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Anna Adamecz
UCL Social Research Institute, University College London, Institute of Economics, HUN-REN Centre for Economic and Regional Studies (KRTK KTI) and IZA

Nikki Shure
UCL Social Research Institute, University College London and IZA

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

The Underconfidence Wage Penalty*

Recent evidence on the gender wage gap shows that it has remained stagnant for those with a university degree and is the largest at the top of the earnings distribution. Many studies have explored institutional factors that contribute to the gender wage gap, but there is little evidence on the role of non-cognitive traits, including overconfidence. This is surprising given its prominence in academic and popular literature. We use a measure of overconfidence captured in adolescence to explain the gender wage gap at age 42. Our results show that overconfidence explains approximately 5.5% of the unconditional gender wage gap. This is driven by women being more underconfident, not men being more overconfident. Furthermore, we find negative wage returns on being underconfident for both men and women. Most of this penalty works via occupational sorting, having lower pre-university educational outcomes, and being less likely to study high-return subjects at university. This has implications for the limitations of workplace-based interventions aimed at boosting women's confidence.

JEL Classification: I24, I26, J24

Keywords: gender gaps, gender wage gap, overconfidence, underconfidence

Corresponding author:
Anna Adamecz
UCL Social Research Institute
University College London
55-59 Gordon Square
London WC1H 0NU
United Kingdom

E-mail: a.adamecz-volgyi@ucl.ac.uk

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1. Introduction

Recent evidence shows that although the gender wage gap is narrowing, it has stagnated and remained substantial at the top of the earnings distribution (Blau and Kahn 2017; Costa Dias, Elming, and Joyce 2016). At the same time, the popularity of the book *Lean In* by Sheryl Sandberg has struck a nerve with many women. In the book, Sandberg posits that not only do structural barriers hold women back in the workplace, but they are also “holding themselves back” with their low confidence (Sandberg 2013). Several non-cognitive traits have received considerable attention in the economics literature as they pertain to labor market outcomes (Almlund et al. 2011; Borghans et al. 2008; Groves 2005; Heckman, Stixrud, and Urzua 2006; Nyhus and Pons 2005), and they have been found to be moderate explanatory factors for the gender wage gap (Blau and Kahn 2017). However, none of this work has investigated over- or underconfidence as an explanatory factor in the gender wage gap, even though previous papers look at the gender gap in the expected wages of university students and show that men being more overconfident than women explains about 7-18% of this gap (Briel et al. 2021; Reuben, Sapienza, and Zingales 2015). There is also evidence that overconfidence contributes to the gender gap in the probability of working in a top job (Adamecz-Völgyi and Shure, 2022), but no work exists using overconfidence to explain the gender gap in actual wages.

This paper fills this gap in the literature by examining the role of adolescent over- and underconfidence in the gender wage gap at age 42 using a nationally representative British cohort study. Psychologists have highlighted the centrality of overconfidence to human interactions (Griffin and Tversky 1992) and typically differentiate between three types of overconfidence. These are: (1) the overplacement of one’s skills compared to others; (2) the overestimation of own abilities compared to objective measures; and (3) the overestimation of the precision of certain beliefs (overprecision) (Moore and Healy 2008). We use the second definition and measure overconfidence by looking at whether one’s self-assessed cognitive skills (how well individuals think they do in mathematics and how clever they are, for example) are higher than their performance on a series of cognitive ability tests taken at ages 5, 10 and 16. While on average people tend to be overconfident, i.e., they think their abilities to be higher than they really are (Bandiera et al. 2022), there is much discussion in the literature about whether there is a gender gap in overconfidence. Some papers find no difference between the overconfidence of men and women (Bandiera et al. 2022; Friehe and Pannenberg 2019), others emphasize the existence of stronger male overconfidence, especially in domains traditionally regarded as “male” (Bertrand 2011; Danková and Servátka 2019; Sarsons and Xu 2021; Exley and Kessler 2022).

Using our measure of overconfidence, we find that it is a statistically significant explanatory factor of the gender wage gap at age 42 and explains about 5.5% of the raw gap. This affirms previous research which showed that other non-cognitive traits are moderate contributors of the gender wage gap (Blau and Kahn 2017). When we look at being under- or overconfident separately, we find women’s underconfidence matters most. While being underconfident carries a roughly 0.05-0.10 log point (roughly 5-10%) penalty in terms of hourly wages for both genders, as women are more likely to be underconfident, they suffer more from this issue. After controlling for social background, educational and employment characteristics, underconfident men earn 0.048 log points less than men who are neither underconfident nor overconfident, that is roughly equivalent to £1,700 per year (in 2023 GBP). For women, the same penalty is 0.053 log points per hour or roughly £1,500 per year (in 2023 GBP). We find that most of the underconfident wage penalty comes from underconfident individuals working in different occupations, having lower pre-university educational outcomes, and being less likely to obtain high-return degrees as compared to more confident individuals. This has implications for workplace-based interventions targeting women’s underconfidence and highlights the need to intervene earlier.

The rest of this paper proceeds as follows. We introduce the data and our measure of overconfidence in Section 2. In Section 3, we present our empirical methods and results. In Section 4, we discuss and conclude.

2. Data

We use the British Cohort Study 1970 (BCS70), which follows the lives of 17,000 individuals born in the UK in a specific week in 1970 (CLS n.d). We restrict the sample to those individuals who participated in: (1) the age 42 wave, from which we measure the outcome variable, log hourly wage, and (2) the age 5, 10, and 16 waves and have data on at least one objective and one subjective self-assessed ability measure that we use to capture overconfidence. Furthermore, following the convention of the gender wage gap literature, we concentrate on those in full-time employment at age 42 who reported data on wage and hours worked that we use to calculate our dependent variable: log hourly wage (number of individuals: 3,858). We appreciate the fact that people make a joint decision about whether they work, whether they work full time, what positions they apply for, what wages they accept, and whether they report data on their wages in a survey. This paper however follows a simplified approach and investigates the gender wage gap after these decisions have been made. While theoretically, attrition, non-response, and our sample-restriction choices could have affected our conclusions, we rely on Adamecz-Völgyi and Shure (2022), who applied a similar sample restriction strategy when evaluating the role of overconfidence in the gender gap in top job employment and showed that these decisions (as well as attrition and non-response) had no influence on their results.

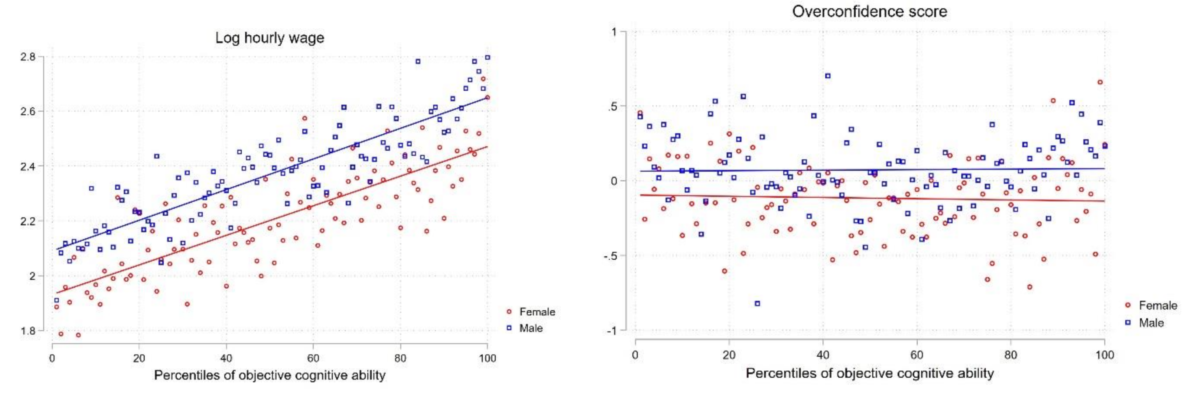
Measuring overconfidence

Following Adamecz-Völgyi and Shure (2022), we construct a measure of overconfidence by comparing a continuous composite measure of individuals' self-assessed abilities (what individuals think about how clever they are and how good they are in school) to a continuous composite measure of their objective cognitive abilities. We measure objective abilities via 18 tests (altogether covering more than one hundred exercises that individuals solved) taken at ages 5, 10 and 16 that we combine into a summary index (see the explanation of measures in Table A1 in the Online Appendix). While measuring cognitive abilities has been shown to be challenging in the literature, measuring them via a large number of tests from three ages in childhood and adolescence reduces measurement error and captures a more credible measure of latent cognitive abilities. Similarly, we measure self-assessed abilities via seven questions answered at ages 10 and 16 (Table A2 in the Online Appendix), leading again to a more robust measure than the one-time measurement of university experiments. Figure A1 in the Online Appendix shows the distribution of these two variables by gender. The gender gap in objective abilities is 0.07 standard deviations (significant on the 5% level) while the gender gap in self-assessed abilities is 0.24 standard deviations (significant on the 1% level) (Table A4 in the Online Appendix). This is in line with other research that shows that ability gender gaps tend to be much smaller in magnitude when compared to self-assessed ability gender gaps (Jerrim et al. 2023).

As both our objective and self-assessed ability measures are continuous, they allow us to compare everyone's place in the two distributions. Thus, following Anderson et al. (2012), we construct an index of overconfidence by regressing each cohort member's percentile rank in the distribution of self-assessed ability on their percentile rank in the distribution of objective ability and predict the residuals (i.e., our overconfidence measure is a *residual score*). Those with a positive overconfidence score are overconfident, while negative scores reflect underconfidence. Figure A2 in the Online Appendix shows the distribution of the overconfidence score by gender. Like most of the previous literature, we find that men are more overconfident than women. Men have a mean overconfidence score of 0.08 and women of -0.13, leading to a gender difference of 0.21 standard deviations, which is significant on the 1% level (Table A4 in the Online Appendix). We also construct alternative binary versions of the measure when the bottom (*underconfident*) and top tercile (*overconfident*) of the distribution are either compared to the middle tercile or the remaining two-thirds of the distribution.

In our empirical models (Section 3), we control for the following individual characteristics: demographics and parental background (region of birth, parental socio-economic status, whether their mother had a qualification, ethnicity), pre-university educational attainment, university degrees, employment characteristics (2-digit occupation codes, work experience in months, working in the private sectors), having a partner, and the number of children in the household. Their descriptive statistics are presented in Table A3 in the Online Appendix for the total sample and compared by gender in Table A4 in the Online Appendix. The raw gender gap in log hourly wages is 0.18 log points (19.7%, roughly equivalent to £4,690 in 2023 GBP) that is significant on the 1% level. Figure 1 shows the gender gap in log hourly wages and overconfidence along the percentiles of objective skills. At all levels of objective skills, men earn more and are also more overconfident as compared to women. Our main question is whether these two phenomena are related, conditional on the individual characteristics of people.

Figure 1: The gender gap in wages and overconfidence along the distribution of objective cognitive skills



Notes: Source: BCS70 (CLS n.d.). Sample of those in full-time employment at age 42. No. of observations = 3,858. The scatter points represent the average log hourly wage/overconfidence score within the given percentile of objective cognitive ability, while the functions are simple linear fits. The same graphs for our measure of self-assessed ability and the binary measures of being over- and underconfident are presented in Figure A3 in the Online Appendix.

3. Empirical methods and results

3.1 The role of overconfidence in the gender wage gap

We estimate the statistical relationship between the gender wage gap and overconfidence using Mincer-type wage models and Kitagawa-Blinder-Oaxaca decompositions (Elder, Goddeeris, and Haider 2010). These methods allow us to measure the gender wage gap and see how it changes when accounting for our variable of interest, overconfidence. The linear regressions we estimate take the following form:

$$y_{it} = \propto + \beta_1 female_i + \beta_2 X_{it} + \beta_3 Overconfidence_{it} + \varepsilon_{it} \qquad (1)$$

where y_{it} is log hourly wage at age 42; $female_i$ is our binary variable for female (0 denotes male, 1 denotes female); X_{it} is a vector of individual and family characteristics as explained in Section 2; $Overconfidence_{it}$ is either our standardized residual score measure of overestimation or an alternative measure previously outlined (being *overconfident* or *underconfident* compared to the middle tercile or the remaining two-thirds of the distribution).

We present our results by adding the control variables sequentially to the model. In the most basic specification, we include only the female dummy to capture the raw gender gap in log hourly wages, which is 0.182 log points (Model 1 in Table 1). When we add our measure of overconfidence in Model 2, the gap decreases by 5.6% to 0.17. Next, we add objective skills and overconfidence together to the model (Model 3) along with childhood family and background characteristics in Model 4.

We estimate Model 4, our preferred specification, three different ways to better understand the role of confidence. This includes using our residual score overconfidence measure (Model 4A), using the self-assessed ability measure (Model 4B), and using the binary variables for over- and underconfidence (Model 4C) that in this setup make a comparison relative to the middle tercile of the overconfidence distribution. Interestingly, this last model shows that the relationship between overconfidence and wages is non-linear: being underconfident is significantly negatively correlated with wages while the estimated coefficient on overconfident is not significant. Thus, in the rest of the analysis, we use the under- and overconfident binary variables as our main variable of interest.

Table 1: The role of overconfidence in the gender gap in log hourly wages at age 42

	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4A	(5) Model 4B	(6) Model 4C
Female	-0.181***	-0.171***	-0.160***	-0.160***	-0.158***	-0.162***
	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)
Overconfidence score		0.050***	0.050***	0.050***		
		(0.007)	(0.007)	(0.007)		
Objective ability			0.157***	0.141***	0.116***	0.138***
			(0.007)	(0.007)	(0.008)	(0.007)
Self-assessed ability					0.061***	
					(0.007)	
Underconfident						-0.074***
						(0.017)
Overconfident						0.030
						(0.017)
Constant	2.396***	2.392***	2.387***	2.292***	2.292***	2.305***
	(0.010)	(0.010)	(0.009)	(0.024)	(0.024)	(0.026)
Obs.	3,858	3,858	3,858	3,858	3,858	3,858
R-squared	0.036	0.047	0.159	0.181	0.184	0.179
Control variables						
Social background				Yes	Yes	Yes

Notes: Source: BCS70 (CLS n.d.). Sample of those in full-time employment at age 42. Robust standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.5. Social background variables include region of birth, parental socio-economic status, whether their mother had a qualification, ethnicity. All coefficients are reported in log points and may be transformed to percentages through the following transformation: 100*(e^{beta} – 1), where beta is the estimated coefficient.

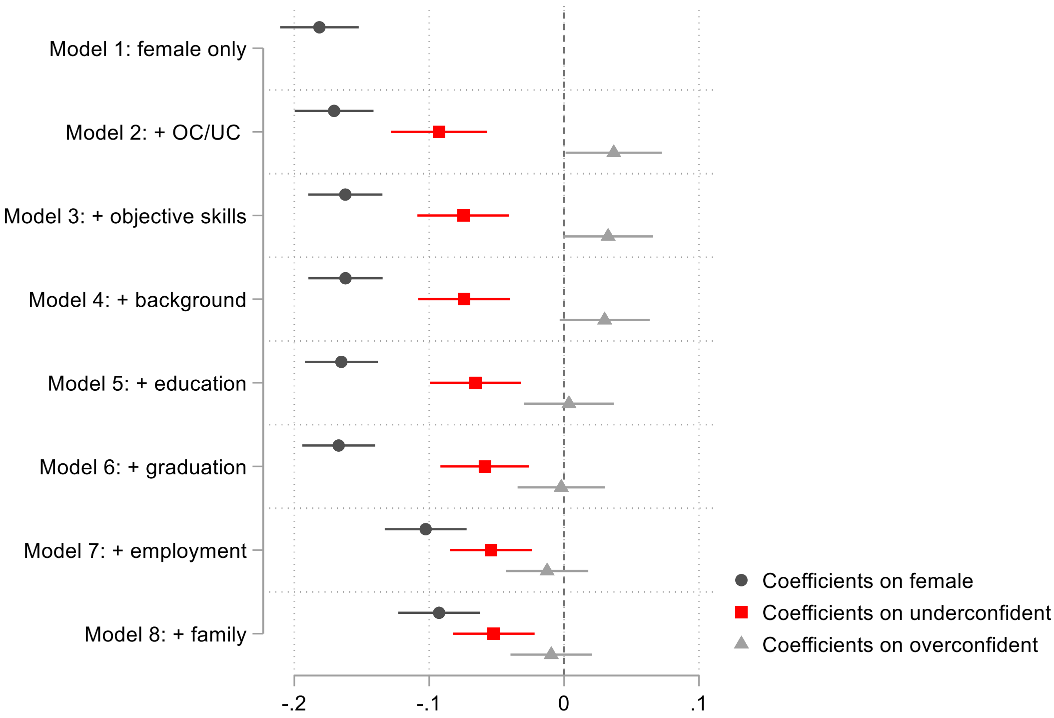
Table A5 in the Online Appendix re-estimates Model 4C using quantile regressions at the 25th, 50st and 75th percentiles of log hourly wages. As expected, the raw gender wage gap is higher at the top of the wage distribution than at the bottom (0.177 vs. 1.67 log points). Interestingly, being underconfident matters more while being overconfident matters less as we move up along the wage distribution.

3.2 Potential channels and wage returns to overconfidence

Next, we investigate why over- or underconfidence matters for the gender wage gap. Figure 2 and Table A6 in the Online Appendix show how the main estimated coefficients on female change when we build our model further, adding control variables that could have already been affected by adolescent overconfidence and thus could serve as a channel between overconfidence and wages. Models 1-4 repeat the same models that we have in Table 1 as a point of comparison, but now we use the binary over- and underconfident variables instead of the overconfidence score. Model 4 in Figure 2 is the same as Model 4C in Table 1. We add pre-university educational attainment in Model 5, graduation (course, elite university) in Model 6, employment characteristics (occupation, work experience, and working in the private sector) in

Model 7, and partnership and children in the household in Model 8. Adding these control variables decreases the gender wage gap to 0.093 log points in Model 8. The estimated coefficient on being overconfident decreases to close to zero in this last model and loses its significance. The estimated coefficient on being underconfident, however, stays at -0.052 log points and is significant on the 1% level in Model 8 (Table A6 in the Online Appendix). Thus, being underconfident in adolescence is still significantly correlated with wages at age 42 even after controlling for family background, education, employment characteristics, occupation, having a partner, and the number of children in the household.

Figure 2: The gender gap in log hourly wages in Mincer-type wage models: the role of being under- and overconfident

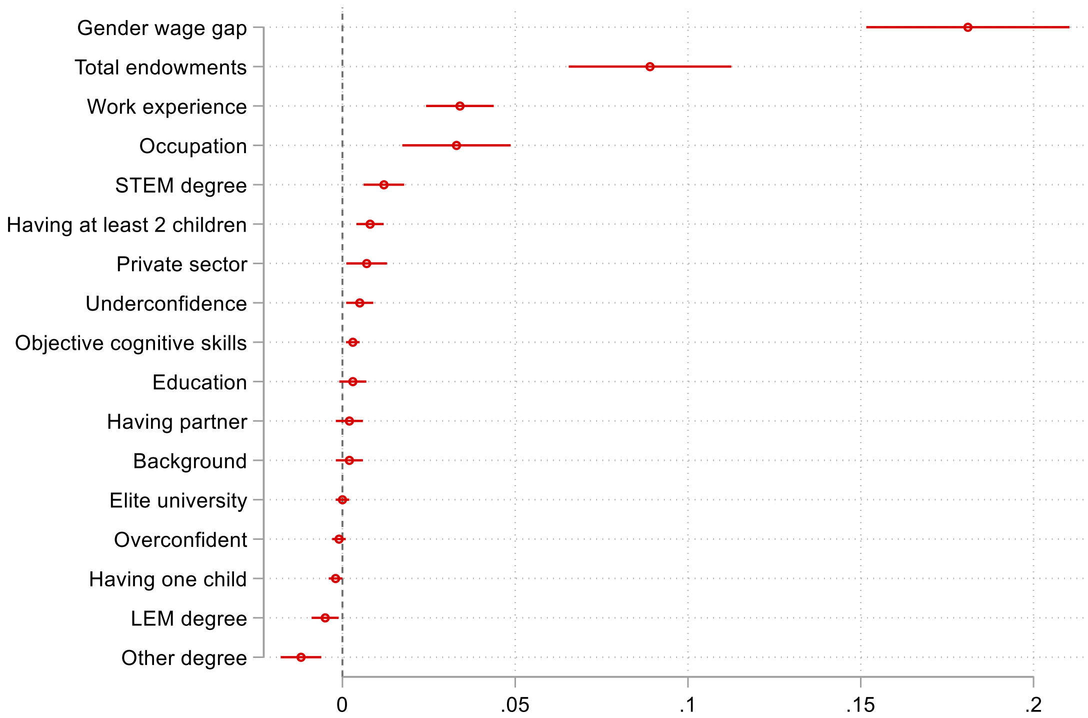


Notes: Source: BCS70 (CLS n.d.). Sample of those in full-time employment at age 42. The estimated coefficients and the control variables are shown in Table A5 in the Online Appendix. All coefficients are plotted with their 95% confidence intervals based on heteroscedasticity-robust standard errors. No. of observations = 3,858.

Estimating the same wage models separately for men and women provides an opportunity to look at the gender-specific wage returns for being under- and overconfident. The estimated coefficients on being overconfident are small and insignificant for both men and women in all models (Tables A7 and A8 in the Online Appendix). On being underconfident, however, the estimated coefficients range from -0.10 to -0.05 log points and stay significant on 5% levels. Being underconfident thus has similar negative wage returns for both genders conditional on all previously discussed control variables. The magnitude of this (negative) correlation is even larger than the magnitude of the (positive) correlation between wages and objective cognitive abilities.

We also implement a Kitagawa-Oaxaca-Blinder decomposition (Blinder 1973; Oaxaca 1973) to probe the role of over- and underconfidence in explaining the gender wage gap, compared to the elements of Model 8 (as in Table A6 in the Online Appendix). This decomposition technique allows us to measure how much of the gender gap comes from the different distributions of individual characteristics (*endowments*) between the two groups and how much of it remains *unexplained* (follows from men and women showing different returns to these characteristics). This method shows the magnitude of each endowment's relative contribution to the raw gap as well as how the returns to these characteristics differ across men and women in one step.

Figure 3: The Kitagawa-Oaxaca-Blinder decomposition of the gender gap in log hourly wages: the contribution of endowments

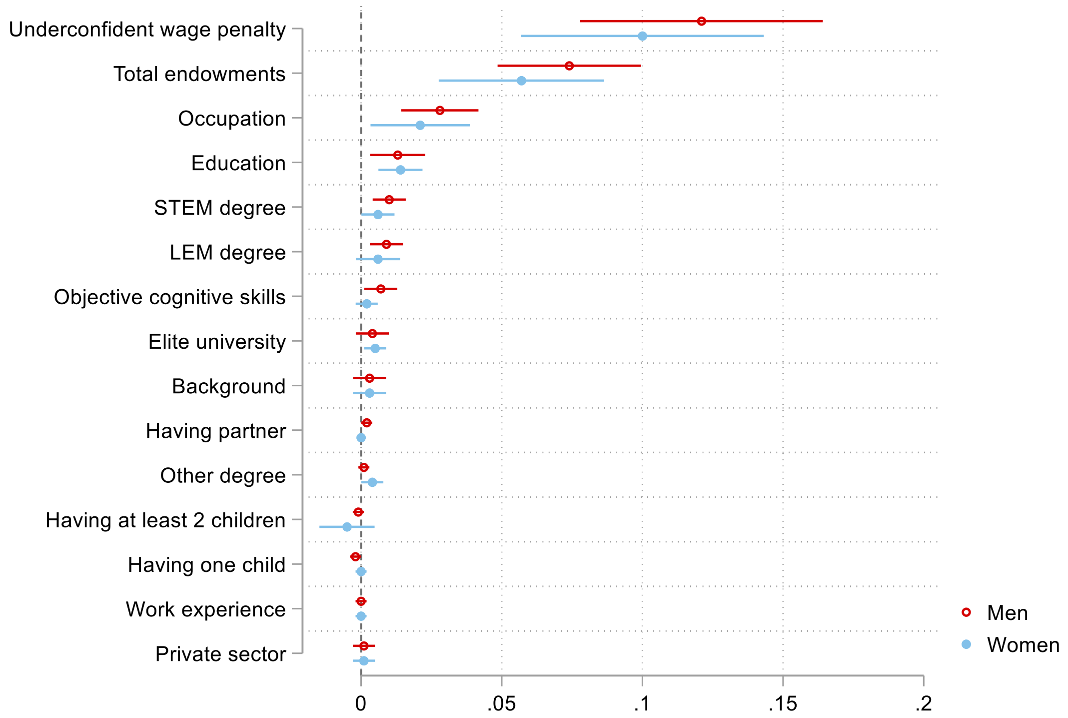


Notes: Source: BCS70 (CLS n.d.). Sample of those in full-time employment at age 42. We apply common coefficients estimated from a pooled regression (Neumark 1988). All coefficients are plotted with their 95% confidence intervals. No. of observations = 3,858.

Figure 3 shows that the contribution of endowments to the gender wage gap is roughly 50%. Within the endowments, labor market experience has the highest contribution, then occupation, having a STEM degree, having at least two children in the household, working in the private sector, followed by a small but significantly positive contribution of women being more likely to be underconfident than men. The contribution of men being more likely to be overconfident than women is close to zero and insignificant.

Lastly, to investigate the main channels behind the relationship between wages and underconfidence, we decompose the underconfident wage penalty, i.e. the difference in log hourly wages between those who fall in the lowest tercile of the overconfidence distribution versus the remaining two-thirds of the sample in Figure 4, separately for men and women. Note that the same graph comparing the lowest tercile of the overconfidence distribution to the middle tercile is shown in Figure A4 in the Online Appendix and suggests similar conclusions.

Figure 4: The Kitagawa-Oaxaca-Blinder decomposition of the underconfident wage penalty in log hourly wages



Notes: Source: BCS70 (CLS n.d.). Sample of those in full-time employment at age 42. All coefficients are plotted with their 95% confidence intervals. "Underconfident" is a binary variable equal to 1 for those who belong to the lowest terciles of the overconfidence score distribution and 0 otherwise. Underconfident individuals are compared to the remaining two-thirds of the distribution. The same graph comparing underconfident individuals to the middle tercile of the distribution is show in Figure A4 in the Online Appendix. No. of observations = 3,858.

Figure 4 shows that roughly half to two-thirds of the underconfident wage penalty comes from the different endowments of underconfident individuals. They earn less because they work in lower-paying occupations, have lower pre-university educational outcomes, less likely to have science, technology, engineering, and mathematics (STEM) and law, economics, and management (LEM) degrees, and among men but not among women, have somewhat lower objective cognitive skills than the rest of the overconfidence distribution.

4. Discussion

This paper has shown that overconfidence, and more importantly, being underconfident in adolescence has a moderate contribution to the gender wage gap at age 42. Women suffer more from the underconfidence wage penalty because they are more likely than men to be underconfident. This result is in line with most of the literature investigating the role of non-cognitive skills in the gender wage gap in terms of the magnitude of this contribution: it is moderate and substantially smaller than the contribution of structural factors. Nevertheless, it still explains a meaningful portion of the gap.

Interestingly, the role of overconfidence in the gender gap in top job employment has been found to be somewhat larger, between 5-11% (Adamecz-Völgyi and Shure, 2022). Choosing an occupation is a more direct, categorical choice that most people make at the beginning of their careers and do not often update, while wage development is a continuous process, and often updated based on one’s (objective and subjective) performance at work. Ending up in a “top job” also requires more self-promotion, something women are less likely to engage in at work (Exley and Kessler 2022).

Our results show there is a wage penalty for underconfidence for both men and women. The penalty is roughly equal in magnitude for both genders. Women tend to bear the brunt of the penalty, however, because they are more likely to be underconfident. This lends support for Sandberg’s (2013) hypothesis that women’s low confidence is holding them back from labor market success; however, it is probably not enough to just focus on confidence-building interventions to boost their earnings. Our decomposition results show that there are several drivers of the underconfidence wage penalty. Underconfident individuals earn less because they work in lower-paying occupations, have lower pre-university educational outcomes, are less likely to study high-earning subjects at university (e.g. STEM and LEM degrees), and only among men, have somewhat lower objective cognitive skills. This highlights the complexity of developing interventions to boost women’s confidence and the fact that doing this in the workplace is probably too little too late.

Replication package

Replication package is available at: https://github.com/aadamecz/UC_wage_penalty

Appendix A. Supplementary data

Supplementary material related to this article can be found in the Online Appendix.

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