90	0.003	0.020***	0.014	0.037***	0.046***	0.069***	0.007	–0.010
		(0.010)	(0.007)	(0.014)	(0.012)	(0.007)	(0.023)	(0.016)	(0.017)
Observations		*10,153*	*23,263*	*10,892*	*9,457*	*14,888*	*6,480*	*5,880*	*7,597*
Male	Mean	–0.016	0.047***	0.011	0.080**	0.121***	–0.097	–0.058	–0.000
		(0.047)	(0.021)	(0.022)	(0.037)	(0.029)	(0.096)	(0.044)	(0.037)
	Q10	0.086***	0.090***	0.056***	0.091***	0.083***	–0.044	0.043*	0.061**
		(0.020)	(0.011)	(0.012)	(0.023)	(0.015)	(0.059)	(0.022)	(0.027)
	Q50	0.053***	0.051***	0.052***	0.050***	0.060***	0.059**	0.035***	0.031***
		(0.007)	(0.004)	(0.005)	(0.006)	(0.005)	(0.025)	(0.007)	(0.008)
	Q90	0.018	0.021*	0.011	0.037*	0.052***	0.067**	–0.001	–0.022
		(0.019)	(0.011)	(0.014)	(0.021)	(0.014)	(0.031)	(0.019)	(0.024)
Observations		*6,464*	*9,808*	*9,134*	*2,940*	*3,895*	*2,288*	*5,364*	*4,589*
Female	Mean	0.074**	0.034**	–0.063	0.051***	0.033**	0.170***	0.019	0.115**
		(0.032)	(0.014)	(0.060)	(0.020)	(0.015)	(0.034)	(0.114)	(0.047)
	Q10	0.109***	0.039***	0.046	0.065***	0.060***	0.128***	0.013	0.123***
		(0.018)	(0.009)	(0.041)	(0.018)	(0.010)	(0.036)	(0.102)	(0.028)
	Q50	0.069***	0.046***	0.051***	0.054***	0.058***	0.090***	0.038	0.051***
		(0.008)	(0.003)	(0.011)	(0.004)	(0.003)	(0.011)	(0.037)	(0.009)
	Q90	0.003	0.023**	0.010	0.039**	0.043***	0.108***	0.043	0.022
		(0.013)	(0.010)	(0.022)	(0.015)	(0.008)	(0.038)	(0.083)	(0.024)
Observations		*3,689*	*13,455*	*1,758*	*6,517*	*10,993*	*4,192*	*516*	*3,008*

Note: Standard errors clustered at the individual level are reported in parentheses. * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Occupations: (i) managers; (ii) professionals; (iii) technicians and trades workers; (iv) community and personal service workers; (v) clerical and administrative workers; (vi) sales workers; (vii) machinery operators and drivers; (viii) labourers.

The FE estimates for males show that on average there are public sector wage premiums among professionals (4.7%), technicians and trades workers (8.0%), and clerical and administrative workers (12.1%). For females, a larger number of occupations provide public sector premiums, including managers (7.4%), professionals (3.4%), community and personal service workers (5.1%), clerical and administrative workers (3.3%), sales workers (17.0%), and labourers (11.5%). The QR-FE estimates by occupation suggest that the wage premiums from employment in the public sector are heterogeneous within most occupations considered, being larger at the lower end of the wage distribution than at other parts.

4.4. By state/territory

The difference in the premium by state/territory is of central policy interest in Australia as the Federal Government is tasked to use fiscal transfers to safeguard similar levels of public services across the whole of the Commonwealth. Several mechanisms are used to this purpose, a critical one being the Commonwealth Grants Commission, which redistributes annually a considerable part of the revenue generated by the Goods and Services Tax from the wealthier to the less wealthy parts of Australia.

Table 8 presents both FE and QR-FE estimation results by state/territory and by gender. The mean public sector premium estimated by FE is at its highest in South Australia (SA) and Tasmania (TAS), which also happen to be the relatively poorer of all Australian states. The premium is lower, but still statistically significant, in New South Wales (NSW), Victoria (VIC), Queensland (QLD) and Western Australia (WA). We do not find a statistically significant mean public sector premium in the Northern Territory (NT) and the Australian Capital Territory (ACT), but this could also be due to the much smaller sample sizes in the NT and the ACT. Looking at the gender results, we find that in NSW on average working in the public sector brings statistically significant higher wages to men than working in the private sector (8.2%). We find no evidence of a mean public sector wage premium for men in the other seven states/territories. In contrast, we find statistically significant mean public sector premiums for women in NSW, VIC, QLD, SA, WA and TAS, but not in NT and ACT. On the whole, this result suggests that (with the exception of NSW), the public sector premium is exclusively driven by female employment throughout Australia. But quantile regressions conducted separately for men and women show this suggestion to be an oversimplification of reality. Consistent with results in Tables 4-6, the distributional patterns estimated by QR-FE at Q10, Q50 and Q90 and presented in Table 8, generally indicate a larger overall public sector wage premium at Q10 (the lower part of the wage distribution), which is also stronger for men than for women in most states. Results in the same table also indicate a smaller public sector wage premium at Q90 (the higher part of the wage distribution), also much more so for men than for women: it is only one of the six states that produces a statistically significant public sector premium result at Q90 for high pay men (NSW), as compared with four states (NSW, VIC, QLD, and SA) for high pay women.

Table 8: Public sector wage premiums by state/territory (FE and QR–FE estimates)

		NSW	VIC	QLD	SA	WA	TAS	NT	ACT
All	Mean	0.063***	0.024*	0.041***	0.093***	0.047**	0.105***	0.025	0.021
		(0.013)	(0.013)	(0.014)	(0.022)	(0.023)	(0.033)	(0.052)	(0.043)
	Q10	0.072***	0.067***	0.042***	0.104***	0.081***	0.095***	0.081**	0.079***
		(0.008)	(0.009)	(0.009)	(0.014)	(0.015)	(0.025)	(0.036)	(0.029)
	Q50	0.055***	0.050***	0.054***	0.053***	0.050***	0.063***	0.052***	0.059***
		(0.002)	(0.003)	(0.003)	(0.004)	(0.005)	(0.008)	(0.017)	(0.012)
	Q90	0.031***	0.022***	0.022***	0.030**	0.021	0.037	0.020	−0.011
		(0.007)	(0.008)	(0.009)	(0.012)	(0.014)	(0.026)	(0.030)	(0.028)
Observations		*26,034*	*22,399*	*18,774*	*7,077*	*7,956*	*2,721*	*867*	*2,152*
Male	Mean	0.082***	0.014	0.025	0.045	0.020	0.105	0.021	0.035
		(0.021)	(0.025)	(0.020)	(0.036)	(0.041)	(0.066)	(0.060)	(0.064)
	Q10	0.090***	0.071***	0.055***	0.117***	0.093***	0.114***	0.157***	0.114**
		(0.012)	(0.013)	(0.013)	(0.014)	(0.027)	(0.034)	(0.056)	(0.064)
	Q50	0.057***	0.047***	0.053***	0.046***	0.049***	0.063***	0.064**	0.052**
		(0.003)	(0.004)	(0.005)	(0.007)	(0.009)	(0.013)	(0.027)	(0.021)
	Q90	0.036***	0.023	0.013	0.002	0.017	0.011	0.070*	−0.038
		(0.011)	(0.015)	(0.012)	(0.018)	(0.011)	(0.035)	(0.042)	(0.035)
Observations		*13,094*	*11,013*	*9,515*	*3,872*	*4,130*	*1,291*	*428*	*1,139*
Female	Mean	0.050***	0.031**	0.054***	0.116***	0.065**	0.111***	0.024	0.048
		(0.015)	(0.015)	(0.020)	(0.025)	(0.029)	(0.039)	(0.077)	(0.052)
	Q10	0.062***	0.065***	0.033***	0.094***	0.069***	0.119***	−0.009	0.030
		(0.011)	(0.013)	(0.012)	(0.019)	(0.019)	(0.031)	(0.139)	(0.037)
	Q50	0.054***	0.051***	0.056***	0.060***	0.050***	0.057***	0.030	0.062***
		(0.003)	(0.004)	(0.004)	(0.006)	(0.006)	(0.010)	(0.027)	(0.016)
	Q90	0.032***	0.025**	0.041**	0.046***	0.018	0.044	0.001	−0.009
		(0.009)	(0.010)	(0.013)	(0.018)	(0.017)	(0.028)	(0.032)	(0.026)
Observations		*12,940*	*11,386*	*9,259*	*3,835*	*3,826*	*1,430*	*439*	*1,013*

Note: Standard errors clustered at the individual level are reported in parentheses. * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Leaving the QR-FE results and returning to the FE results in Table 8, we note that when public sector pay is compared with private sector pay in the same jurisdiction, SA and TAS pay premiums are above the national average premium, while VIC in particular pays a premium that is well below the national average. The overall picture is that the two states (SA and TAS) that have the lowest private sector wages, also have the lowest public sector wages, and also pay the highest public sector premium (9.3% and 10.5%).

There is a case that those that are less prosperous states (SA and, TAS) have to pay more for their public sector employees, relative to their private sectors, to attract the quality of worker that is needed. SA and TAS pay a low wage compared with public sectors in other states, but a high wage relative to their own private sectors. They do so in an environment where their private sector pay is relatively low. It is likely that part of the market that they are competing with to obtain and retain their public sector workforce is not just their local private sector labour market, but both their local and national public sector market for the skills they want, e.g. for police, teachers, nurses, prison officers. When making these comparisons, VIC is the outlier. It has relatively low pay compared both with other jurisdictions and with its own private sector. We note that VIC also has the most female-intensive public sector workforce. While this might explain part of the VIC low public sector wage, the difference in female-intensity is not large enough to be the whole explanation.

Results on state differences appear to suggest that the jurisdictions do pay at different rates to attract labour of a similar quality. The key evidence in support of this argument is the public sector premium identified in the FE and QR-FE estimations. The evidence supports the view that the states compete for workers in two labour markets simultaneously. One is the national labour market for public sector workers. In this case, where they compete nationally, they must pay attention to the pay of comparable public sector workers in other jurisdictions. The other is the local labour market. In this case, where they compete within their own jurisdiction, they must pay attention to the pay of private sector workers in their own state.

The paper suggests that the ACT and the NT should be treated as special cases, for different and specific reasons. The ACT public sector has a high proportion of Commonwealth public sector workers, who seem to be relatively high quality and high paid. To include them confounds the story for the states. The NT is remote and exceptional in other ways. It is also relatively small (in both sample and population size), so the paper suggests that the broader story is best seen by focussing on the more populous states, whilst noting the distinctive nature of the NT.

5. Results

This paper estimates the wage differentials between the public sector and the private sector in Australia. After controlling for observed characteristics and unobserved individual heterogeneity using fixed effects panel estimation, the paper shows that, on average, workers in the public sector earn about 5.1% percent more hourly wages than in the private sector, and that the public sector wage premium is slightly higher for females (5.5%) than for males (4.6%). The paper shows that by ignoring unobserved heterogeneity, OLS estimates overstate the positive wage impact of working in the public sector, but only for females.

The paper uses the quantile regression fixed effects model proposed by Canay, 2011 and shows that there are considerable differences in the public sector pay premium across the wage distribution, by gender, by education, and by state and territory.

The paper shows that when fixed effects are introduced in the analysis, the public sector positive wage premium is larger at the lower end of the wage distribution, thus arguing that a focus on the mean will mask the premium heterogeneity across the full wage distribution. The finding by Birch, 2006 and by Cai and Liu, 2011, that employment in the public sector has a negative impact on the wages of high-paid male workers is not supported in our study, when unobserved individual heterogeneity is allowed for. Indeed, there is a significant public sector premium across the whole distribution, for both males and females.

The paper finds some gender differences across the wage distribution. Males receive a higher premium at the lowest end of the wage distribution and females do so at the highest end of the wage distribution. In contrast, the public sector premium is statistically significant throughout the middle area of the wage distribution (from the 25th to the 75th quantiles) and almost identical for both males and females.

Post-school education is shown to influence the public sector wage premium. The average public sector wage premium is at its highest among those with a certificate or diploma, and at its lowest among those with a university degree.

Combining education with gender, the paper shows that, at the lower end of the wage distribution, males with post-school qualifications attract a higher public sector premium than their female counterparts. In contrast, at the higher end of the wage distribution, it is females with post-school qualifications who attract the higher wage premium. The paper thus paints a very interesting picture where post-school education appears to favour males in lower pay public sector jobs and females in higher pay public sector jobs. We also find that for men on average there are public sector wage premiums among professionals, technicians and trades workers, and clerical and administrative workers. For females, public sector premiums can be found among more occupations, including managers, professionals, community and personal service workers, clerical and administrative workers, sale workers, and labourers. We find evidence of heterogeneous wage premiums from employment in the public sector for most occupations considered, with comparatively larger impact at the lower end of the wage distribution.

Finally, the paper examines the public sector wage premium by state and territory and finds that the relatively poorer states offer a higher public sector premium and that the GFC resulted in a post-2008 increase in the public sector premium, which could inform the relevant federal policy on fiscal transfers across states and territories in Australia.

A caveat applies to the quantile results reported in this paper. The quantile regression estimates obtained are conditional on the control variables used. We are not aware of a method that allows us to estimate the impact on the unconditional distribution of wages while controlling for individual fixed effects. We leave this aspect for future research when appropriate methods are available.

References

Antecol, H., Eren, O., and Ozbeklik, S. (2013). The effect of Teach for America on the distribution of student achievement in primary school: Evidence from a randomized experiment, *Economics of Education Review*, 37, 113-125.

Bargain, O. and Kwenda, P. (2014). The informal sector wage gap: New evidence using quantile estimations on panel data. *Economic Development and Cultural Change*, 63, 117-153.

Binder, M. (2016). "Do it with joy!"-Subjective well-being outcomes of working in non-profit organizations. *Journal of Economic Psychology*, 54, 64-84.

Binder, M., and Coad, A. (2015). Heterogeneity in the relationship between unemployment and subjective wellbeing: A quantile approach. *Economica*, 82, 865-891.

Birch, E. (2006). The public{private sector earnings gap in Australia: A quantile regression approach. *Australian Journal of Labour Economics*, 9, 99-123.

Blackaby, D. H., Murphy, P. D. and O'Leary, N. C. (1999). The payment of public sector workers in the UK: Reconciliation with North American findings. *Economics Letters*, 65, 239-243.

Borland, J., Hirschberg, J. and Lye, J. (1998). Earnings of public sector and private sector employees in Australia: Is there a difference?. *Economic Record*, 74, 36-53.

Cai, L. and Liu, A.(2011). Public-private sector wage gap in Australia: Variation along the distribution. *British Journal of Industrial Relations*, 49, 362-390.

Campos, M. and Centeno, C. (2012). Public-private wage gaps in the period prior to the adoption of the Euro: An application based on longitudinal data. *Banco de Portugal Working papers* No. 1/2012 January.

Canay, A.I. (2011). A simple approach to quantile regression for panel data. *Econometrics Journal*, 14, 368-386.

Christopoulou, R. and Monastiriotis, V. (2013). The Greek public sector wage premium before the crisis: Size, selection and relative valuation of characteristics. *British Journal of Industrial Relations* 52, 579-602.

Dell'Aringa, C., Lucifora, C. and Origo, F. (2007). Public sector pay and regional competitiveness. A first look at regional public-private wage differentials in Italy. *The Manchester School*, 75, 445-478.

Ehrenbergh, R., and Schwarz, J. (1986). Public sector labor markets. In O Ashenfelter and R Layard (Eds), *Handbook of Labor Economics*, Volume 2, 1219-1260. North Holland, New York.

Elliott, R., Mavromaras, K. and Meurs, D. (2007). Special issue on public sector pay structures and regional competitiveness: Editors' introduction. *The Manchester School*, 75, 373-385.

Fortin, M.N. (2008). The gender wage gap among young adults in the United States: The importance of money versus people. *Journal of Human Resources*, 43, 886-929.

Garcia-Perez, J.I. and Jimeno, J.F., (2007). Public sector wage gaps in Spanish regions. *The Manchester School*, 75, 501-531.

Gregory, R. and Borland, J. (1999). Recent development in public sector labour market. In O. Ashenfelter and R. Layard (eds.), *Handbook of Labor Economics*, Volume 3, pp.3573-3630. Amsterdam: North Holland.

Heitmueller, A., Mavromaras, K.G. (2007) On the post-unification development of public and private pay in Germany. *The Manchester School*, 75, 422-444.

Hospido, L. and Moral-Benito, E. (2014). The public sector wage premium in Spain: Evidence from longitudinal administrative data. *Labour Economics*, 42, 101-122.

Koenker, R. and Bassett, G. (1978). Regression quantiles. *Econometrica*, 46, 33-50.

Lausev, J. (2014). What has twenty years of public-private pay gap literature told us? Eastern European transitioning vs. developed economies, *Journal of Economic Surveys,* 28, 516-550.

Lucifora, C. and Meurs, D. (2006). The public sector pay gap in France, Great Britain and Italy. *Review of Income and Wealth*, 52, 43-59.

Mahuteau, S. and Zhu, R. (2016). Crime victimisation and subjective well-being: Panel evidence from Australia. *Health Economics*, 25, 1448-1463.

Melly, B. (2005). Decomposition of differences in distribution using quantile regression. *Labour Economics,* 12, 577-590.

Mueller, R. (1998). Public{private sector wage differentials in Canada: Evidence from quantile regressions. *Economics Letters*, 60, 229-235.

Nikolic, J. (2014). The effect of large-scale privatization on public sector pay gap in a transition economy. *Economics of Transition*, 22, 759-781.

Nordman, C.J., Rakotomanana., F. and Roubaud F. (2016). Informal versus formal: A panel data analysis of earnings gaps in Madagascar. *World Development*, 86, 1-17.

Siminski, P. (2013). Are low-skill public sector workers really overpaid? A quasi-differenced panel data analysis. *Applied Economics*, 45, 1915-1929.

Vella, F. (1993). Non-wage benefits in a simultaneous model of wages and hours: Labour supply functions of young females. *Journal of Labor Economics*, 11, 704-723.