Gender pay gap and returns to cognitive and non-cognitive skills: Evidence from Australia

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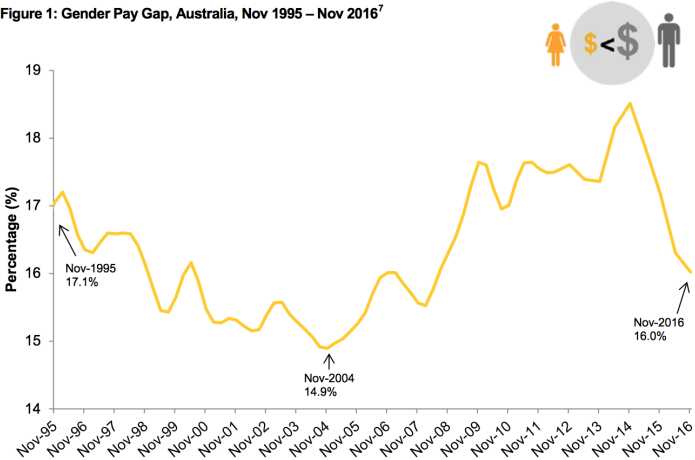
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Introduction

▶ Recent figures: national gender pay gap - 16% (ABS, 2017).

Figure 1: Gender Pay Gap, Australia, Nov 1995 – Nov 2016[7]

Nov-1995
17.1%

Nov-2004
14.9%

Nov-2016
16.0%

Source: Australian Bureau of Statistics (2017), Average Weekly Earnings. Based on full-time average weekly earnings with May as the reference period.
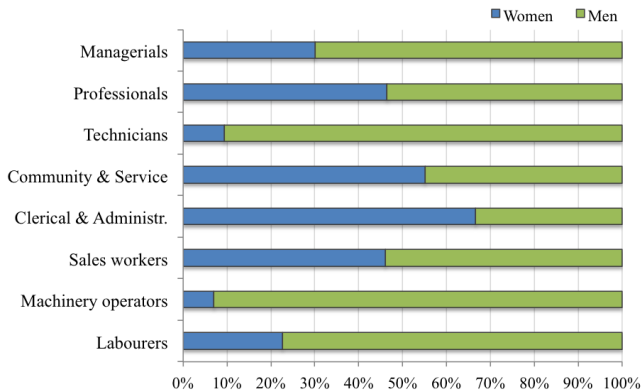
Introduction:

Several explanations for gender difference in wages:

- ▶ Women - shorter career in the labour market due to childbearing - invest less in some types of human capital than men (Becker, 1973)

- ▶ Women - discriminated against based on gender segregation by occupation (Bergmann, 1974; Becker, 1957 'discrimination model', Arrow's (1973) statistical discrimination argument - rooted in this notion)

    - ▶ Men & women do different kinds of work (Cobb-Clark & Tan) (Fig.1)
    - ▶ Individuals' occupational choices are driven in part by their personality traits and preferences (Filler, 1986; Mueller & Plug, 2006; Cobb-Clark & Tan, 2011; Nyhus & Pons, 2012)

Distribution of full-time male and female workers within occupation classes in Australia, HILDA 2014

- ▶ Full-time machinery operators, managerial and technicians are much more likely to be men than women;
- ▶ Clerical and administrative workers are dominated by women;

Source: Author's calculations based on HILDA data.

In this paper:

We use human capital approach and rich national data to explore:

- ▶ The role of cognitive and non-cognitive skills in explaining the gender wage differences along earnings distribution in Australia:

  - ▶ possible channel: through sorting of workers across sectors on the basis of their personality traits (Cobb-Clark & Tan, 2011)

  We aim to document:

- ▶ (i) differences in the returns of cognitive and non-cognitive skills by gender;
- ▶ (ii) how males and females sort out their occupations based on their cognitive and non-cognitive attributes;
- ▶ (iii) what contribution of both cognitive and non-cognitive attributes in explaining the gender wage gap is?

Preliminary findings:

- (i) Both cogn. & non-cogn. skills predict wages and are valued differently for men and women
  - Scoring one additional point on reading cogn. test results in a *bigger gain* in terms of wage for women than for men, *ceteris paribus*;
  - Conscientiousness & agreeableness had the greatest influence on earnings;
    - some personality traits are rewarded while other are punished;

- (ii) Evidence of labour market sorting:
  - men who are more extroverted (i.e. assertive, social) have a 1.9 percentage point higher probability of working as managers;

- (iii) The magnitude of the conditional gender wage gap varies throughout wage distribution:
  - Cognitive skills and personality traits reduce the unexplained gender wage difference;

Background Literature:

- Men - more ambitious in their career & value money more, while women - place people and family first (Fortin, 2008).

  - 8% of gender wage gap in the US - explained by differences in non-cognitive traits such as importance of money/work & importance of people/family;

- Gender differences in behavioural traits - competitiveness, risk preferences & attitudes towards negotiation - factors that *explain* gender differences in labour market outcomes (Marianne, 2011).

- Gender differences in return to the 'big-five' traits explain between 7% and 16% of the wage gap in the US, while IQ differences play no role (Mueller & Plug, 2006).

Background Literature (continue):

In contrast:

- Even after accounting for the wide set of human capital components, capturing cognitive and/or non-cognitive abilities - significant part of gender pay gap across 26 European countries *still remains unexplained* (Christofides, 2013, *Labour Economics*).

- Psychological attributes account for a small to moderate portion of the gender pay gap, considerably *smaller* than say occupation and industry effects (Blau and Kahn, 2016).

Empirical specification

- ▶ Linear Mincerian specification:

$$w = \alpha C + \sigma NC + \Gamma' \gamma + \epsilon$$

where w - log of hourly earnings; C and NC - cognitive & non-cognitive attributes; Γ is a vector of individual characteristics and ϵ is the error term.

- ▶ Chernozhukov et al. (2013, *Econometrica*) decomposition quantile regression-based estimators for evaluating counterfactual effects (e.g.Machado & Mata, 2005):

$$\Delta_\theta = \underbrace{(Q_{m,\theta} - CF_\theta^f)}_{\text{Endowment effect}} + \underbrace{(CF_\theta^f - Q_{f,\theta})}_{\text{Quantile treatment effect}}$$

where $CF_\theta^f = X_i^f \beta_{m,\theta}$ which is the density that would arise if women retained their own labour market characteristics, but were paid like men.

The HILDA data: cognitive skills

Restrict sample to employees aged 20-65;
Dep.var= log of gross hourly wage

- ▶ Cognitive tests - collected in one point in time 2012:

    - ▶ (*i*) *National Adult Reading* - reading test of 50 irregularly spelled words (test of pre-morbid intelligence)
    - ▶ (*ii*) *Backwards Digit Span* - working memory - repeat in reverse order longer strings of single-digit numbers;
    - ▶ (*iii*) *Symbol Digits Modality* - match symbols to numbers using a printed key;
        - ▶ the score is the number of correctly matched within a 90 second time interval;
        - ▶ underlie many substitution tasks, including attention, visual scanning, and motor speed;

The HILDA data: personality traits

- Big-Five psychological traits - collected in 2005, 2009, 2013:

  - *Extroversion* - relates to outward orientation rather being reserved (sociable, talkative, outgoing);

  - *Agreeableness* - act in a cooperative & unselfish manner (altruistic, kind, forgiving nature);

  - *Conscientiousness* - organized, responsible, hard-working;

  - *Emotional stability* - opposite to neuroticism;

  - *Openness to experience* - open to aesthetic, cultural or intellectual experience (active imagination, intellectually curious);

- We average the scores for each individual across available waves to reduce the measurement error in self-assessed non-cognitive skills (Cobb-Clark et al., 2014);

- Cogn.& non-cogn.traits are converted into z-scores, with mean 0 and standard deviation 1;

Descriptive statistics

t-table	Men	SD	Women	SD	Difference
Log hourly wages	3.120	[0.49]	3.010	[0.45]	0.11***
Reading test	14.07	[5.31]	14.51	[4.78]	-0.44***
Working memory	4.11	[1.44]	4.14	[1.44]	-0.02
Matching symbols	51.78	[10.19]	55.19	[10.06]	-3.41***
Extroversion	4.35	[0.95]	4.61	[1.09]	-0.25***
Agreeableness	5.17	[0.79]	5.65	[0.73]	-0.48***
Conscientiousness	5.01	[0.90]	5.25	[0.94]	-0.24***
Emotional stability	5.11	[0.95]	5.12	[0.99]	-0.01
Openess to experience	4.33	[0.92]	4.25	[0.97]	0.08***

Notes: The sample includes men and women aged 20-65 with no missing information on earnings and other characteristics. Cells contain means, brackets contain standard deviations. * Difference is statistically significant at the 10% level. ** Difference is statistically significant at the 5% level. *** Difference is statistically significant at the 1% level.

Return to cognitive and non-cognitive skills - z-scores, OLS

Dep.Var.log hourly wage	MEN		WOMEN	
Reading test	0.034***	0.036***	0.052***	0.054***
	(0.010)	(0.010)	(0.010)	(0.010)
Working memory	0.011	0.012	-0.015	-0.016
	(0.009)	(0.009)	(0.008)	(0.008)
Matching symbols	0.022*	0.018	0.032***	0.029***
	(0.009)	(0.009)	(0.009)	(0.009)
Extroversion		0.011		0.007
		(0.009)		(0.007)
Agreeableness		-0.036***		-0.039***
		(0.009)		(0.011)
Conscientiousness		0.042***		0.027***
		(0.010)		(0.008)
Emotional stability		0.004		0.005
		(0.010)		(0.008)
Openness to experience		0.009		-0.006
		(0.011)		(0.009)
R^2	0.204	0.213	0.214	0.221
N	3060	3060	3036	3036

Notes: Standard errors in parentheses. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$. Specifications control for age, age2, marital status, full-time, permanent job status, born overseas, states dummies, cohort dummies; Column (2) additionally adds Big-Five personality traits. F-test indicates whether estimated coefficients for the Big-Five personality are jointly significant. Traits are converted into z-scores, with mean 0 and standard deviation of 1.
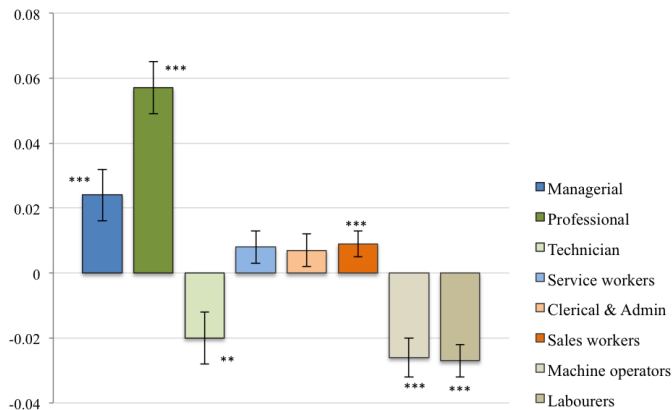
Return to cognitive and non-cognitive skills -z-score, QR

	MEN			WOMEN		
	10th	50th	90th	10th	50th	90th
Reading test	0.036*	0.037***	0.053**	0.038*	0.043***	0.085***
	(0.017)	(0.010)	(0.018)	(0.019)	(0.010)	(0.016)
Working mem.	0.021	0.018*	0.021	-0.017	-0.002	-0.013
	(0.015)	(0.009)	(0.016)	(0.015)	(0.008)	(0.013)
Matching symb.	0.008	0.022*	0.011	0.036*	0.022*	0.008
	(0.017)	(0.010)	(0.018)	(0.017)	(0.009)	(0.015)
Extroversion	-0.012	0.008	0.019	0.001	0.009	0.016
	(0.015)	(0.009)	(0.016)	(0.014)	(0.007)	(0.012)
Agreeableness	-0.041*	-0.034***	-0.029	-0.002	-0.030**	-0.064***
	(0.016)	(0.010)	(0.017)	(0.018)	(0.010)	(0.016)
Conscient.	0.045**	0.044***	0.035*	0.031	0.020*	0.032*
	(0.016)	(0.009)	(0.017)	(0.016)	(0.008)	(0.014)
Emotional stab.	-0.020	0.006	0.027	-0.018	0.005	0.022
	(0.016)	(0.009)	(0.017)	(0.017)	(0.009)	(0.014)
Openness to exp.	-0.002	0.013	0.004	-0.015	-0.006	0.007
	(0.017)	(0.010)	(0.019)	(0.017)	(0.009)	(0.014)
Pseudo R2	0.1066	0.1585	0.1548	0.123	0.1662	0.1669

Notes: Standard errors in parentheses. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.. The test of whether the estimated returns to cognitive and non-cognitive skills differ across each of these quantile levels is significantly different in reading tests (F= 2.91**, p=value=0.020), emotional stability (F=2.04**, p-value=0.066) and agreeableness (F= 2.73**, p-value=0.085) for women.

Labour market sorting for Men: Matching symbols z- score
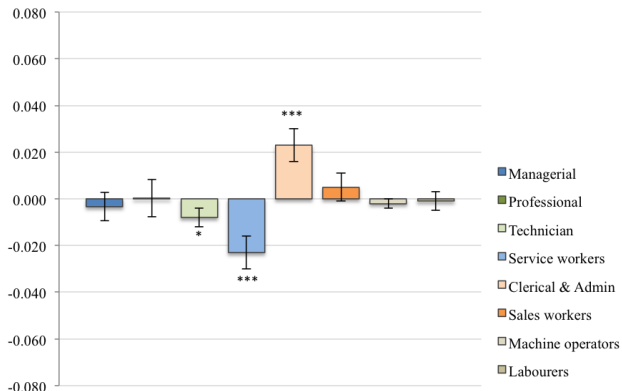
1-SD increase in matching symbols scores - 5.7 percentage points higher probability of working as professionals

Note: The reported marginal effects are average marginal effects after multinomial logit which reflect the change in the probability of being observed in an occupation for each observation averaged across the sample. Specifications additionally control for age, age2, marital status, full-time, permanent job status, born overseas, states dummies, cohort dummies; $*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

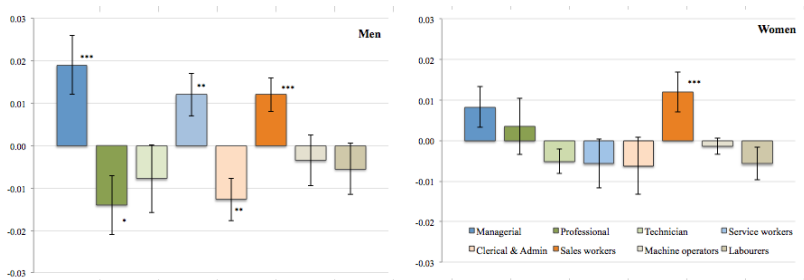# Labour market sorting - Women: Matching symbols z-score

1-SD increase in matching symbols - 3.2 percentage points higher probability of working in clerical & administration occupations

Note: The reported marginal effects are average marginal effects after multinomial logit which reflect the change in the probability of being observed in an occupation for each observation averaged across the sample. Specifications additionally control for age, age2, marital status, full-time, permanent job status, born overseas, states dummies, cohort dummies;
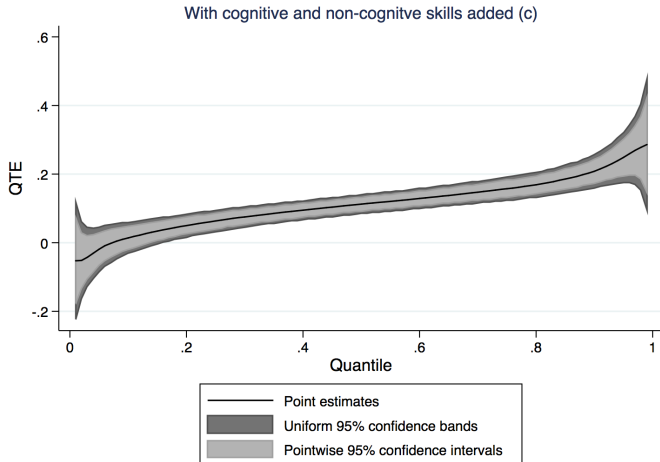
Labour market sorting: Extroversion z- score

▶ Men rating themselves as 1-SD more extroverted (i.e., assertive, active, energetic, upbeat, talkative and optimistic individuals) have a 1.9 percentage point higher probability of working as managers;

Note: The reported marginal effects are average marginal effects after multinomial logit which reflect the change in the probability of being observed in an occupation for each observation averaged across the sample. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$. Specifications additionally control for age, age2, marital status, full-time, permanent job status, born overseas, states dummies, cohort dummies;

Gender wage gap along earnings distribution

▶ 'Glass ceiling' effect - the gender gap is negligible & insignificant at the lower end of the distribution & increased to 22.4 log points at the upper end;

Notes: The differential is calculated at each percentile. The specification controls for education, age, marital status, full-time, permanent job status, being born overseas, states dummies, both cognitive and personality scores.

Decomposition results: gender wage gap along earnings distribution

- ▶ Adding traits appears to reduce the unexplained gender gap at the 90th percentile by about 10%.
- ▶ Cognitive skills & personality traits - explain the gender wage gaps in the lower part of the conditional wage distribution;

	Wage gap	QTE	Endowments	QTE	Endowments	% of total gap
		Only socio-economic characteristics		Cognitive & non-cognitive		
10	0.036***	0.022*	0.014	0.014	0.023**	63.9%
	(0.009)	(0.013)	(0.009)	(0.017)	(0.012)	
25	0.077***	0.072***	0.005	0.063***	0.016	20.1%
	(0.007)	(0.008)	(0.006)	(0.012)	(0.009)	
50	0.122***	0.122***	-0.001	0.112***	0.012	10.2%
	(0.007)	(0.009)	(0.006)	(0.010)	(0.008)	
75	0.162***	0.170***	-0.008	0.157***	0.003	2.0%
	(0.009)	(0.011)	(0.007)	(0.013)	(0.010)	
90	0.199***	0.231***	-0.032***	0.208***	-0.016	-7.9%
	(0.011)	(0.015)	(0.009)	(0.018)	(0.013)	

Notes: Bootstrapped standard errors based on 100 repetitions reported in parenthesis. The differential is calculating by every 1th percentile and results are path dependent. We present the main percentiles. First panel includes age, education, marital status, full-time, and permanent job status controls, being born overseas dummy, states and cohort dummies.

Decomposition results: gender wage gap in Managerial occupation group

▶ Positive endowment effect indicating favourable male characteristics: differences in cogn. & non-cognt.traits of men and women working within the same occupation explain at about 17% of disparity at 25th percentile

Percentile	Wage gap	QTE	Endowments	QTE	Endowments	% of total gap
		Only socio-economic characteristics		Cognitive & non-cognitive		
10th	0.055 (0.035)	0.056 (0.034)	-0.002 (0.021)	0.053 (0.044)	0.024 (0.032)	43.5%
25th	0.138*** (0.023)	0.141*** (0.023)	-0.002 (0.016)	0.115*** (0.029)	0.024*** (0.024)	17.4%
50th	0.151*** (0.022)	0.159*** (0.023)	-0.007 (0.015)	0.119*** (0.024)	0.013*** (0.022)	8.6%
75th	0.165*** (0.025)	0.182*** (0.029)	-0.017 (0.019)	0.145*** (0.0295)	0.008*** (0.025)	4.8%
90th	0.209*** (0.034)	0.228*** (0.044)	-0.019 (0.028)	0.202*** (0.044)	-0.004*** (0.033)	-1.9%

Notes: Bootstrapped standard errors based on 100 repetitions reported in parenthesis. The differential is calculating by every 1th percentile. We present the main percentiles. First panel includes age, education, marital status, full-time, and permanent job status controls, being born overseas dummy, state and cohorts.

Decomposition results: gender wage gap within Technician occupation group

- ▶ Accounting for cogn.& non-cogn.traits does not change significantly the explained component of the gap within techn. occup group;

	Wage gap	QTE	Endowments	QTE	Endowments
Percentile		Only socio-economic characteristics		Cognitive & non-cognitive	
10th	0.101***	0.026	0.075***	0.086	0.010
	(0.044)	(0.054)	(0.034)	(0.073)	(0.044)
25th	0.149***	0.108***	0.041	0.133***	0.003
	(0.022)	(0.028)	(0.022)	(0.037)	(0.031)
50th	0.243***	0.220***	0.022	0.231***	0.005
	(0.018)	(0.025)	(0.022)	(0.034)	(0.028)
75th	0.339***	0.353***	-0.014	0.358***	-0.033
	(0.022)	(0.037)	(0.033)	(0.046)	(0.035)
90th	0.426***	0.580***	-0.154***	0.530***	-0.119
	(0.045)	(0.077)	(0.067)	(0.075)	(0.064)

Notes: Bootstrapped standard errors based on 100 repetitions reported in parenthesis. The differential is calculating by every 1th percentile. We present the main percentiles. First panel includes age, education, marital status, full-time, and permanent job status controls, being born overseas dummy, state and cohorts.

Conclusions

- Both cogn. & non-cogn. skills are important determinants of earnings
  - some personality traits are rewarded while other are punished (wage penalty of 6.4% for women at the top end - consistent with Judge et al.1999; Heineck, 2011)
    - it might well be that very agreeable persons are too passive in conflict situations / poor wage negotiators;
- Evidence of labour market sorting into different occupations based on cogn. & non-cogn. skills & the effects vary between gender:
  - Increased extroversion & conscientiousness - associated with higher probability that men work in managerial occupations, but insignificant for women;
- Small pay gap at the bottom end of the distribution, explained significantly by observable productive characteristics
  - The gap is negligible & insignificant at the 10th percentile and increased to 22.4 log points at the to end of the distribution.

Limitations and future research

- Cognitive test - observed in one time point - we are confronted with cross-sectional variation;
  - cognitive & non-cognitive traits reflect, rather than cause the outcome;

- Decomposing gender wage gap accounting for endogenous occupational choice;

- Sequential decomposition - results are path dependent, i.e. coefficients depending on which variables we begin with in the model.
  - several feasible paths and results are similar in magnitude & pattern;