

Age, Period, Cohort Effects in the Gender Pay Gap in Australia

M. Kamal¹ P. Blacklow¹

¹Tasmanian School of Business and Economics
University of Tasmania

ACE, July 2022

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- In Australia and other OECD economies, younger cohorts of women have significantly outperformed younger male cohorts in terms of upper secondary graduation rate, tertiary level education attainment and life expectancy (OECD 2017, 2018; ABS 2018b).
- Such progress has been accompanied by improvements in the legal framework in many of the same countries to ensure equal pay and opportunity for all citizens (Fagan and Rubery 2018; O'Reilly et al. 2015; Byrnes 2013; Charlesworth and Macdonald 2015).
- The median income gap of fulltime female employees showed only little change across the OECD in the past decade to equal 14.3 percent in 2015 (OECD, 2017).
- Similarly, in Australia, the average full-time female weekly earnings was 85 percent of the average male earnings in 2018, which also has been fairly unchanged over the last decade (ABS, 2018).

Motivation cont.

- These advances are expected to be reflected in the gender pay gap, through the age, period and birth cohort (APC) effects.
- Age effects: “a direct determinant of earnings” associated with the maturity of the individual (Heckman and Robb, 1985)
- Period effects: legislative and attitudinal improvements that reduce discrimination
- Cohort effects: large size of some birth cohorts later raises the youth labour supply and suppresses their wages (Topel, 1997); educational boom within a cohort can also lead to cohort effects (Card and DiNardo, 2002).
- Recent research has been increasingly concentrating on how the gender pay gap progresses over an individual’s life cycle or how it varies between different cohorts (e.g., Tyrowicz, Velde, and Staveren 2018; Fortin 2019; Erosa, Fuster, and Restuccia 2016).
- However, these studies often ignore or poorly address the APC identification problem.

- This identification problem arises from the statistical difficulty in separating the effects of these three components from one another due to the identity, survey year = birth year + age (Glenn, 2005).

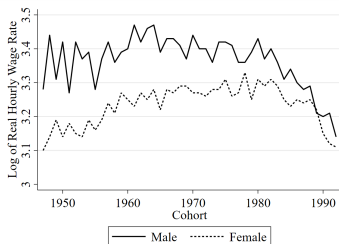
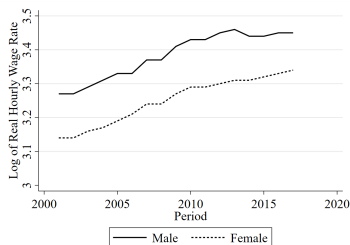
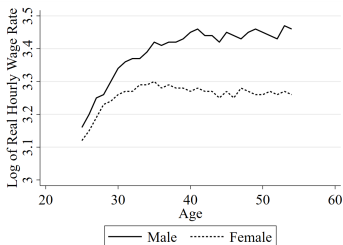
Table 1: Hypothetical data

	p2011	p2012	p2013
a21	c1990	c1991	c1992
a22	c1989	c1990	c1991
a23	c1988	c1989	c1990

- It, therefore, remains unclear whether any change in the gender wage gap ratio between two cohorts representing two different time periods is actually the result of a birth cohort effect or not.
- This paper examines the individual impact of the APC variables on the convergence or persistence of the Australian gender wage gap and isolate the APC effects from traditional human capital effects.

Data and Raw APC Effects

- The data for this research will primarily come from the Household, Income and Labour Dynamics in Australia (HILDA) Survey.



Identification Strategy

Popular methods to resolve the APC identification issue can be grouped into two categories.

- One of the first proposed solutions is to assume that only two from age, period and cohort are relevant for a particular problem.
- However, this is a rather strong theoretical assumption to make, which does not hold in many situations including the present one (Winship and Harding 2008).
- Another widely used approach is to make one or more identifying constraints on the regression parameters, such as the one that the coefficients of the first two cohorts are equal (Yang and Land 2013).
- A major problem with this second approach is that it depends on the number of age, period, and cohort categories that are considered in the study or produces significantly different results based on the choice of constraints (Jürges 2003; Luo 2013a).

Identification Strategy cont.

This study applies the proxy variable method to replace at least one of the age, period, or cohort effects.

Economic conditions: Unemployment rate in major statistical region of the person involved (see Nientker and Alessie 2019)

Technological progress: Change in the growth of information technology net capital stock to net capital stock (Kelly 2007)

Legal environment: Dummy variables for Age Discrimination Act 2004 and Fair Work Act 2009

Cohort: The size and educational level of a person's birth cohort

- The solutions to the APC problem can never be found in statistical manoeuvring, but should come from theories (Glenn 1976).
- Since age, period, and cohort effects act as a summary measure of the influences of different factors (Hobcraft, Menken, and Preston 1985), the use of those factors directly as proxy variables provides valuable information about the underlying forces at work.

Econometric Model Specification

The present paper begins the empirical analysis by utilizing variations of a Mincer-type earnings function of the following form

Equation 1

$$y_{it} = \beta_A A_{it} + \beta_P P_t + \beta_C C_i + \beta_F F_i + \beta_{AF} A_{it} F_i + \beta_{PF} P_t F_i + \beta_{CF} C_i F_i + \mathbf{Z}_i \gamma + \mathbf{X}_{it} \beta + \mathbf{W}_i + \varepsilon_{it}$$

where y_{it} is the log of the hourly real wage for individual i in year t . A_{it} , P_t , C_i , and F_i are the dummy variables representing age, period, cohort, and female, respectively.

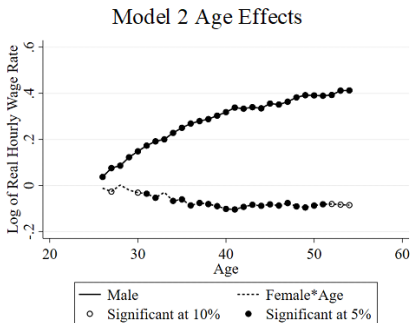
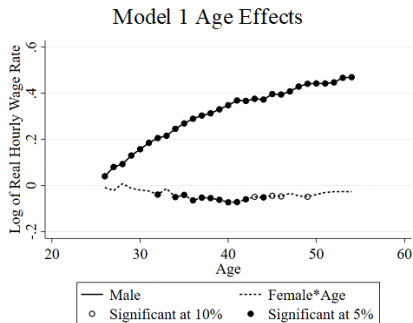
- The vector of all time-varying regressors other than age is denoted by \mathbf{X}_{it} .
- On the other hand, \mathbf{Z}_i is the set of time-constant observed variables excluding cohort and gender and \mathbf{W}_i contains the unobserved heterogeneity or individual effect and a constant term.

Estimation Strategy and Sample Selection Bias

- Equation 1 is estimated using mainly the correlated random effects (CRE) model.
- By including the means of the time-varying variables (e.g., occupational tenure and age), the CRE approach can estimate the coefficients of time-constant covariates while allowing for arbitrary correlation between unmeasured heterogeneity and the observed explanatory variables (Joshi and Wooldridge 2019).
- Control variables includes, for example, Age, Country of Birth, Marital Status, Children, Geographic remoteness, Tenure, Employment Status (e.g., Full-time, Casual, Public sector, and Union Membership), Health Condition, and Education, Occupation and Industry Dummies.
- Selection bias and endogeneity issues are addressed according to the procedure in Wooldridge (1995) and Semykina and Wooldridge (2010). The method is similar to Heckman's two-step estimation.

Results... Age Effects

- Model 1 replaces period dummies with year proxy variables.
- Model 2 employs cohort proxies instead of cohort dummies.

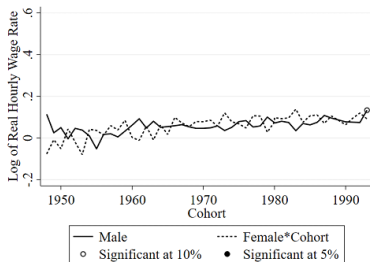


- Age effect is a significant predictor of the male-female wage gap in Australia, even after controlling for period effects and labour market experience, education, health, and cohort status of the respondents.

Results cont.... Cohort Effects

- Model 1 replaces period dummies with year proxy variables.

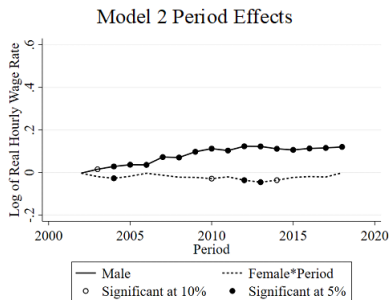
Model 1 Cohort Effects



- The impact of cohort effects is found to be inconsequential, both for the overall wages as well as for the gender difference in wage rates.
- Age Discrimination Act and Fair Work Act dummy variables show a significantly positive relationship with wage rates.
- The unemployment rate and the interaction of women and the Fair Work Act dummy, in contrast, are negatively related to wage rates.

Results cont.... Period Effects

- Model 2 employs cohort proxies instead of cohort dummies.



- It is reasonable to say that period effects play some considerable role in the determination of the gender wage gap by relatively suppressing the female wage rate compared to the male rate.
- Cohort size, cohort educational level and their interaction with female dummy have failed to achieve statistical significance in all the models

Results cont.... Estimates w/o Period and Cohort Proxies

- The next two specifications attempts to understand the consequences of not controlling for all three of APC variables simultaneously.
- Model 3 considers the impact of only age and birth cohort on the gender wage gap as it keeps the period effect out of the analysis.
- The average age and cohort effects, for example, are now overestimated by about 7.77 and 15.34 percentage points, respectively, for the male employees.
- In contrast, Model 4 includes age and period effects, but disregards the cohort effect entirely.
- The result shows no major impact of the absence of cohort variables.
- We also estimate the models without the job-related variables to find out that if the correlation between the cohort effect and these variables are the reason the cohort effects' absence in previous models.
- The cohort effect still remains insignificant even without the inclusion.

- This finding regarding age effects corroborates similar studies performed in Australia and other countries (e.g., Tyrowicz, Velde, and Staveren 2018; Erosa, Fuster, and Restuccia 2016; Wu 2007; Chatterjee, Singh, and Stone 2016).
- The finding that no cohort effects exist on the Australian gender wage gap contradicts its significant role (both positive and negative) in the determination of gender wage gap in previous such studies performed elsewhere (e.g., Abe 2010; Naur and Smith 2002; Tyrowicz, Velde, and Staveren 2018).
- The insignificant cohort effects in our results may indicate that cohorts are perfect substitutes for one another.
- This result aligns more with Card and Lemieux (2001) who suggest the wage gap can be fully captured by age and period effects and that cohort effects cannot be expected to play any role.

Conclusion

- Overall, the findings imply that the application of Mincer type equations for certain purposes, such as estimating the wage rate over the life cycle or across cohorts, can lead to over or under-estimation of the parameters if the APC problem is ignored.
- From the policy perspective, the paper supports previous evidence to suggest that since the gender wage gap increases with age, economic conditions would be more unfavourable for women at retirement age and particularly for single female households.
- The paper shows the necessity of being more attentive to the effects of yearly changes in socio-economic conditions since estimated period effects show a further diverging role in the male-female wage gap.
- Finally, it establishes that since eliminating the educational difference between the genders is not proving to be enough for ensuring wage gains for younger female cohorts compared to their male counterparts, policy measures need to be broadened in Australia if they are to reduce the wage gap for recent cohorts.

The End

Thank You

*References are available upon request.