Distributional Australian Gender Wage Gap over time

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Using the Household, Income and Labour Dynamics in Australia survey the gender wage gap is analysed over time and across the wage distribution. The quantile regression counterfactual decomposition analysis results show that in both 2001 and 2012, the gender wage gap is positive and increasing along the wage distribution. The wage gaps are higher along the entire wage distribution in 2012 compared to 2001. Further, the gender wage gap has becomes worse over time. The analysis highlights that women's human capital is not vastly different (worse) than men's human capital. Rather, the returns to the labour market characteristics differ between the two genders and are the major contributor to the Australian gender wage gap.

1. Introduction

Measuring the gender wage gap has been a topic of interest to economists for decades (Weichselbaumer and Winter-Ebmer, 2007, Magnusson, 2010). Studies have used three theories to explain the gender wage gap including human capital characteristics (education, work history, and work experience); job characteristics (hours worked, industry and occupation); and family responsibilities (being the primary caregiver for dependent children, and being a sole parent). The gender wage gap has been reported in a number of countries (Dixon, 2000, Siphambe and Thokweng-Bakwena, 2001, Kidd and Shannon, 2002, Rubery et al., 2005, Daly et al., 2006) and empirical studies find that it is persistent (Chang and Miller, 1996, Preston, 2003).

Empirical studies that measure the gender wage gap have progressed beyond analysis at the mean onto analysis along the wage distribution. Most studies measure the gap at a point in time. The main purpose of this study is to extend the existing literature by measuring the Australian gender wage gap over time (2001 to 2012). Conditional regressions will be used to estimate the wage gaps along the wage distribution in each year. The second purpose is to determine whether the gender wage gap is due to difference in labour market characteristics or differences in the returns to labour market characteristics. A counterfactual decomposition will be used to attribute the wage gaps to the two components.

The rest of the paper is organised as follows. Section 2 provides an overview of existing literature on the gender wage gap including reasons for the gender wage gap as determined through previous literature. Section 3 describes the data used for the analysis. The

methods used are explained in section 4. Section 5 presents the results and discusses the findings. The final section concludes.

2. Literature review

i) Empirical literature

The literature on the gender wage gap at the mean is well established (Altonji and Blank, 1999, Weichselbaumer and Winter-Ebmer, 2007, Weichselbaumer and Winter-Ebmer, 2005). Following extensive analysis of the Australian mean gender wage gap (Haig, 1982, Jones, 1983, Chapman and Mulvey, 1986, Langford, 1995, Chang and Miller, 1996, Preston, 2001), Australian studies over the last decade have considered the gender wage gap along the earnings distribution (Whitehouse, 2001, Eastough and Miller, 2004, Miller, 2005).

Whitehouse (2001) used percentile comparisons and highlights that investigation of wage gaps beyond the mean are required. Eastough and Miller (2004) suggested that a smaller gender pay gap exists among low-wage earners compared to high-wage earners. Miller (2005) also reported that there is a much larger gap among high-paid workers than among low-paid workers, and found that differences in returns to schooling reduce the gaps among the least paid, but worsen the gaps for all other groups considered. Detailed analysis of the gender wage gap along the earnings distribution include Kee (2006) who used the first wave of the HILDA data to explore the gender wage gap across the earnings distribution and found evidence of a glass ceiling for women in the private sector. Baron and Cobb-Clark (2010) also used HILDA data from 2001 to 2006 to explore the gender wage gap along the earnings distributions in the private and public sector. The authors found that irrespective of the labour market sector, difference in labour market characteristics can explain the gender wage gap among low-paid workers. However, the difference among high-wage workers is unexplained by difference in labour market characteristics suggesting that a glass ceiling prevails in both the private and public sectors.

To investigate the effect of women's self-selection into full-time employment, Chzhen et al. (2013) used HILDA data to decompose the gender wag gap across the earning distribution for full-time Australian employees in the private sector. The authors did not find a selection effect in the Australian private sector, that is, women in the sample working full-time in the Australian private sector did not have higher earnings potential than women in general, especially for women in the lower and upper ends of the earnings distribution.

Explanations for the gender wage gap are often separated into supply-side theories focusing on differences in individual mechanisms, and demand-side theories that focus on structural constraints in the labour market such as discrimination (Glauber, 2007).

ii) Labour market supply

Female labour market participation is an important factor in explaining overall labour market participation rates (Burniaux et al., 2003). Female labour market participation has been linked to gender wage equity, poverty reduction, and counteracting the aging population (Jaumotte, 2003). *Human capital theory* suggests that women earn less than men due to differences in labour market characteristics such as education, labour market experience and tenure (Becker, 1967, Polachek, 1995). Since the 1980's women's human capital has increased to become almost the same as men (Asienbrey and Brücker, 2008, Blau and Kahn, 2007, Waldfogel, 1998). However, it has been shown that men and women continue to have different labour market characteristics, especially regarding labour market experience, seniority, part-time work, fields of education and the selection of university courses (Reskin and Bielby, 2005). According to the human capital theory, there is a distinction between *general human capital* and *firm specific human capital*. General human capital refers to characteristics such as education that are useful for all employers, which is generally measured empirically through experience variables. Specific human capital refers to skills acquired on the job such as using firm specific technology, and building social contacts (Becker, 1962, Mincer, 1962). Firm specific human capital is attained through on-the-job training to increase the workers' productivity and is measured empirically through tenure variables. Investment in firm specific human capital generates higher returns to workers and the amount of firm specific investment depends on the costs and benefits associated with the investment.

According to the neo-classical view, men and women invest differently in human capital because of differences in life prospects (Polachek, 2004). Women tend to invest more effort in family-oriented activities than men (Becker, 1991, Mincer and Polachek, 1974) so the division of labour in the household leads to gender differences in the labour market. This is supported by the time allocation model (Becker, 1965) which recognises that women attribute time between leisure, work, and home responsibilities. As women undertake a greater proportion of unpaid work and therefore have a lower lifetime participation rate than men, the

human capital theory suggests that the benefits of human capital investment are lower for women than for men (Magnusson, 2010). Women's fewer incentives to invest in training can lead to lower wages/earnings (Mincer and Polachek, 1974, Polachek, 2004).

Expected labour market interruptions (Magnusson, 2010), occupational segregation Anker, 1998, Charles and Grusky, 2004), and differences in field of education (Brown & Corcoran, 1997 and Bobbitt-Zeher, 2007) between men and women are other supply-side factors that have been shown to contribute to the gender wage gap.

iii) Labour market demand

Differences between men and women on the supply side are only part of the explanation for gender inequality in the labour market. Women's labour market disadvantages might also be due to discrimination, job crowding and social closures on the demand side.

Altonji and Blank (1999) explain statistical discrimination and taste discrimination which can be faced by women in the labour market. Statistical discrimination is the idea that employers treat female employees as a group and make decisions based on the average productivity of women and not on women's individual characteristics. As employers assume that women are more likely to make work-life interruptions for parental purposes or are more likely to reduce their time in paid work than men, employers may be reluctant to hire or promote a female worker (Altonji and Blank, 1999, England, 1992, Phelps, 1972). For the same reasons, employers may be less likely to place women into jobs that involve tasks that are difficult to combine with family duties but lead to career opportunities and higher wages (for example, a large amount of over-time work and many business trips). Employers may also be reluctant to invest in on-the-job training for female workers. Highly specialised roles require a large degree of on-the-job training, have high turn-over costs and attract higher wages (Mincer and Jovanovic, 1979). As women have higher chances of work interruptions, employers are likely to allocate women to positions with low turn-over costs, which yield lower wages (Bielby and Baron, 1986). Organisational promotional structures in the Australian public sector and some large private sector organisations are subject to well-defined procedures. However, the exact appointment of a successful candidate can be based on demand-side discrimination (Booth et al., 2003). For example, Landers et al. (1996) show that some promotion criteria such as long working hours can worsen the glass ceiling effect

for US lawyers. This highlights the idea of "presenteeism", which implies that long working hours are a part of the job culture and not actually a reflection of efficiency (Simpson, 1998). Working long hours could have been a measure of "hard work" when organisations were predominantly male, or they could be used to limit women from accessing the jobs (Booth, 2009). Sociology literature suggests the former, for example, Reskin (1993) shows that occupational gender segregation occurs when recruitment relies on informal networks. This is further supported through a recent study by van den Brink et al. 2008 showing that the recruitment of professors into Dutch academia occurs through scouting of appropriate candidates. This process can lead to a gendered group if networking occurs only with individuals of the same gender.

Studies have found that organisational networking and group interactions (Bridges and Villemez, 1986, Boxman et al., 1991, Simon and Warner, 1992), crowding and competition (Tilly, 1998), and institutionalisation (Le Grand, 1997; England, 1992; Tomaskovic-Devey, 1995) within a workplace are demand side factors that hinder women's upward mobility within an organisation and contribute to the gender wage gap.

3. Data

Waves 1 and 12 of the Household, Income and Labour Dynamics in Australia (HILDA) are used for this study. HILDA is the first nationally based random panel dataset of Australian households, and was first conducted in 2001. Waves 1 and 12 of the survey were collected from 2001 and 2012. The advantage of using the HILDA survey is the wide range of information available. The survey includes data on the respondents' earnings, education, labour market status, occupation, labour market experience, hours of work, attitude towards work and gender roles as well as extensive information on children. Information on the respondents' family background, fertility and relationship histories, health and attitude on particular aspects of life is also collected.

Wave 1 (2001) and Wave 12 (2012) datasets contain full-time, part-time and casual employees in the labour force, aged between 18 and 65 years. The self-employed respondents are excluded from this study. The dependent variable, real hourly wages, is calculated using the respondents' hours usually worked in the main job per week and the respondents' current weekly gross wages or salary in their main job. Wages are adjusted for inflation and

productivity changes over time using the Average Weekly Earnings from the Australian Bureau of Statistics[1]. The variables and a description of the variables used are listed in Table 3.

Table 1 Variables names and definitions

Total sample

Name	Wave 1 (2001) Mean	Wave 12 (2012) Mean	Definition
	n = 6434	**n = 8805**	
Sex	0.504	0.498	= 1 for male; = 0 for female
Education variables			
Post graduate	3%	6%	= 1 if respondent's highest level of education is postgraduate; = 0 otherwise
Bachelor/honours degree	16%	18%	= 1 if respondent's highest level of education is postgraduate; = 0 otherwise
Graduate diploma	6%	7%	= 1 if respondent's highest level of education is graduate diploma or graduate certificate; = 0 otherwise
Advance diploma/diploma	10%	9%	= 1 if respondent's highest level of education is bachelor or honours; = 0 otherwise
Certificate	19%	24%	= 1 if respondent's highest level of education is certificate I or II; = 0 otherwise
Year 12	19%	20%	= 1 if respondent's highest level of education is year 12; = 0 otherwise
Year 11 or less	27%	17%	= 1 if respondent's highest level of education is year 11 or below; = 0 otherwise
Location			
area	67%	66%	= 1 if respondent resides in major cities of Australia; = 0 otherwise
Experience			
tenure	8.7	8.7	Tenure with current employer (in years)
tenure_2			Tenure squared
experience	17.8	16.7	Years in paid work
experience_2			Experience squared
Parenthood			
Children	83%	84%	= 1 if has residential child(ren) or intend to have child(ren) = 0 otherwise
Labour force status			

[1] The AWOTE series is obtained from the ABS cat. no. 6302.0 Table 3.

Part time	29%	30%	= 1 if respondent is working part time; = 0 otherwise
Private Sector	71%	74%	= 1 if respondent works in the private sector; = 0 otherwise

In the 2001 dataset, the proportion of men was slightly higher than that of women; 3,242 and 3,192 individuals respectively. The 2012 dataset contained 8,805 individuals with slightly more women (4,422) than men (4,383). Most individuals in the 2001 dataset (27 per cent) had year 11 or less as their highest level of education. However, in 2012, most individuals (24 per cent) reported certificate as their highest level of education. This presents an overall improvement in educational attainment of individuals between 2001 and 2012. The proportion of individuals living in an Australian capital city in 2012 reduced slightly compared to 2001; from 67 per cent in 2001 to 67 per cent in 2012. More interestingly, a comparison of human capital investment (tenure and experience) between 2001 and 2012 shows that the average years of tenure stayed the same (8.7 years) while the average years spent in paid work reduced by 6 per cent; from an average of 17.8 years in 2001 to 16.7 in 2012. The proportion of individuals who have or intending to have children increased slightly; from 83 per cent in 2001 to 84 per cent in 2012. Similarly, the proportion of individuals working part-time increased from 29 per cent in 2001 to 30 per cent in 2012. The proportion of individuals working in the private sector increased from 71 per cent in 2001 to 74 per cent in 2012. The labour market characteristics for men and women separately are presented in Appendix, Table 1.

4. Methods

a) Mincer wage equation

The analysis begins with an estimation of the Mincer (1974) wage equation to describe the relationship between wages, education, and labour market experience.

Consider the following pooled earnings function;

Equation 1 $$\text{In } W_i = B_0 + B_1 x_i + B_2 G_i + \varepsilon_i$$

Where W is the hourly wage for individual i; B_0 is an intercept term; B_1 is a vector of coefficients of individual characteristics; S_i is the gender dummy variable where 1 indicates a male individual and 0 a female individual; x is a vector of individual characteristics; ε is the

'usual' residual. Pooled regression imposes the restriction that the returns to labour market characteristics are the same for men and women. Consequently, the coefficient on the gender dummy variable indicates the extent to which the gender wage gap remains unexplained after controlling for individuals' characteristics.

Next, the Mincer (1974) wage equation is used to describe the relationship between wages, education, and labour market experience separately for men and women;

Equation 2 $\ln W_i^m = B_0^m + B_1^m x_i^m + \varepsilon_i^m$

Equation 3 $\ln W_i^f = B_0^f + B_1^f x_i^f + \varepsilon_i^f$

Where *W* is the hourly wage for individual *i*; subscripts *m*, and *f* refer to male, and all female, observations; B_0 is an intercept term; B_1 is a vector of coefficients of individual characteristics; *x* is a vector of individual characteristics; ε is the 'usual' residual.

This estimation allows for the observation of the difference in returns to the labour market characteristics for men and women. However, this conventional method has several limiting assumptions. Firstly, the length of time in the current job (tenure) is treated as exogenous to wages. Generally, tenure is a function of wages. However, as the focus of this analysis is the decomposition component, this endogeneity is not concerning. Secondly, this model assumes that the returns to labour market characteristics are the same across industries/occupations. Thirdly, estimating wages at the sample mean does not allow the observation of the gender wage gap across the wage distribution. This is limiting as Miller (2005) reported a larger gap among high-paid workers than among low-paid workers. It is important to keep these caveats in mind when interpreting the estimate results.

b) Quantile regression

The quantile regression model was developed by Koenker and Bassett (1978). The description below is based on Buchinsky (1998). Let (y_i, x_i), $i = 1, 2, \ldots, n$ be the sample of a population, where *yi* is the dependent variable of interest, and *xi* is a *k* x 1 vector of regressors The relation between *yi* and *xi* is given by:

Equation 4 $yi = x'_i\beta_\theta + u_{\theta i}$ with $Quant_\theta\ (y_i\ |x_i) = x_i\beta_\theta$

where $Quant_\theta\ (y_i, x_i\ )$ refers to the conditional quantile of y_i, conditional on x_i, and $u_{\theta i}$ is an unknown independently and identically distributed error term. In the classical linear

regression model, the normal distribution of the unknown error is specified. In this case, however, the error term $u_{\theta i}$ for the θ^{th}quantile is left unspecified and is only required to satisfy the constraint of

$Quant_{\theta}\ (u_{\theta i}\ |x_i) = 0$

with no other distributional assumptions being made. The estimator for $\beta_{\theta}$of the θ^{th} quantile regression is obtained by solving

Equation 5 $\hat{\beta}\theta = \underset{\beta_{\theta}}{arg}\ \min\left(\sum_{i:yi>xi'\beta\theta}\theta|\ y - x'_i\beta_{\theta}| + \sum_{i:yi<x'i\beta\theta}(1-\ \theta)\ |\ yi - x'_i\beta_{\theta}|\right)$

where 0< θ < 1. In other words, β_{θ} is chosen to minimise the sum of the weighted residuals. For a negative residual, the weight is (1 $-\theta$); for a positive residual the weight isθ.

The advantage of this method allows for the estimation of the marginal effect of a covariant on the log wage at different points in the distribution, instead of just at the mean.

ii) Counterfactual wage decomposition

The decomposition approach developed by Blinder (1973) and Oaxaca (1973) is widely accepted in analysing the gender wage gap.

This approach decomposes the differences between two groups' distributions into two components. The first attributes the difference in wages between two groups to differences in labour market characteristics (endowments) including education, work experience, and tenure. This component is generally referred to as the "explained" component of the decomposition. The second component of the decomposition shows differences in the rewards that the two groups receive for their labour market characteristics (coefficients), referred to as the "unexplained" component. This unexplained component is generally a measure for discrimination, but also includes the effects of group differences in unobserved heterogeneity that the model does not capture (Jann 2008).

If we denote the labour market returns of men, and women by β_m, β_f and their characteristics by x_m , x_f , respectively, we are able to generate two counterfactual densities. The first is the female log wage density that would arise if women retained their labour market characteristics but were paid like men.[2] In "non-discriminatory" situations where men

[2] Alternatively, one could generate the density that would arise if women were given men's labour market characteristics but continued to be paid like women.

and women possess the same productive characteristics, the returns to labour market characteristics/wage of men and women would be equal ($\beta_f = \beta_m$), and no wage gap will be evident. Therefore, observed wage differences can be seen as a cause of unequal treatment by gender, or other unobserved heterogeneity that the model fails to capture. A positive (negative) sign implies that market returns to characteristics for men are higher (lower) than the returns to characteristics for women.

The steps of the procedure are summarised below:

1. Using the log wage equation and (2), estimate the β^m and β^f using the male and female datasets, respectively.
2. Use female's average characteristics to predict wages by using the estimated coefficients β^m from step.
3. Use male's average characteristics to predict wages by using the estimated coefficients β^f from step. Step (2) and generate two female counterfactual wages.
4. To calculate gender wage gaps, take the difference between the female's counterfactual wages and female's actual wages.

5. Results

In this section, sets of results are presented using different methods to compare the wage gaps between 2001 and 2012. The dependent variable is log hourly wage in 2012 real dollars. The dependent variable is derived by using the respondent's main job. A summary of the results from each method is presented in Table 2.

Table 2 OLS wage gaps, 2001 and 2012

	2001	**2012**
Method	Wage Gap	Wage Gap
Raw sample average	10%	18%
Pooled regression with gender dummy	11%	15%
t-stat	8.98	16.05
Decomposition results		
Raw gap	11%	14%
t-stat	8.75	14.10
Unexplained gap (Coefficient)	14%	17%
t-stat	10.16	17.16
Explained gap (Endowment)	3%	1%
t-stat	2.34	1.24

i) Estimation at the mean, 2001 and 2012

a) Raw gender wage gap

In the 2001 dataset, the average woman earned $30.05 per hour and the average man earned $33.06 per hour (in 2012 dollars). Observing the male and female wages at the sample mean indicates a gender wage gap of 10 per cent (Table 2). In the 2012 dataset, the average woman in the sample earned $28.48 per hour, while the average man earns $33.71 per hour. This shows a gender wage gap of 18 per cent in 2012. This method shows that between 2001 and 2012, the gender wage gap increased from 10 per cent to 18 per cent, respectively. Although this method merely allows for the observation of sample averages and does not account for labour market characteristics, the results are consistent with Preston (2001) who shows that the average weekly earnings gap between men and women in the ABS Average Weekly Earnings Survey increased from 7.1 per cent in 1992 to 8.2 per cent in 2000.

b) Pooled regression with gender dummy

To investigate the effects of difference in labour market characteristics on the gender wage gap, an ordinary least squares (OLS) regression on the pooled datasets with a gender dummy variable in 2001 and 2012 are computed. Pooled regression imposes the restriction that the returns to labour market characteristics are the same for men and women. Consequently, the coefficient on the gender dummy indicates the extent to which the gender wage gap remains unexplained after controlling for individuals' characteristics. The results from this method show that, given no labour market experience, the gender wage gap is 11 per cent in 2001 and 15 per cent in 2012. Similar to the raw wage gap results, this method shows that the mean gender wage gap is positive in both 2001 and 2012, and has increased between the two years.

By using pooled regression it is assumed that the returns to labour market characteristics for the pooled groups are the same i.e. returns to labour market characteristics for men and women are the equal. To test if the pooled estimation is appropriate, a Wald test is conducted by interacting all the explanatory variables with the gender dummy variable for the pooled gender regression for both years. The results are statistically significant at a 5 per cent level, and therefore the estimations should be stratified by gender[3].

c) Mean estimation stratified by gender

[3] These results are not presented in the report due to space constraints. The results can be requested from the author.

Regressions on subsamples stratified by gender relax the assumption that men and women have the same returns to labour market characteristics. The results show the extent to which returns to labour market characteristics differ between men and women.

The coefficient estimates from stratified regressions at the sample mean allow for the construction of earnings functions using the prediction of average hourly wages for each cohort (Figure 1 & Figure 2). The earnings functions for 2001 show that men and women earn similarly when commencing in the labour market at the age of 18 years. Between the ages of 18 and 22, the earnings difference between men and women was minimal. The wage difference between men and women increases from 7 per cent at the age of 23 years to 15 per cent at the age of 43 years. This is reflected in the average growth rate for men's and women's wages over the 20 year period; where women's average hourly wages increased by 1.07 per cent, while men's average hourly earnings grew by 1.46 per cent. These results show that men's average earnings grew 36 per cent faster than women's. An explanation for the different wage growths and divergence between the wages of men and women could be the motherhood and fatherhood statuses. As the average mother and father in the 2001 sample were 38 year of age, it is likely that the anticipation, arrival, and care of children drive the earnings divergence between men and women. The anticipation of children for women can impact career choices in the form of less investment in formal education or the selection of "family friendly" jobs that lead to a reduction in the accumulation of labour market investment (Ben-Porath 1967). Following the arrival of children, women tend to become the primary care taker of the family and household, which leads to a reduction of participation in the labour market. Given family financial circumstance, during the intensive children-rearing years, women may return to the labour force at a part-time basis, select employment in family friendly jobs (Budig & England 2001) or may elect to exit the labour force for a number of years. As expected, these choices lead to a reduction in women's earnings. At the same time, the arrival or anticipation of child(ren) is believed to change men's behaviour and encourage them to pursue a role of "financial provider". This translates into increased labour market participation, higher productivity and higher wages for men (Pollmann-Schult 2011).

The 2012 earnings functions (Figure 3) also showed that men and women earned similar average hourly wages when commencing in the labour market (at age 18). The difference between the wages of men and women between 18 and 23 years of age is small. This difference may be an indication of industry segregation as individuals acquire positions within specific labour market industries. This is supported by Coelli (2014) who found that

occupational segregation made a large positive contribution to explaining the gender wage gap. The divergence between the average hourly earnings of men and women becomes clearer between the ages of 22 and 32 years, with the average earnings of men growing faster than the earnings of women. The difference in the growth rates of men's and women's average hourly earnings could be a result of a difference of investment in human capital or the anticipation of work interruptions that influence the labour market investment of women (Mincer & Polachek 1974; Polachek 2004). The difference between men's and women's average hourly earnings is evident along the rest of the wage distribution. However, it grows at a slower rate between the ages of 32 and 42, increases between the ages of 42 and 57 years, and declines between the ages of 57 and 65 years.

Figure 1 Earnings functions, 2001

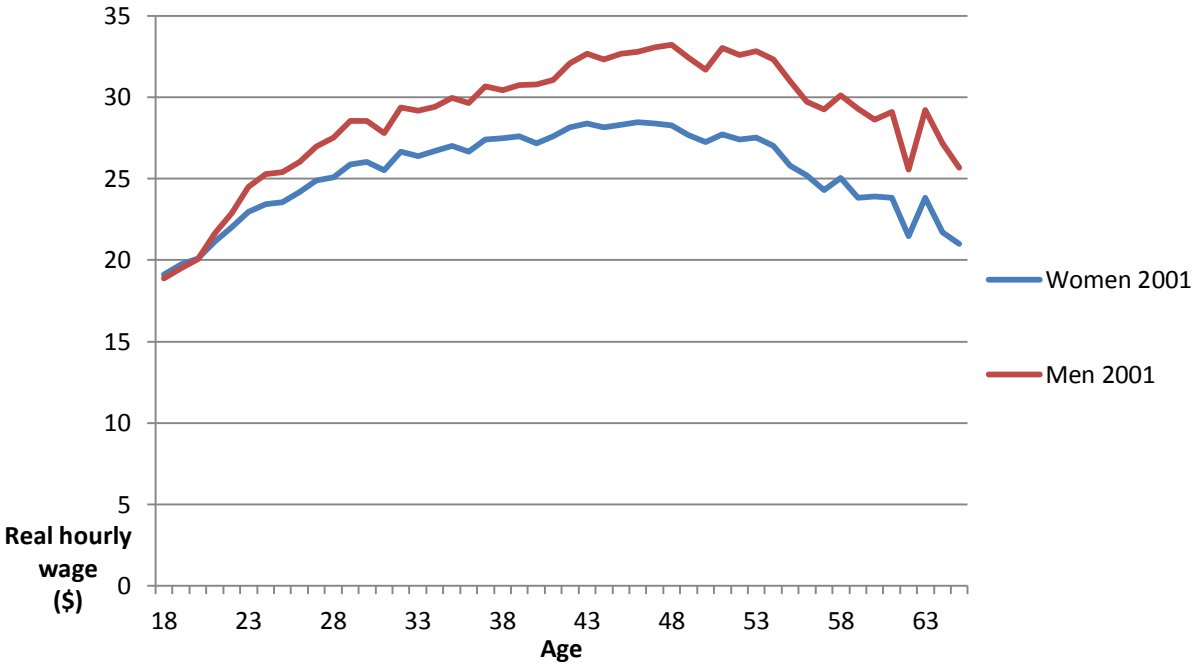
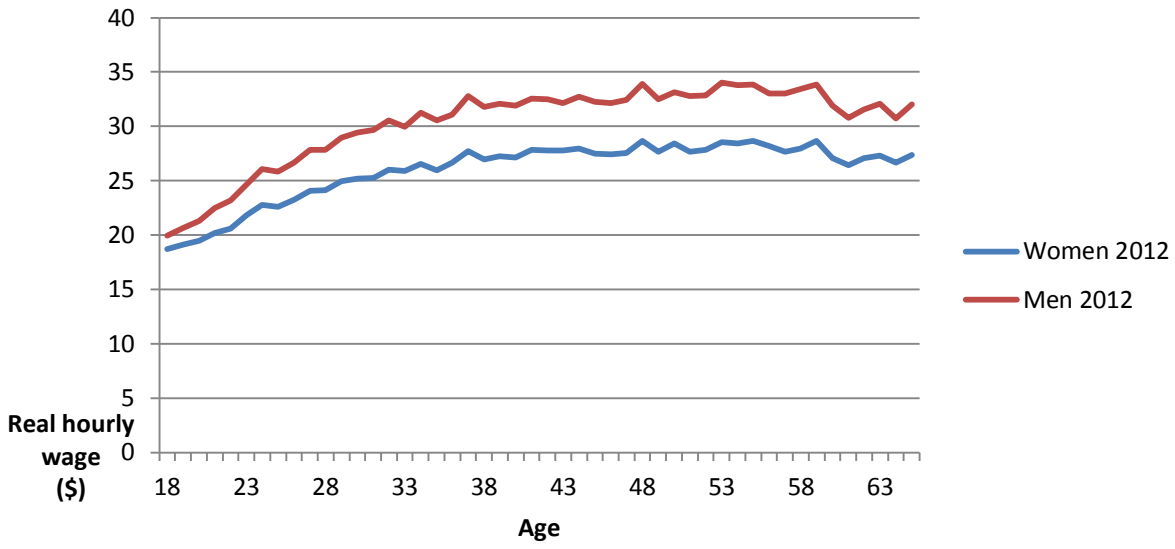


Figure 2 Earnings functions, 2012



A comparison of the earnings profiles between 2001 and 2012 shows that the difference between the starting wages of men and women was smaller in 2001 than in 2012. The average growth rate of earnings in 2001 was 0.7 per cent for men and 0.2 per cent for women. By contrast, the average growth rate of earnings in 2012 was 1 per cent for men and 0.8 per cent for women. This indicates that the average growth rate of earnings has increased for both men and women between 2001 and 2012, and that the disparity between the wage growth rates of men and women has declined. This declined is a result of women's average earnings growing at a faster rate than that of men's.

d) Counterfactual decomposition

This section of the analysis presents the decomposition results at the sample mean. The purpose of the decomposition is to identify whether the gender wage gap at the mean is attributable to the difference in labour market characteristics (endowments) or to differences in the returns that men and women receive for their labour market characteristics (coefficients). The endowment component of the decomposition is generally referred to as the explained component and attributes the wage gap to differences in labour market characteristics. The coefficient component of the decomposition is generally referred to as the unexplained or discriminatory component and attributes the gender wage gap to the differences that are unobserved in the model. The results show that, in both 2001 and 2012, the mean gender wage gap is positive (Table 3). The decomposition results showed that in 2001, a statistically significant mean gender wage gap of 11 per cent existed; where women

on average earned a real hourly wage of $26.10 while men earned $29.07 per hour. Decomposing this gender wage gap into coefficient and endowment differences showed that the mean gender wage gap is mostly attributable to the unexplained (coefficient) differences. In other words, if women retained their labour market characteristics, but were paid like men, their average hourly wage would increase by 14 per cent to $29.70. A small and statistically significant proportion of the mean gender wage gap in 2001 is also attributable to differences in endowments/labour market characteristics between men and women. The results show that if women obtained men's labour market characteristics but continued to be paid like women, their average hourly wages would increase by 3 per cent to $26.80 per hour.

The 2012 decomposition results show that a positive raw mean gender wage gap of 14 per cent exists; where women earned an average real hourly wage of $25.70 while men earned an average real hourly wage of $29.70 (Table 3). Decomposing the 2012 mean wage gap into coefficient and endowment components presents similar results to the 2001 decomposition. The mean gender wage gap in 2012 is mostly attributable to differences in coefficients; if women retained their labour market characteristics and were paid like men, their average hourly wages would increase by 17 per cent to $30.05. However, if women had the same labour market characteristics as men and continued to be paid like women, their earnings would increase by a statistically insignificant amount of 1 per cent to an average hourly wage of $26.04 (Table 3).

Comparing the mean gender wage gap between 2001 and 2012, it is evident that the mean gender wage gap has increased over time; from 11 per cent to 14 per cent. A comparison of the decomposition results shows that most of the mean gender wage gap is attributable to coefficient differences and to a greater extend over time. These results are consistent with previous empirical studies that decompose the mean gender wage gap into coefficient and endowment components. The early work of Chapman and Mulvey (1986) showed that the gender wage gap in 1982 was attributed mainly to coefficient difference rather than endowment difference between men and women. The decomposition of Chapman and Mulvey (1986) showed that if women had the same labour market characteristics (endowments) as men, their earnings would increase by 2 per cent. However, if women retained their labour market characteristics but were paid like men (coefficient), their earnings would increase by 14 per cent.

Table 3 Mean gender wage gap decomposition, 2001 and 2012

	Raw wage gap	Coefficient (unexplained) gap	Endowment (explained) gap
2001	11%	14%	3%
	8.75	10.16	2.34
2012	14%	17%	1%
	14.1	17.16	1.24

ii) Quantile regression

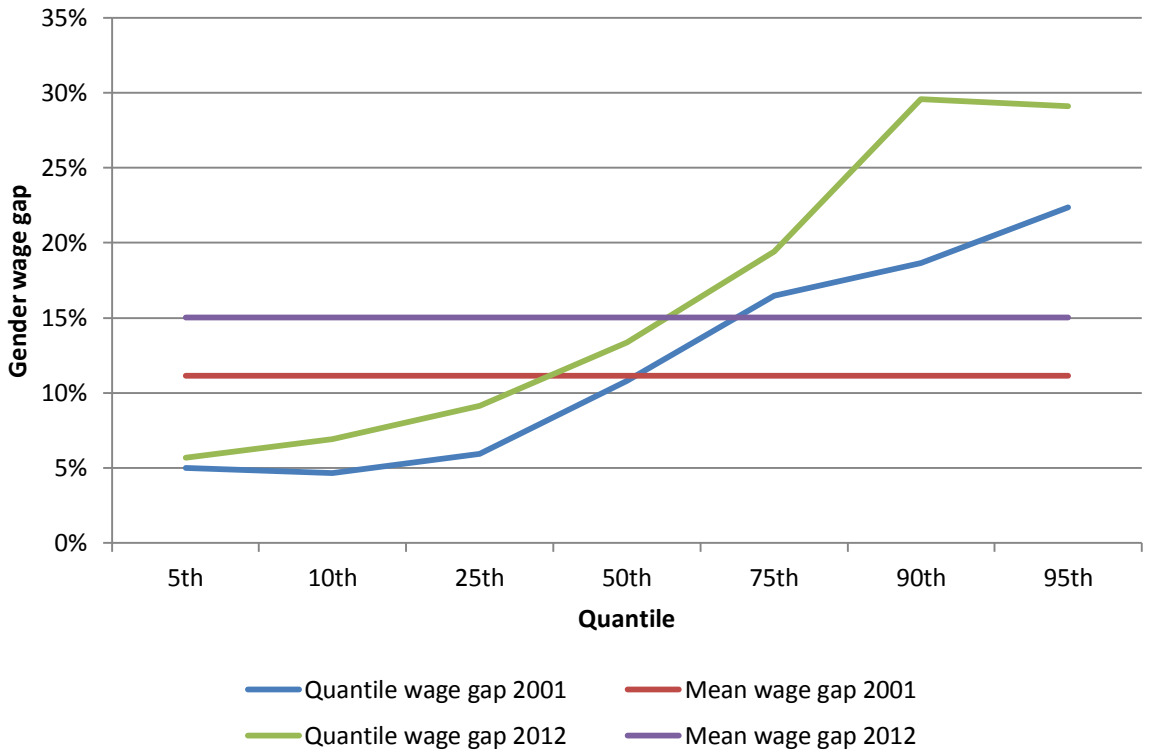
The analysis so far has focused on estimation at the sample mean. Analysis at the mean is limiting because it does not show the wage difference between men and women along the earnings distribution or how these differences change when we move along the earnings distribution. Justification for the use of quantile regression is determined by undertaking joint interquantile tests, and the results show statistical significance between the quantiles. Therefore, the assumption of equality is rejected, which justifies for the use of quantile regression[4]. This concludes that the quantile regression method is superior to the OLS, and that interpretation of the OLS mean results can be misleading.

a) Pooled quantile regression with gender dummy

Estimating a pooled quantile regression with a gender dummy variable for 2001 and 2012 separately presents the distributional gender wage gap while accounting for labour market characteristics. The results of this estimation show that the gender wage gap is positive and increasing along the wage distribution in both 2001 and 2012 (Figure 3), which supports the glass ceiling argument that exists in the Australian labour market. Interestingly, the results also show that the gender wage gap has increased between 2001 and 2012. The difference between the distributional gender wage gap in 2001 and 2012 is larger at the top of the distribution than at the bottom, indicates that the glass ceiling effect has worsened over time.

[4] These results are not presented in the report but can be requested from the author.

Figure 3 Mean and distributional gender wage gap – gender dummy variable, 2001 and 2012



The estimation so far has assumed that the returns to labour market characteristics are the same for men and women. A Wald test is conducted to test whether or not the pooled estimation is appropriate. The Wald test is undertaken by interacting all explanatory variables with the gender dummy and the result is significant at a 5 per cent level. Therefore, the estimation should be stratified by gender[5]. The pooled estimates presented above are of interest for ease of interpretation, simplicity of understanding and comparison of methods.

b) Stratified by gender

The quantile regression coefficient estimates stratified by gender show the extent to which the labour market characteristics for men and women vary at different points within the wage distribution in 2001 and 2012. As experience and tenure are indicators of investment in human capital and job-specific training, respectively, the most interesting results are the difference in returns to these labour market characteristics between men and women along the earnings distribution.

[5] A Wald test conducted to test whether or not the pooled estimation is appropriate. The results can be obtained from the author.

The segregated quantile estimation shows that men in 2001 received between 7 per cent and 37 per cent higher returns to experience depending on the wage quantile (). Although the difference between the returns to men's and women's labour market experience is evident, a pattern between the different quantiles does not exist. By contrast, the difference to the returns to tenure to men and women are positive and increase gradually as we progress up the wage quantiles. The 2012 quantile regression stratification results show that the returns to men's labour market experience is not persistently higher than that of women's along the wage distribution. In fact, at the 25^{th}, 90^{th} and 95^{th} wage percentiles, women received higher returns for an additional year of general labour market experience compared to men. These results indicate that additional years of experience for senior women with high wages are valued higher than additional years of experience for senior, high paid men. As such, these results may indicate that the benefits of investment in the labour market for women are realised later in their careers, which is beyond the years of childrearing. By contrast, the quantile regression results show that the difference between the returns to tenure for men and women follows an increasing trend along the wage distribution in 2012. As individuals within an organisation become more senior, an additional year of men's job-specific experience has higher values than women's. This idea is explored by Booth et al. 2003 who find that women were just as likely as men to become promoted. However, women received smaller pay increases upon promotion as they become "stuck" at the bottom end of the new pay grade.

In general, the results showing that men receive higher returns an additional year of experience and tenure are consistent with previous studies which argue that disparity between men and women's labour market participation, seniority and part-time work still exists (Reskin & Bielby 2005) despite an increase in women's general labour market participation. In turn, such trends in labour market participation contribute to the disparities in the returns to labour market characteristics.

Table 4 Distributional experience and tenure returns by gender, 2001 and 2012

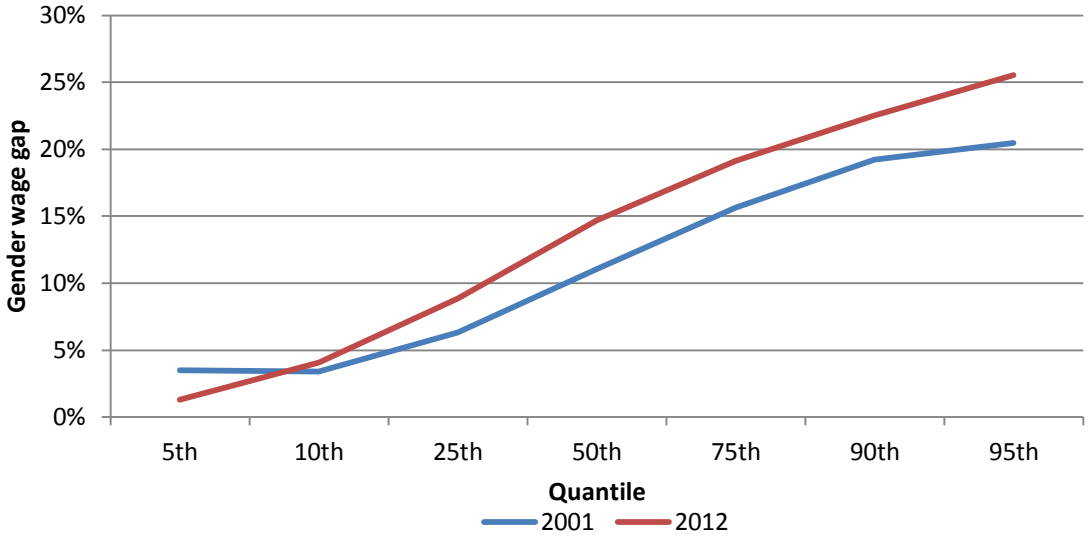
	Women (n = 3182)													
	2001													
	5th		10th		25th		50th		75th		90th		95th	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
Experience	0.034	4.4	0.031	6.44	0.02	7.8	0.021	5.91	0.020	6.4	0.023	5.13	0.025	3.56
Experience2	-0.001	-4.09	-0.001	-5.36	0.00	-7.3	0.000	-6.42	0.000	-6.52	0.000	-4.34	0.000	-2.35
Tenure	0.008	0.76	0.011	2.26	0.01	4.6	0.007	2.88	0.006	2.56	0.007	1.53	0.007	1.01
Tenure2	0.000	0.38	0.000	-0.59	0.00	-2.05	0.000	-0.51	0.000	-0.66	0.000	-0.9	0.000	-1.11
	Men (n = 3239)													
	2001													
	5th		10th		25th		50th		75th		90th		95th	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
Experience	0.043	4.87	0.033	6.6	0.027	8.05	0.026	9.44	0.028	11.5	0.026	5.06	0.030	4.35
Experience2	-0.001	-4.64	-0.001	-5.84	0.000	-7.55	0.000	-9.15	0.000	-8.61	0.000	-3.31	0.000	-2.62
Tenure	0.009	1.24	0.015	3.78	0.013	5.7	0.013	4.78	0.014	3.45	0.020	4.57	0.017	2.09
Tenure2	0.000	-0.09	0.000	-2.15	0.000	-2.72	0.000	-2.86	0.000	-2.46	0.000	-4.29	0.000	-2.29
	Women (n = 4410)													
	2012													
	5th		10th		25th		50th		75th		90th		95th	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
Experience	0.026	5.76	0.021	6.12	0.018	8.81	0.014	10.21	0.013	7.34	0.016	5.15	0.013	2.84
Experience2	-0.001	-4.68	0.000	-4.47	0.000	-7.28	0.000	-7.55	0.000	-4.77	0.000	-3.6	0.000	-1.95
Tenure	0.016	3.49	0.008	2.23	0.007	3.29	0.006	3.55	0.007	2.85	0.003	0.68	0.004	0.62
Tenure2	0.000	-2.34	0.000	-1.36	0.000	-1.6	0.000	-1.3	0.000	-0.66	0.000	0.76	0.000	0.32
	Men (n = 4375)													
	2012													
	5th		10th		25th		50th		75th		90th		95th	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
Experience	0.026	8.03	0.024	11	0.016	10.8	0.016	8.22	0.014	4.79	0.016	4.64	0.011	2.63
Experience2	0.000	-6.22	0.000	-7.8	0.000	-7.53	0.000	-6.51	0.000	-2.94	0.000	-2.75	0.000	-1.06
Tenure	0.016	2.48	0.016	5.8	0.016	8.22	0.017	9.37	0.016	7.05	0.015	4.2	0.016	2.51
Tenure2	0.000	-2.06	0.000	-4.34	0.000	-5.73	0.000	-6.99	0.000	-3.79	0.000	-3.62	0.000	-2.42

c) Decomposition

Decomposing the gender wage gap along the wage distribution identifies the explanations for the gender wage gap along the wage distribution and show whether the explanations differ between the higher earning and lower earning men and women. The decomposition results show that in both 2001 and 2012, a positive and increasing gender wage gap existed along the wage distribution (Figure 4). The increasing gender wage gap along the wage distribution in 2001 and 2012 confirms the existence of the Australian glass ceiling as discussed by Kee (2006). A comparison of the distributional gender wag gap between 2001 and 2012 shows

that the gender wage gap has increased over time[6]. Interestingly, as we move along the wage distribution, the difference between the distributional gender wage gap increases. This indicates that the glass ceiling effect in the Australian labour market is not only persistent but becoming increasingly worse over time.

Figure 4 Quantile gender wage gap, 2001 and 2012



In 2001, the quantile decomposition results (Table 5) show that the gender wage gap is attributable to difference in the returns (coefficients) that women and men receive for their labour market characteristics along the entire wage distribution. This is the unexplained component of the decomposition, which is often referred to in the literature as "discrimination". As we progress along the wage distribution, the gender wage gap becomes more attributable to differences in coefficients; the returns to labour market characteristics. For example, at the distribution's extremes, namely the 5th wage percentile, if women retained their labour market characteristics but were paid like men, their average hourly earnings would increase by 4 per cent. However, at the 95th wage percentile, women's average hourly earnings would increase by 27 per cent.

The endowment component of the decomposition, which attributes the gender wage gap to differences in the labour market characteristics of men and women, is small and negative along the entire 2001 wage distribution. This implies that if women had the same labour market characteristics (endowments) as men but continued to be paid like women, their average hourly earnings would decline. The endowment impact becomes increasingly

[6] With the exception of the 5th wage percentile

negative as we progress along the wage distribution. For example, at the distribution's extremes, women earning at the 5th wage receive a 1 per cent reduction in hourly earnings if they had the same labour market characteristics as men but continued to be paid like women. While women earning at the top of the wage distribution (at the 95th wage percentile) experience a 7 per cent average hourly wage declined if they obtained men's labour market characteristics but continued to be paid like women.

The 2012 quantile decomposition results (Table 5) show that the persistent and increasing gender wage gap along the wage distribution is attributable mainly to differences in returns to labour market characteristics (coefficients), rather than the differences in labour market characteristics (endowments). Similarly to 2001, the decomposition results in 2012 show that as we process along the wage distribution, the gender wage gap becomes increasingly attributable to coefficient differences, while the impact of endowment differences becomes significantly negative. For example, at the 10th wage percentile, the coefficient component of the decomposition explains the entire gender wage gap. As such, in 2012, if women at the 10th wage percentile possessed the same labour market characteristics as men and continued to be paid like women, their average hourly earnings would remain unchanged. However, if women retained their labour market characteristics but were paid like men, their average hourly wage would increase by 4 per cent. At the other end of the distribution, at the 95th wage percentile, the gender wage gap is 26 per cent. At this wage percentile, if women had men's labour market characteristics but continued to be paid like women, their average hourly earnings would decline by 5 per cent. By contrast, if women at the 95th wage percentile retained their labour market characteristics but were paid like men, their earnings would increase by an average of 31 per cent. The quantile decomposition result show that the gender wage gap has not improved between 2001 and 2012. Further, the gender wage is more attributable to the unexplained component of the decomposition in both 2001 and 2012, at the mean and along the wage distribution.

Table 5 Quantile gender wage gap decomposition, 2001 and 2012

	2001						
	5th	10th	25th	50th	75th	90th	95th
Raw wage gap	3%	3%	6%	11%	16%	19%	20%
t-stat	1.67	2.71	729%	12.9	13.67	12.79	11.18
Coefficient (unexplained) gap	4%	3%	7%	13%	20%	25%	27%
t-stat	1.76	2.39	7.6	17.31	20.22	18.62	13.74
Endowment (explained) gap	-1%	0%	-1%	-2%	-5%	-5%	-7%
t-stat	-0.21	-0.01	-0.8	-2.64	-4.09	-3.54	-3.31
	2012						
	5th	10th	25th	50th	75th	90th	95th
Raw wage gap	1%	4%	9%	15%	19%	23%	26%
t-stat	0.85	4.02	11.87	17.89	18.79	15.39	13.02
Coefficient (unexplained) gap	0%	4%	10%	18%	24%	27%	31%
t-stat	0.21	3.9	16.89	26.02	27.03	24.49	18.82
Endowment (explained) gap	1%	0%	-1%	-3%	-5%	-5%	-5%
t-stat	0.65	0.09	-1.66	-3.82	-4.72	-3.82	-3.13

Discussion and conclusion

The key findings from this paper are that, overall, women's labour market characteristics have improved between 2001 and 2012. Although this improvement is expected to lead to a reduction of the gender wage gap over time, the mean and distributional analysis show that the gender wage gaps in 2001 and 2012 have not improved in the Australian labour market between these years. The mean decomposition results indicate that the gender wage gap is positive and unexplained; with a greater extent and significance in 2012 compared to 2001. These findings are confirmed by the quantile decomposition results, which show a positive and increasing gender wage as we progress up the earnings distribution and confirm the existence and worsening of the glass ceiling effect. The quantile decomposition results also show that the gender wage gap is unexplained along in the entire wage distribution; as such, the gender wage gap cannot be attributed to differences in labour market characteristics between men and women. The increasing unexplained (coefficient) distributional gender wage gap indicates that women earning at the top of the wage distribution are "underpaid" given their labour market characteristics. These results are consistent with Australian (Kee 2006, Baron and Cobb-Clarke 2010) and international (Arulampalam et al. 2007) of gender wage decompositions. Baron and Cobb-Clarke (2010) find that regardless of the sector of employment, the gender wage gap at the top of the wage discrimination is larger compared to

the bottom of the wage distribution and this gap is unexplained by labour market characteristics.

As most of the distributional gender wage gap is unexplained, especially at the top of the earnings distribution, these results indicate that unobserved heterogeneity is driving the wage gap between men and women. The lack of attribution of the gender wage gap to the endowment component of the wage decomposition can be a result of error in the measurement of labour market experience. The unobserved heterogeneity is a result of time invariant factors that were not captured by the model such as women's choice of whether or not to participate in the labour market, the choice of sector of employment, and the choice of hours worked.

The unobserved heterogeneity that drive the gender wage gap includes 1) statistical and taste discrimination as described by Altonji and Blank (1999); 2) male dominated organisational networking and group interactions which hinder women from progressing up the career path and into seniority (Bridges and Villemez, 1986, Boxman et al., 1991, Simon and Warner, 1992); 3) choices made by women of selection into the labour force and into particular sectors of employment; the Australian public and private sectors; and 4) Cognitive ability and productivity differences between men and women.

Appendix

Table 1 Variables names and definitions by gender – 2001 and 2012

Women

Name	Wave 1 (2001) Mean	Wave 12 (2012) Mean	Definition
	n = 3192	n = 4422	
Education variables			
Post graduate	3%	6%	= 1 if respondent's highest level of education is postgraduate; = 0 otherwise
Bachelor or honours degree	17%	20%	= 1 if respondent's highest level of education is postgraduate; = 0 otherwise
Graduate diploma	8%	8%	= 1 if respondent's highest level of education is graduate diploma or graduate certificate; = 0 otherwise
Advance diploma/diploma	10%	10%	= 1 if respondent's highest level of education is bachelor or honours; = 0 otherwise
Certificate	11%	19%	= 1 if respondent's highest level of education is certificate I or II; = 0 otherwise
Year 12	20%	20%	= 1 if respondent's highest level of education is year 12; = 0 otherwise
Year 11 less	30%	17%	= 1 if respondent's highest level of education is year 11 or below; = 0 otherwise
Location			
City	67%	66%	= 1 if respondent resides in major cities of Australia; = 0 otherwise
Experience			
Tenure	8.0	8.3	Tenure with current employer (in years)
Tenure^2			Tenure squared
Experience	16.3	15.8	Years in paid work
Experience^2			Experience squared
Parenthood			
Children*	84%	84%	= 1 if has residential child(ren) or intend to have child(ren) = 0 otherwise
Labour force status			
Part time	46%	45%	= 1 if respondent is working part time; = 0 otherwise
Private Sector	66%	69%	= 1 if respondent works in the private sector; = 0 otherwise

* have or intend to have children

Men

Name	Wave 1 (2001) Mean	Wave 12 (2012) Mean	Definition
	n = 3242	n = 4383	
Education variables			
Post graduate	4%	6%	= 1 if respondent's highest level of education is postgraduate; = 0 otherwise
Bachelor or honours degree	14%	15%	= 1 if respondent's highest level of education is postgraduate; = 0 otherwise
Graduate diploma	5%	5%	= 1 if respondent's highest level of education is graduate diploma or graduate certificate; = 0 otherwise
Advanced diploma/diploma	9%	9%	= 1 if respondent's highest level of education is bachelor or honours; = 0 otherwise
Certificate	27%	28%	= 1 if respondent's highest level of education is certificate I or II; = 0 otherwise
Year 12	17%	19%	= 1 if respondent's highest level of education is year 12; = 0 otherwise
Year 11 or less	24%	17%	= 1 if respondent's highest level of education is year 11 or below; = 0 otherwise
Location			
City	66%	66%	= 1 if respondent resides in major cities of Australia; = 0 otherwise
Experience			
Tenure	9.3	9.1	Tenure with current employer (in years)
Tenure^2			Tenure squared
Experience	19.3	17.6	Years in paid work
Experience^2			Experience squared
Parenthood			
Children*	82%	83%	= 1 if has residential child(ren) or intend to have child(ren) = 0 otherwise
Labour force status			
Part time	12%	14%	= 1 if respondent is working part time; = 0 otherwise
Private Sector	76%	79%	= 1 if respondent works in the private sector; = 0 otherwise

* have or intend to have children

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