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Working Paper No. 19-09

October 2019

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# The gender gap in wages over the life course: evidence from a British cohort born in 1958.

Heather Joshi<sup>1</sup>, Alex Bryson<sup>2</sup>, David Wilkinson<sup>3</sup> and Kelly Ward<sup>4</sup>

## **Abstract**

Using data tracking all those born in a single week in Great Britain in 1958 through to their mid-50s we observe an inverse U-shaped gender wage gap (GWG) over their life-course: an initial gap in early adulthood widened substantially during childrearing years, affecting earnings in full-time and part-time jobs. In our descriptive approach, education related differences are minor. Gender differences in work experience are the biggest contributor to that part of the gender wage gap we can explain in our models. Family formation primarily affects the GWG through its impact on work experience. Family composition is similar for male and female workers but attracts opposite wage premia. Not all of the GWG however is linked to family formation. There was a sizeable GWG on labour market entry and there are some otherwise unexplained gaps between the pay of men and women who do not become parents.

**JEL Codes:** J16; J31

**Keywords:** family formation, gender wage gap; work experience; life course; NCDS birth cohort

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Acknowledgements: We thank UCL for seed funding and the ESRC for grant funding (grant number ES/S012583/1). We are also grateful for the comments on earlier versions from participants in the CLS Workshop July 2017, the NCDS 60th Birthday conference, March 2018, the SLLS and WPEG conferences in July 2018, Gender Inequalities in Extending Working Lives Conference September 2018, ESPE conference, June 2019, EALE conference September 2019.

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## INTRODUCTION

Unequal rates of pay between men and women underpin gender inequality within and beyond the labour market. They offer disincentives to educating girls, and to women taking up training, they reinforce a gendered division of labour in the home and unpaid caring, they imply economic vulnerability of families who depend on women's earnings, particularly lone parents, and affect the adequacy of women's pensions in old age. Many governments have intervened in the labour market to tackle the gender wage gap (GWG) through legislation in an effort to squeeze out discriminatory practices which may underlie at least some of the gap. The relative pay of men and women has been slowly converging in the UK, as elsewhere (Kunze, 2018). According to the Annual Survey of Hours and Earnings, the raw median GWG (full and part-time combined) stood at 17.9% in 2017, having fallen from 27.5% in 1997 (Office for National Statistics, 2018). It had changed little over the previous 20 years (though falling somewhat for full-timers recorded in the New Earnings Survey). There was a dramatic change in relative wages in 1975-1976 on the implementation of Equal Pay in 1975. The GWG, which reduced by around 10 percentage points (for full-timers) between 1973 and 1977 had previously stood around 40% over the post-war period.<sup>1</sup>

The raw GWG continues to be a source of concern, as illustrated by the public outcry at the size of these gaps as reported by larger firms in response to the government's Gender Pay Audit.<sup>2</sup>

Assuming the operation of a fully efficient labour market, workers would be paid their marginal product, such that differences in hourly pay rates would reflect workers' human capital as indicated by their qualifications and work experience. The gap in formal qualifications between men and women, which favoured men entering the labour market until the 1980s, has reversed. There has also been a reduction in the work experience gap as women return to employment more quickly after childbirth, more often into full-time jobs (Roantree and Vira, 2018). Yet, in spite of these trends, studies conditioning on human capital and other worker attributes continue to find a residual

GWG, prompting speculation as to the source of this underlying gap. The residual gap has been attributed, at least in part, to discriminatory employer practices. There is clear evidence from audit studies that employers tend to discriminate, consciously or not, against women in their hiring and promotion practices (Mullany and Yoong 2019), and evidence from legal cases, as well as some experimental studies, that employers discriminate against women in pay setting for jobs of equal value (Azmat and Petrongolo (2014) review the literature). Sexual harassment in the workplace can reinforce the GWG (McLaughlin, Uggen and Blackstone 2017).

However, the GWG is also likely to reflect wider societal expectations about gender roles which result in different labour market aspirations for young men and women, leading to differential investments in human capital, different occupational choices and, perhaps, differences in labour market attachment. Still, even when these factors are accounted for, a residual gap persists (Adda, Dustmann and Stevens, 2017). Men and women combine employment and family life in different ways. Their choices, given gendered constraints (Folbre, 1994) are a major, but perhaps not the only factor behind the GWG. The GWG itself may reinforce prevailing sets of gendered expectations and practices in society at large (Brueghel and Perrons 1995).

The contribution of this paper is to unpack the GWG over the life-course. Most studies of its genesis rely on cross-sectional data to compare the wages of workers of particular ages born at different times. These studies indicate that the GWG has fallen over time, and thus across cohort, but that within-cohort the GWG tends to rise to a mid-life peak, falling back somewhat thereafter (Gardiner 2017, Manning and Swaffield, 2008). Thus the raw GWG is not uniform across ages: it has a life course profile.

According to Becker (1985) actual and anticipated domestic roles give men and women different incentives to invest in 'effort', which will result in differential pay and reinforce the domestic division of labour. That differential pay remains associated with parenthood, when other gender inequalities in the labour market weaken, is illustrated empirically by Goldin (2014); Blau and Kahn (2017) and

Juhn and McCue (2017) for the USA; and by Costa Dias, Joyce and Parodi (2018) for the UK. Pay penalties in the UK are particularly pronounced for women returning to part-time employment after a gap in employment. Some maintain that these patterns reflect women's preferences for work-life balance (Hakim, 2000). Conventional norms about the division of domestic labour lead women, but not men, to seek flexibility in their work schedule for which they are prepared to accept lower rates of pay as compensating differentials (Goldin 2014). Among a number of other sources of the GWG reviewed by Blau and Khan (2017) are discriminatory practices which may be stronger for women with family responsibilities, such as fewer opportunities for training or promotion in part-time jobs (Manning and Petrongolo 2008), or women's limited ability to search for a better job match (Manning and Swaffield, 2008, Addison et al., 2017). Under prevailing cultural norms, women may be less likely to apply for promotion, less likely to get it, and face, perhaps unconscious, discrimination in appointment to higher paid jobs (Babcock and Lashever, 2003; Mullany and Yoong, 2019).

Recent studies indicate that the gap between men's and women's pay widens considerably on entry to parenthood (Costa Dias et al., 2018; Lucifora et al., 2018, Kleven et al., 2019). Additional children lead to further wage penalties for women (Harkness, 2016) which may, however, be ameliorated by maintaining employment continuity through maternity leave (Waldfogel, 1998; Joshi, Paci and Waldfogel, 1999). Women's life-time earnings losses, through lower wages, hours and participation associated with childrearing are substantial (Adda et al., 2017; Rake, 2000).

The question still arises of whether the widening gap in men's and women's wages from their twenties onwards is fully accounted for by unequal accumulation of human capital and family responsibilities. Any 'residual gap', not accounted for by human capital and family responsibilities, can be thought of as 'unequal treatment' of equally qualified persons, even those without children. An unexplained, possibly discriminatory, male premium would contribute to differing opportunities for mothers and fathers in the labour market, and reinforce traditional patterns in the choice of who

works longer hours and who takes parental leave. It would also mean that those who do not enter parenthood, may not completely escape the pay penalties of gender.

We chart the pay gaps and employment histories that have been uniquely recorded for a cohort who entered the labour market in the mid-1970s and has been followed over four decades. We explore the obstacles that have faced women born in 1958 over their careers to age 55 in 2013. This cohort, the National Child Development Study (NCDS), entered the labour market as the Equal Pay Act and other equal opportunity policies were introduced. Women were catching up with men on educational attainment (and overtaking them at school level) but at the academic high end males outnumbered females at university entry well into the 1980s (Smith 1985). This cohort also lived through a time when choice and control over fertility had advanced. They had fewer children, at a later age, than their parents' generation but more and sooner than the cohorts which followed them. The cohort were in their forties when a fresh set of policies was introduced around 2000 to facilitate flexible parental employment and public support for children's early years. Most of the women in this cohort would have had their children already in a less 'family friendly' policy environment. The lowest paid women, mostly part-timers, would have benefitted from the introduction of the National Minimum Wage in 1999 (Dex, Sutherland and Joshi, 2000). Women would have started their careers under the 1975 State pension legislation, contributing in their own right.<sup>3</sup> Changes in pension legislation mean that neither women nor men are able to claim their state pension until they are 66 in 2024. In a wider context, including cohorts who are still in mid-career, maternal employment has been increasing, and the GWG has been declining. Our focus here on the connection of these phenomena within a single cohort will provide a starting point for understanding subsequent developments as well as the pension assets of women born in the Baby Boom.

Ours is a descriptive account of the GWG and how it is accounted for by human capital and family formation variables, all the way through to age 55, providing a unique life-course insight into the relative fortunes of women in the labour market. Our results confirm that family formation

exacerbated this cohort's GWG. This worked mainly via its association with work experience, particularly women's shorter record in full-time work. Unequal treatment was amplified in the asymmetric remuneration, all else equal, of mothers and fathers, wives and husbands. But the gap was not just associated with family formation. There was a sizeable unexplained pay gap on labour market entry, pre-parenthood, and there was still a gap at age 55 between men and women who never became parents.

## **METHOD**

The objective of this paper is to marshal the descriptive evidence on the composition of the GWG in terms of Human capital and Family composition.

We estimate log hourly wage regressions for those observed in employment at the time of each survey sweep for those with non-missing data on the dependent variable in a series of models.

The explanatory X terms in all models include a set of dummy variables for highest educational qualification, academic or vocational equivalent (NVQ levels 1 to 5 ) achieved by the time of each survey. They also include controls for the number of times the cohort member has appeared in the wage estimation sample in previous surveys (a rough allowance for unmeasured characteristics associated with repeated observation in the unbalanced panel) and a dummy for residence in London or the South East (a rough allowance for regional price levels). As qualifications are the main focus of interest in this baseline model we label the block of variables 'ED'. The set of work experience variables 'EXP' includes the number (and its square) of months that cohort members had worked full-time or part-time up to each survey. This allows for the low, possibly negative, pay returns to part-time work experience (as found by Neuburger, 2010 and Costa Dias et al., 2018). Inclusion of the length of tenure of current job could reveal returns to job specific skills, or alternative returns to changing employer. The family composition variables (FAM) indicate the current presence of a partner in the household, and of children at various ages; and whether the cohort member had ever reported a child in the household, even if no longer present. We count any



co-resident dependent child, assuming that those who might be adopted, fostered or step children would present similar constraints to parental employment as natural children, and that biological offspring not in the household do not. Model 1 includes educational qualifications and controls (ED) at the time of interview; Model 2 adds work experience to Model 1 (ED+EXP); Model 3 drops experience and introduces current and past family responsibilities (ED+FAM). Our full model 4 includes them all (ED+ EXP+ FAM).

Wage regressions are run for men and women pooled, with the female dummy interacted with all other explanatory variables in the model. These fully-interacted linear models (FILM, programmed by Leuven and Sianesi, 2004), estimated in STATA, allow values for all parameters in the model to vary by gender, whose difference can be tested.

Equations of the following form (for the fullest model) are estimated at each of five ages:

$$\begin{aligned}
 W_i = & \beta_0 + qual_i \cdot \beta_1 + qualmiss_i \cdot \beta_2 + obs_i \cdot \beta_3 + LonSE_i \cdot \beta_4 \\
 & + ftdur_i \cdot \beta_5 + ftdursq_i \cdot \beta_6 + ptdur_i \cdot \beta_7 + ptdursq_i \cdot \beta_8 + tenure_i \cdot \beta_9 + tenmiss_i \cdot \beta_{10} \\
 & + partner_i \cdot \beta_{11} + everchild_i \cdot \beta_{12} + childage_i \cdot \beta_{13} + u_i
 \end{aligned}$$

$$with E(u_i|x_i) = 0$$

The  $\beta$ s parameters are estimated separately for each sex in the full interactions but are not shown for simplicity. Definitions of each variable are given in the Technical Annex

We decompose the GWG between men and women using Oaxaca-Blinder decompositions based on separate regressions for men and women. This divides the GWG into the part associated with individual attributes and the part associated with unequal coefficients (including constant terms), and any interaction between them. We weight the differences in model coefficients,  $\beta_m - \beta_f$ , by the mean attributes of the female sample at each age, thereby estimating the gain women would have if paid like men, which can be thought of as the 'price of being female'.

Formally the decomposition takes the following form:

$$GWG = [E(Xm) - E(Xf)]' \beta f + E(Xf)' (\beta m - \beta f) + [E(Xm) - E(Xf)]' (\beta m - \beta f)$$

Characteristics

Coefficients

Interaction

The X terms are the various combinations of ED, FAM and EXP introduced into our regression models. The interaction term allows for any correlation between the X terms and coefficient gaps.

We undertake additional analyses for three sub-groups: those in full-time employment at the time of survey (who are assumed to be among those with the greatest labour market attachment); employees who had no children by a given survey; and those who never had children in their home at any survey.

Our estimates offer an accounting exercise to map the correlates of unequal pay over the life cycle and to establish empirical regularities, as advocated by Goldthorpe (2001). We make no efforts to recover causal estimates of the influences on the GWG, though we recognise that many choices regarding human capital and family investments are endogenous with respect to earnings potential. We do not adjust for sample selection, either in terms of survey response or employment participation.<sup>4</sup> That said, we do estimate the GWG for those in full-time employment and compare those results to the full sample, thus shedding some light on the role of labour market attachment and structure. Occupation is another important feature in the literature which we set aside.

Although it is commonly added to human capital models of wages (Brynin 2012) assignment to gender-typical-work may itself be discriminatory or reflect worker preferences (Goldin 2014, Blau and Khan 2017). We included two-digit indicators of occupation, but they made little difference to explaining the GWG, differentials being more important within these categories than between them.<sup>5</sup> Thus the residual, or adjusted, value of the GWG which emerges as the combination of coefficient differences may to some extent reflect occupational segregation. It may also reflect a whole host of other factors which may differ between male and female employees and may attract

differential remuneration: such as, subject and place of study, cognitive and soft skills, the organisation of the workplace, commuting opportunities, health of self or family members. While not formally introduced into the regressions, the possibility of omitted factors should be borne in mind when interpreting the results.

## **DATA**

Our data are drawn from the British National Child Development Study (NCDS)<sup>6</sup> a nationally representative birth cohort study of men and women born in 1958 (Joshi, 2012; Pearson, 2016). We track the wages of those in employment at ages 23, 33, 42, 46, 50 and 55. Unlike cross-sectional data, the NCDS also allows us to place observed wages in the context of what the informants had done in the past, without needing to rely on later life recollection.

The cohort study started with 17,414 members born in a single week of 1958.<sup>7</sup> There was a net loss of informants by the first sweep in adulthood, at age 23, where our study starts, with 12,537 young adults providing data (Table 1). All but the telephone survey at age 46 involved an interviewer visit to the home. The achieved sample suffered further losses through death, emigration and attrition. The latter was not necessarily permanent, as some cohort members who were absent at one sweep participated later. At age 55, 9,137 cohort members responded. The number of current employees in each sweep is somewhat lower, and the estimation sample is still smaller due to missing data on wages. We also excluded outliers at the top and bottom percentile of each sweep's wage distribution, a common practice to deal with potential measurement error among outliers. The final estimation sample for men runs from 4,263 at age 23 to 2,346 at age 55, and for women from 3,585 to 2,546.

Over 6,000 men and women provide wage data at some point, but only 808 men and 551 women provide wage data in all 5 sweeps (other than the age 46 telephone survey). Thus, intermittent

membership of the panel is the norm for men as well as women, though to a greater extent, as one would expect, among the women.

**Table 1 Descriptive statistics for whole cohort and wage sample, by gender NCDS**

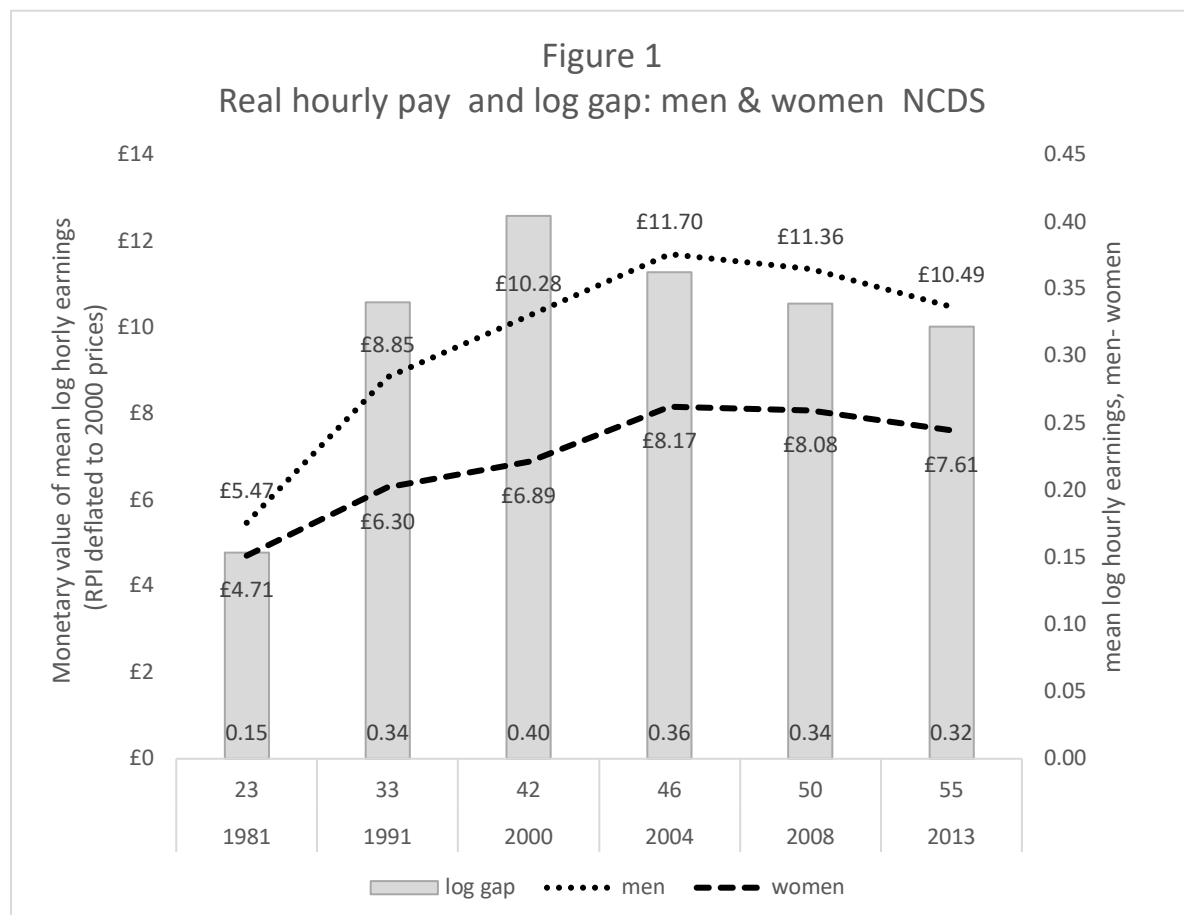
	Males						Females					
	23	33	42	46*	50	55	23	33	42	46*	50	55
Whole cohort												
N in contact	6267	5634	5626	4644	4822	4433	6270	5835	5793	4890	4968	4704
N employees	4737	4161	4077	3392	3291	2739	3881	3542	4128	3684	3632	3129
% with NVQ Level 4 or 5 <sup>1</sup>	17.7	27.6	32.2	35.2	34.9	38.3	18.7	24.4	30.2	33.5	35.4	38.5
Average work experience in years	5.2	13.8	21.5	26.2	29.5	33.9	4.5	10.6	16.9	21.2	24.2	28.2
% with dependent children	16.7	61.1	69.5	68.0	58.7	46.0	32.6	74.9	79.7	73.4	59.7	43.3
N with observed wages	4363	3755	3629	891	2880	2392	3648	3126	3546	827	3151	2600
Wage sample – excluding outliers <sup>2</sup>												
N with observed wages <sup>2</sup>	4263	3691	3567	871	2801	2346	3585	3050	3464	811	3108	2546
N observed at all previous sweeps <sup>2</sup>		2,450	1,703	338	257	181		1,734	1,153	211	164	108
N all previous sweeps <sup>2</sup> except 46					1,124	808					799	551
N observed <sup>2</sup> intermittently			1,362	490	2,415	2,115			1,552	539	2,696	2,368
N observed <sup>2</sup> at no previous sweep		1,241	502	43	129	50		1,316	759	61	248	70
Real log hourly pay <sup>3</sup>	1.70	2.18	2.33	2.46	2.43	2.35	1.55	1.84	1.93	2.10	2.09	2.03
% with NVQ Level 4 or 5 <sup>1</sup>	18.1	31.5	36.6	39.4	38.2	42.1	23.3	28.9	32.9	35.4	38.7	40.8
% working full-time	99.2	99.1	98.0	98.0	97.3	94.8	90.5	55.1	60.3	67.4	67.4	65.6
Mean years full-time experience	5.4	13.8	21.7	26.7	30.0	34.6	4.8	9.4	13.0	16.4	18.0	21.0
Mean years part-time experience	0.1	0.2	0.3	0.4	0.5	0.6	0.3	2.3	5.2	6.4	8.1	9.8
Years with current employer	3.5	6.9	10.6	13.4	12.7	14.4	3.2	4.7	6.8	9.1	8.9	11.3
% with dependent children	16.3	61.8	72.9	64.3	60.3	47.7	9.0	65.4	78.5	68.1	60.4	44.6

\* Telephone survey. 1. Percentage based on cases with non-missing education data. 2. Excluded outliers are top and bottom 1% of sweep specific wage sample. 3 Hourly wage deflated to January 2000 prices by the RPI

## RESULTS

### Wages

Figure 1 shows real hourly mean pay for men and women for those with wage data at each survey sweep. The grey bars indicate the raw gap in mean log hourly earnings between men and women. Real wages for both men and women grew until their mid-forties, with men's rates of pay rising faster than women's until both fell back slightly in their fifties. Among employees at age 23, men's mean log hourly earnings exceeded women's by 15 log points. The gap had grown to 40 log points by age 42 in 2000, but by age 55 in 2013 it had closed somewhat to 32 points. The data for age 46, though shown in Figure 1, are discarded in the regressions, due to the high level of missing wage data (see Table 1). £'s express the monetary value of the log mean hourly wage, (deflated to 2000 prices by the RPI)



Before presenting the regression-adjusted wage gaps we introduce the key independent variables of interest, namely educational qualifications, employment experience, and family formation.

### ***Educational qualifications***

NCDS men and women entered adulthood with similar levels of tertiary attainment in their twenties (Makepeace, Woods, Galinda-Ruedo & Joshi, 2003). As they grew older, more cohort members acquired tertiary qualifications - from around one in six at age 23 to around one in three by 42, partly due to the acquisition of further qualifications as time passed (Jenkins, 2017) and partly due to selective attrition. The proportion with high qualifications in the wage sample is greater than in the cohort as a whole, consistent with positive selection into employment. Male employees' qualifications tend to be higher than female employees' except at age 23. Among women at that age the gap between qualifications of employees and the whole sample was particularly pronounced, reflecting the higher employment participation rates of more educated women. Table 1 summarises the percentages with tertiary qualifications (Level 4 or 5) but the regression analyses include a full battery of six qualification levels (see Annex Table A1).

### ***Employment experience***

Many of the mothers who had returned to employment mid-life worked part-time. The men in the sample worked almost exclusively full-time, with negligible rates of part-time employment at the survey snapshots. The proportion of women in part-time jobs was always substantial, particularly at age 33 (46%) and age 42 (40%). The mean full-time work experience of men in the wage sample grew steadily to 35 years at age 55, compared to 21 years' experience for women employed at age 55. They had accumulated 10 years of part-time experience on average, compared with just 7 months for men. The block of work experience variables also includes time spent with the current

employer (recorded in months but reported in years). Women employees' average job tenure is lower than men's but rises with time.

### **Family**

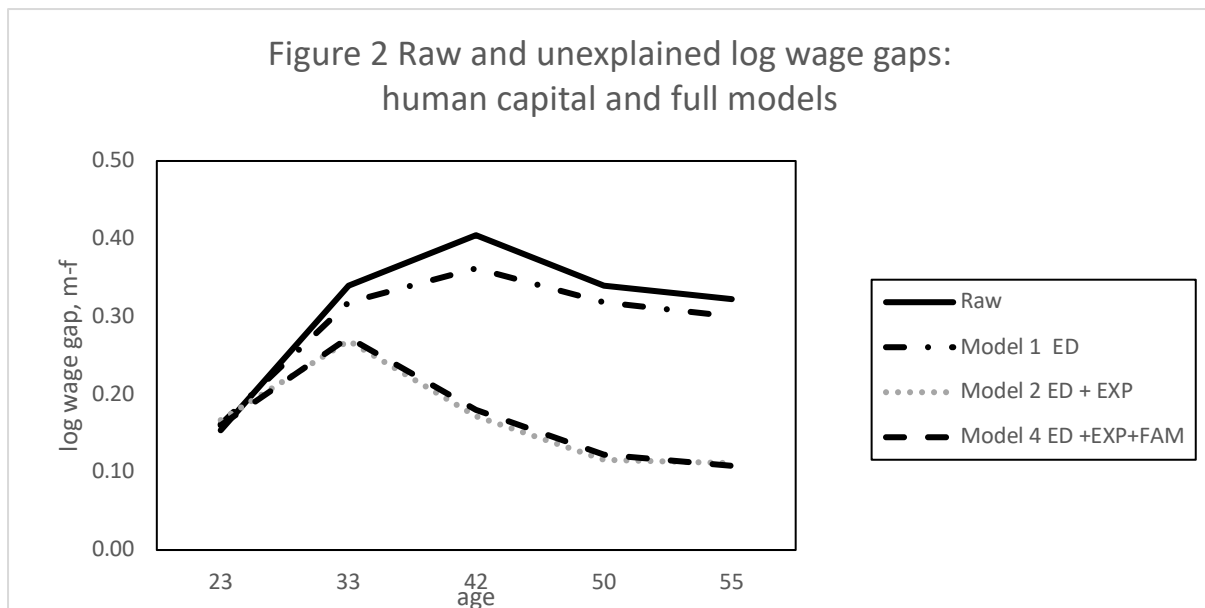
We characterise family responsibilities on the basis of household composition rather than reported events. At 23, the women in the wage sample were more likely than men to have a partner (53% vs 43%), but from age 33 onwards around eight in ten of men and women in the wage sample were partnered. At 55, 85% of the men had partners against 78% of women, perhaps reflecting more remarriage among men.<sup>viii</sup> We account for the presence of dependent children (i.e. under 16) in the household at each snapshot survey regardless of whether they are the biological offspring of the cohort member. By age 55, over four-fifths of men and women (82% and 85% respectively) in the estimation sample had had a dependent child at home at some point. Only one-in-six men had such children at 23 while twice that proportion of the women did. At age 42, 70% of men and 80% of women employees had children at home. The difference reflects childbearing starting earlier for the women and their higher likelihood of single parenthood. By age 55, later fatherhood meant more men than women had children in the home (46% vs 43%). The proportion of men in the wage sample with dependent children is much the same as for the cohort at large, whereas for women it is lower at ages below 42 (only), reflecting the lower employment of mothers of young children. Further details are presented in in Table A1.

### **REGRESSION-ADJUSTED WAGE GAPS**

Estimates of the three components of all four models were made for 5 age samples (Table A2). The main results are summarised in Figure 2. The five raw wage gaps, shown in bars in Figure 1, reappear as the top line in Figure 2 which also shows the estimates of the residual GWG after adjustments for the blocks of variables in the step wise regression. The adjusted gaps consist of the gaps in coefficients weighted by average female characteristics, which represent an estimate of



unequal treatment for a given endowment. Gender differences in ED (education with the baseline controls) make only a few log points difference to the explanation of the raw gap, as shown by the proximity of the plot for model 1 adjusted gap to the the raw one. The addition of the other conventional human capital terms, experience, in Model 2 (ED + EXP) makes a major contribution to the account of the gap at all ages beyond 23. The inclusion of FAM terms in the full model 4 makes hardly any difference to the residual GWG, witness the lines for Models 2 and 4 ( grey dots and black dashes) being more or less identical. The addition of FAM terms without EXP ( model 3) also makes virtually no difference to the model 1 estimate. It is not plotted for simplicity as it lies almost exactly along the path of Model 1. The lack of explanatory contribution from family status ‘endowments’ reflects the similar family composition of male and female workers at a given age, whereas the employment experience of men and women diverges.



At age 23 there is little difference between the raw GWG and any of the adjusted GWGs, when the gap was around 16 log points, and relatively little at 33. The explained gap (between the raw and fully adjusted wage in model 4) widens as time passes between age 33 and age 50, accounting for around half the raw gap at 55. The main source of divergence is employment experience. The

residual GWG that is apparent in Model 4 when all controls have been introduced (represented by the dashed line) rises 11 log points between ages 23 to 33 to 27 log points, but then falls again by 9 log points by age 42. It continues to decline gently but remains at 11 log points by age 55 (equivalent to 10 percent of men’s wages). The decomposition of pay gaps into those accounted for by endowments, coefficients, and their interaction in all 4 models is reported for reference in Annex Table A2. The interaction term is generally quite small.

<b>Table 2: Decomposition of gender wage gap in NCDS: full model 4</b>										
<b>AGE</b>	<b>23</b>		<b>33</b>		<b>42</b>		<b>50</b>		<b>55</b>	
<b>Difference in Log Hourly Wage</b>										
	0.154	***	0.340	***	0.405	***	0.339	***	0.322	***
<b>Accounted for by differences in Endowments</b>										
Education <sup>1</sup>	-0.016	***	0.023	*	0.038	***	0.013	*	0.018	**
Experience	-0.001		0.137	***	0.148	***	0.174	***	0.136	***
Family	-0.006	**	-0.002		0.02	***	-0.006	**	0.008	**
Total	-0.022	***	0.158	***	0.206	***	0.181	***	0.162	***
<b>Accounted for by differences in Coefficients</b>										
Education <sup>1</sup>	0.051	***	-0.074		0.038		0.042		0.016	
Experience	0.068	***	0.307		0.053		0.122		0.254	
Family	0.038	***	0.156	***	0.177	***	0.130	***	0.131	***
constant	0.003		-0.188		-0.087		-0.172		-0.292	
Total	0.16	***	0.202	**	0.18	***	0.122	***	0.108	**
<b>Interaction of Coefficients and Endowments</b>										
Education <sup>1</sup>	0.007	***	-0.012		-0.003		-0.001		-0.004	
Experience	0.011	***	0.008		0.039		0.023		0.055	
Family	-0.002		0.008		-0.019	***	0.014	***	0.001	
Total	0.016	***	0.004		0.018		0.036		0.052	
<b>R squared in Fully Interacted Linear Regression</b>										
		0.220		0.433		0.331		0.400		0.350
<b>N (males +females)</b>										
	7848		6741		7031		5909		4892	

<sup>1</sup> Education block includes controls for region and times observed in wage sample

Using Model 4 Table 2 takes a closer look at how blocks of regressors account for the GWG. Negative terms represent cells where women do better than men do (e.g. on the education endowment for employees at 23). As can be inferred from Figure 2, the gap in educational attainment between the men and women makes a relatively small contribution to the endowment gap, and the gap in returns to education, summarized in the coefficients gap, is also relatively small (and generally insignificant). Work experience accounts for most of the endowment gap, except at age 23 (when experience had hardly begun accumulating). The coefficients on the experience terms generally favour males, but the difference is only statistically significant at age 23. While the family terms contribute little to the endowment gap, they are an important and well determined part of the gap in coefficients, reflecting differential remuneration of men and women with given family responsibilities.

Drilling further down into the coefficients gap in Model 4 (fully reported in Table A3), we focus first on estimates for each term in the family status block. Having a partner appears to attract a higher wage premium for men than women, across the life-cycle. All else equal, this accounts for a 5 log point difference in wages at age 23, 2 points at age 42, and 8 points at age 55. This could be due to the labour market perceiving married/partnered men as more productive than partnered women. Alternatively, it might reflect low paid men having relatively less success in finding or keeping a partner. The indicator of parenthood attracts opposite signs for fathers and mothers from age 33 onwards. For example, at age 42, fathers, all else equal, receive a pay premium of 0.082 in the logs while mothers face a penalty of -0.094, resulting in a coefficient gap of 0.176. However, this term has to be evaluated in conjunction with the variables indicating the ages of currently co-resident children. For a 42 year old living in a household with children all in the school age range (5-15), fathers earn +0.110 (i.e.  $0.082+0.028$ ) more in log hourly earnings than their child-free counterparts.

Mothers, on the other hand, earn -0.104 (i.e.-0.094-0.010) less than child-free women. This yields an adjusted GWG among such parents of 0.214. However, women employees with younger children are estimated to be less poorly paid, which is enough to offset the gender gap in coefficients at 33 and 42, if there are only children under 3 present. This may be picking up the protective effect of remaining in employment over childbearing. Employment continuity at this juncture might have been facilitated by taking maternity leave.<sup>ix</sup> An alternative explanation for the reduced wage penalty for older mothers who participate in the labour market in children's earliest years is positive selection due to especially high earning ability, which may not be fully captured elsewhere in the model. At age 55, dependent children had largely departed the home, but the legacy of having ever had a parental role remains. There is a coefficient gap for mothers relative to fathers of 8 log points at both 50 and 55, but the relative pay of mothers relative to men and women who have not had children is also reflected in the lagging employment experience of mothers.

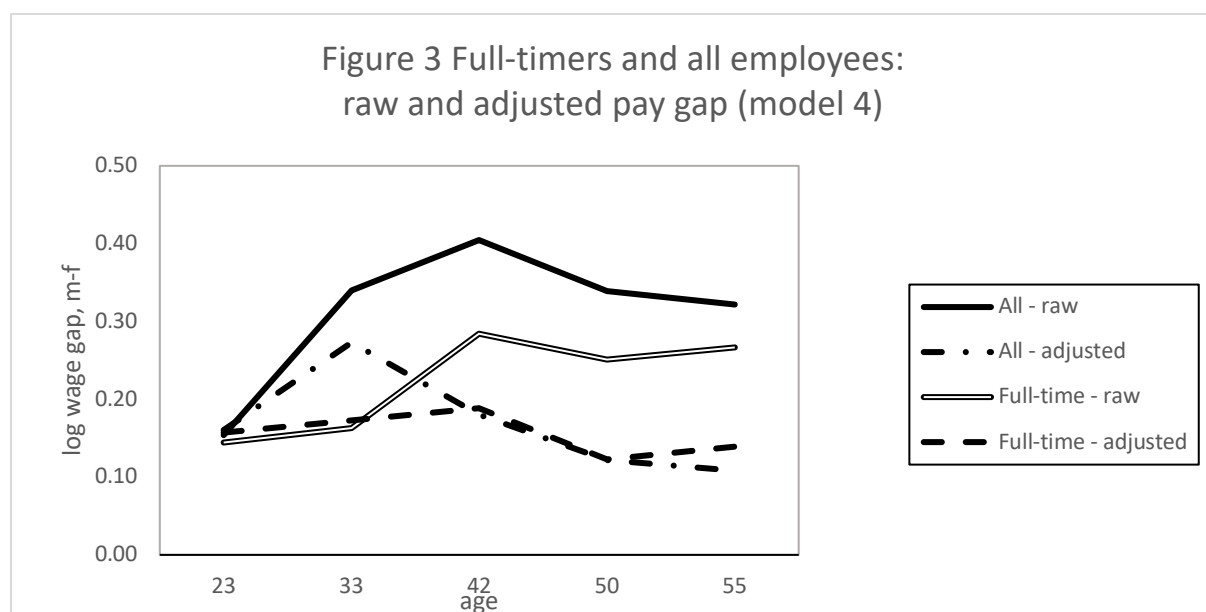
The coefficients on the experience terms reveal positive returns to full-time experience and negative returns to part-time employment (at least in the linear terms) but little significant difference in these returns for men and women. The few men with experience in part-time jobs are equally if not more penalised. Years in the current job generally attracts no more than a modest addition to the returns to employment in general. These modest estimates are higher for women than men, but only significantly so at age 23. This is consistent with the idea that women gain from staying with the same employer while men are more likely to gain from 'job shopping', at least in early stages of labour market life. This may reflect the protective effect of maternity leave for women, but needs further investigation

### **Analysis of Sub-groups**

We consider three sub-samples of cohort members, namely full-timers (who might be more attached to the labour market) and non-parents defined in two different ways: no kids to date and never parents (Table A4).

### Full-timers

On the whole, the raw GWG for full-timers is less than the GWG for the whole sample. The sample of full-timers excludes very few men but a sizable minority of women from age 33 onwards. At 33 the proportion part-timers peaks at almost half of the employees. If some of the female pay disadvantage arises from low wages in part-time jobs, unequal treatment among full-time workers would be expected to be less than for all workers. The comparison in Figure 3 (also presented in Annex Table A4) indicates that this only applies at age 33. The adjusted GWG between full-timers and the whole sample is, perhaps surprisingly, virtually indistinguishable at ages 42, 50 and 55 when conditioning on the full set of controls of model 4. However, the GWG, raw and adjusted, is considerably reduced if working full-time among those aged 33. The smaller GWG among full-timers at age 33 was not surprising as it is in line with earlier studies focusing on this sweep (Joshi and Paci 1998, and Neuberger 2010). The penalty to part-time wages seems to have been particularly marked at age 33. One reason could be that our specification in terms of past part-time experience is not sufficiently sensitive to low pay in current part-time jobs which had only started recently. Another consideration is this sweep in 1991 precedes the National Minimum Wage of 1999 which would have put a floor under low part-time wages after that.



### *No Parenthood*

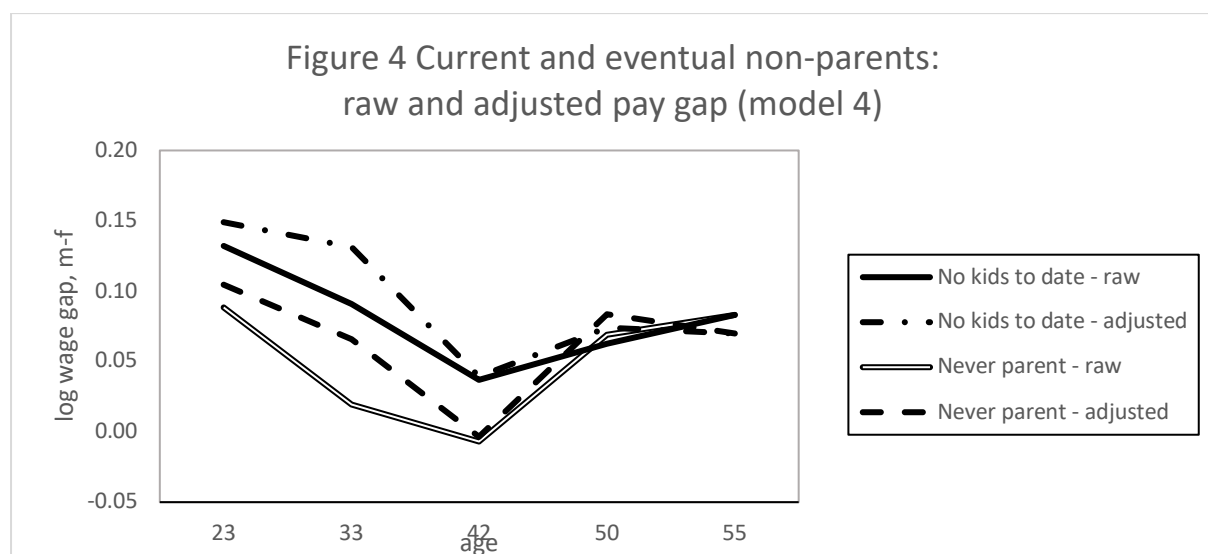
The second sub-group we consider, labelled 'No kids to date', are those who at the time of the survey did not have dependent children in the home and had not had them in the past. Isolating them from the general sample yields an estimated GWG which is lower than it is for parents at the same point in the life-cycle and takes the opposite shape – U shaped rather than the inverse.

However, a gap remains. Figure 4 shows the raw gap stands at 13 log points at age 23 and 9 points at 33, compared to 16 and 34 among the whole cohort ( Figure 1). Adjusted for human capital and partnership) ( in model 4) the estimate of unequal treatment rises to 15 log points at 23 and 13 log points at age 33, reflecting a correction for the relatively favourable human capital of women who had not (yet) become parents. At 42 the raw and adjusted pay gap among those who had not ( yet) had children in their home drops to statistical insignificance but the gaps then re-emerge, with very little difference between raw and adjusted around 7 log points at ages 50 and 55. Analysis incorporating the health of cohort members and their family members is beyond the scope of this paper, but will be included in future work. While it is not clear that health conditions would affect older men and women differentially, caring responsibilities could affect older women's earning power more than men's.

Some of those observed with no children, present or past, had postponed parenthood, and were observed as parents at later sweeps. The remaining cohort members who never became (co-residential) parents up to age 55 are distinguished in Figure 4 and the last column of Table A4. These are the same people as the 'non-parents' at 55 but a sub-set of the non-parent group at ages before 55. The difference between them is the number of employees who were subsequently observed with co-resident children. At ages 23 and 33 these 'permanently child-free' employees had smaller raw and adjusted wage gaps than the parents-to-be. At age 42 the wage gap for employees who eventually remained without children was apparently zero. However, women with no children experienced a wage penalty relative to their male counterparts at age 50 and 55. This was little

affected by including measured endowments or dropping cases, mainly men, whose household acquired children after age 42.

Figure 4 GWGs among current and eventual non-parents



## CONCLUSIONS

Almost half a century after the Equal Pay Act women in Britain continue to earn less than their male counterparts. The rate of convergence is slow, despite successive cohorts of women closing most of the gap in work experience and overtaking men in their academic attainment.

The descriptive analyses presented in this paper track the GWG for a cohort of men and women born in a single week in 1958. We track the gap faced by those in employment through to age 55. We control for information collected at six survey sweeps on their human capital, family formation

and work experience. In doing so we are extending previous work, notably Neuburger (2010), by including later sweeps of data, and in developing sub-group analyses. This provides a unique life-course insight into the relative fortunes of women in the labour market compared to those of men in one cohort.

We have run repeated estimates of a linear model, fully interacting gender with a consistent set of predictors of the log hourly wage of men and women in the 1958 birth cohort, conditional on their being in employment at successive surveys. We have partitioned pay gaps into those explained by blocks of regressors and the unexplained coefficient gap – a residual attributable to a wage penalty for being female. There are important limitations to this analysis. First, we do not seek to account for the potential endogeneity of family formation, work experience, or human capital accumulation. Second, we take no account of potentially non-random selection into employment over the life-course, and across genders. Third, we do nothing to account for sample attrition. We will be tackling these and other simplifications in future work on this and other cohorts as well as including more complete sets of explanatory variables.

The raw GWG among this birth cohort follows an inverse U-shape, running from age 23 in 1981 before most of them had become parents to a peak at the age 42 and then falling back somewhat at surveys in their fifties. The increase in the raw wage gap as family building proceeded to mid-life was mainly accounted for by a divergence in work experience - women's slower accumulation of experience in full-time employment, which was an indirect consequence of family building. For this cohort the GWG did not start (or end) with family formation. After allowing for the widening differences in experience over the life-cycle there is still a residual wage gap which starts at age 23 indicating a significant price for being female, around 16 log points (or 15% of male pay), and ends at around 11 log points at 55. Much of this residual gap is associated with asymmetric remuneration of men and women with family responsibilities, but unequal treatment is not wholly due to parenthood. There was a wage penalty to being female before parenthood and women who never



had children did not entirely escape it at the later ages. Female full-timers faced a similar gender penalty to all workers (except at age 33), which does not appear to decline much as the cohort grows older, despite the historical trend towards gender equality in the overall labour market and in social norms. Within this single cohort the different pattern of men's women's life cycle dominates the passage of historical time in shaping the profile of the gender wage gap. The examination of other cohorts will reveal how far the secular decline in the GWP across cohorts is due to cohort-wise improvement in treatment or endowments.

This evidence on wages and work experience at our various snapshots indicate that women's lifetime earnings for this cohort will be considerably below men's, for reasons which include and extend beyond, the direct and indirect effects of motherhood. This will have implications for the pension income they can expect. The protection of state pension rights from the direct consequences of spending years out of paid work will not level the differences in earnings received by men and women when in work. From this point of view, the experience of this cohort will form a yardstick by which to judge the fortunes of those who follow.

## REFERENCES

- Adda, J. Dustman, C. and Stevens, K. (2017) The Career Costs of Children. *Journal of Political Economy*, 125, 2: 293-337
- Addison, J. T., Orgul, D, Si Wang (2014) "The Role of Gender in Promotion and Pay over a Career." *Journal of Human Capital* 8 (3):280–317
- Azmat, G. and Petrongolo, B. (2014) Gender and the labor market: What have we learned from field and lab experiments? *Labour Economics*, 2014, vol. 30, issue C, 32-40
- Babcock L and Lashever S (2003) *Women Don't Ask Negotiation and the Gender Divide* Princeton: Princeton University Press
- Becker, G.S. (1985). "Human Capital, Effort, and the Sexual Division of Labor." *Journal of Labor Economics* 3 (1 Part 2): S33–58.
- Blau, F. D., and Kahn, LM ( 2017). "The Gender Wage Gap: Extent, Trends, and Explanations." *Journal of Economic Literature*, 55 (3): 789-865. DOI: 10.1257/jel.20160995
- Blundell, R., Gosling, A., Ichimura, H. and Meghir, C. (2007) Changes in the distribution of male and female wages accounting for employment composition using bounds. *Econometrica*, 75: 323-363
- Brueghel, I. and Perrons, D. (1995) Where do the costs of unequal treatment for women fall? An analysis of the incidence of the costs of Unequal pay and sex discrimination in the UK. In Humphries J and Rubery, J. *The Economics of Equal Opportunities*. Manchester: Equal Opportunities Commission
- Brynin, M. and Güveli (2012) Understanding the ethnic pay gap in Britain, *Work, Employment and Society* <https://doi.org/10.1177/0950017012445095>
- Colebrook, C., Snelling, C and Longlands, S (2018) *The state of pay. Demystifying the gender pay gap*. IPPR London
- Costa Dias, M., Joyce, R .and Parodi, F. (2018) The gender pay gap in the UK: children and experience in work. Institute for Fiscal Studies, London
- Davies, H.B. and Joshi, H.E. (1998) 'Gender and Income Inequality in the UK: 1968-1990: Feminization of Earning or of Poverty?' *Journal of the Royal Statistical Society, Series A*, 33-61.
- Dex, S., Sutherland, H. and Joshi, H. (2000). Effects of minimum wages on gender pay gap. *National Institute Economic Review*, 173, July 80-88.
- Folbre, N. (1994) *Who Pays For the Kids? Gender and the Structures of Constraint*. New York: Routledge
- Gardiner, L. (2017) Is the gender pay gap on the brink of closure for young women today? Resolution Foundation, blog. <http://www.resolutionfoundation.org/media/blog/the-gender-pay-gap-has-almost-closed-for-millennial-women-but-it-comes-shooting-back-when-they-turn-30/>
- Goldin, C. (2014) "A Grand Gender Convergence: Its Last Chapter", *American Economic Review*, 104(4): 1091-1119

- Goldthorpe, J.H.(2001) Causation, statistics and sociology. *European Sociological Review* 17(1): 1–20.
- Hakim, C. (2000) *Work-lifestyle Choices in the 21<sup>st</sup> Century: Preference Theory*, Oxford University Press, Oxford
- Harkness, S. (2016) “The effect of motherhood and lone motherhood on the employment and earnings of British women: a lifecycle approach”, *European Sociological Review*, 32, 6: 850-863
- Hawkes D and Plewis I. (2006) Modelling non-response in the National Child Development Study. *Journal of the Royal Statistical Society, Series A*, 169, 479-492.
- Jann, B ( 2008) The Blinder Oaxaca decomposition for linear regression models. *The Stata Journal*, 8( 4) 453-479
- Jenkins, A. (2017) Adult learning and qualifications in Britain. [\*Journal of Education and Work\*](#), 30(4), 445-455.
- Joshi, H. (2012) From Cradle to Career; Evidence from the British Birth Cohort Studies on the Family, Education and Employment- Introduction. *National Institute Economic Review*, October Issue, R1-R6
- Joshi, H. E., Layard, P. R. G. and Owen, S. J. (1985) Why are more women working in Britain? *Journal of Labor Economics*, Vol 3 January 1985, S147-S176.
- Joshi , H. and Paci, P. (1998) *Unequal pay for women and men: Evidence from the British Birth Cohort Studies*. The MIT Press, Cambridge, Ma.
- Joshi, H., Paci, P. and Waldfogel, J. (1999) ‘The Wages of Motherhood: better or worse?’ *Cambridge Journal of Economics*, 23, 5, 543-564
- Juhn, C. and McCue, K. (2017) “Specialisation then and now: marriage, children, and the gender earnings gap across cohorts”, *Journal of Economic Perspectives*, 31, 1: 183-204
- Kleven, H., Landais, C. and Sjøgaard, J. (2019) "Children and Gender Inequality: Evidence from Denmark." *American Economic Journal: Applied Economics*, 11 (4): 181-209.
- Leuven, E. and Sianesi, B. (2004) *FILM Software*. London: Institute for Fiscal Studies.<https://www.ifs.org.uk/publications/2712>
- Lucifora, C., Meurs, D., and Villar, E. (2018) “Children, Earnings and Careers in an Internal Labor Market: An Event Study”, WP 3.2018, CRELI, Università Cattolica del Sacro Cuore, Milan
- Makepeace, G, Woods, L. and Galinda-Rueda, F.and Joshi, H.(2003) ‘From School to the Labour market’ in E. Ferri, J. Bynner and M. Wadsworth (eds) *Changing Britain: Changing Lives*, Institute of Education, London, 29 – 104
- Manning A and Petrongolo B. (2008) The part-time penalty for women in Britain. *The Economic Journal*, 118, F28-F51.
- Manning, A .and Swaffield, J. (2008) The gender pay gap in early-career wage growth. *The Economic Journal*, 118, 983-1024.
- Mc Laughlin, H, Uggen, C and Blackstone, A. (2017) The Economic and Career Effects of Sexual Harassment on Working Women, USA, *Gender and Society*, 31, 3, 333-358.

- Mullany, L. and Yoong, M. (2019.) Gender and the Workplace. In: Vine, B, ed., *The Routledge Handbook of Language in the Workplace* Routledge. (In Press.)
- Neuburger J. (2010) Trends in the unequal pay of women and men across three British generations. PhD thesis, Institution of Education, University of London
- Neuburger, J., Kuh, D. and Joshi, H., (2011) Cross-cohort changes in gender pay differences in Britain: accounting for selection into employment using wage imputation, 1972-2004, *Longitudinal and Life Course Studies*, 2 ,3 Pp 260 – 285
- Office for National Statistics, (2018) Gender Pay Gap in the UK:2018.  
<https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/bulletins/genderpaygapintheuk/2018>
- Pearson, H. (2016) *The Life Project: The extraordinary story of our ordinary lives*. Allen Lane, Penguin Random House UK
- Rake, K (ed) 2000 Women's Lifetime Earnings. Cabinet Office, London: HMSO
- Roantree, B and Vira, K (2018) The rise and rise of women's employment in the UK, Briefing Note Note234, IFS, London
- Smith, T.M.F(1985) contribution to symposium on projections of student numbers in higher education, *Journal of the Royal Statistical Society Series A*, 148.184-180
- Waldfoegel, J (1998) The Family Gap for Young Women in the United States and Britain: Can Maternity Leave Make a Difference? *Journal of Labor Economics*, 16: 3, 505-545

## Technical Annex

### 1. Full citation of NCDS datasets

University of London, Institute of Education, Centre for Longitudinal Studies. (2008). *National Child Development Study: Sweep 4, 1981, and Public Examination Results, 1978*. [data collection]. 2nd Edition. National Children's Bureau, [original data producer(s)]. National Children's Bureau. SN: 5566,

\_\_\_\_\_. (2008). *National Child Development Study: Sweep 5, 1991*. [data collection]. 2nd Edition. City University. Social Statistics Research Unit, [original data producer(s)]. UK Data Service. SN: 5567, <http://doi.org/10.5255/UKDA-SN-5567-1>

\_\_\_\_\_. (2008). *National Child Development Study: Sweep 6, 1999-2000*. [data collection]. 2nd Edition. Joint Centre for Longitudinal Research, [original data producer(s)]. UK Data Service. SN: 5578, <http://doi.org/10.5255/UKDA-SN-5578-1>

\_\_\_\_\_. (2008). *National Child Development Study: Sweep 7, 2004-2005*. [data collection]. 3rd Edition. UK Data Service. SN: 5579, <http://doi.org/10.5255/UKDA-SN-5579-1>

\_\_\_\_\_. (2012). *National Child Development Study: Sweep 8, 2008-2009*. [data collection]. 3rd Edition. UK Data Service. SN: 6137, <http://doi.org/10.5255/UKDA-SN-6137-2>

\_\_\_\_\_. (2015). *National Child Development Study: Sweep 9, 2013*. [data collection]. UK Data Service. SN: 7669, <http://doi.org/10.5255/UKDA-SN-7669-1>

### 2. Definitions and Derivations

#### 2.i Derivation of the dependent variable

Hourly earnings are deflated to January 2000 prices by the RPI. They are derived from separate survey questions about the amount cohort members were paid, the pay period this relates to (allowing weekly earnings to be calculated) and the hours worked per week in the respondent's main job. Hourly wage.

In all surveys, cohort members were asked about gross pay, that is before any deductions for tax, national insurance, pension etc. They were asked to include any overtime, bonuses, commissions, tips or tax refunds. At age 55 cohort members were simply asked to report their gross pay, whilst at age 42, 46 and 50 they were asked to report gross pay last time they were paid, and at age 23 and 33 they were asked to report their usual gross pay. At 50 and 55 respondents who could not recall their pay were encouraged to provide an approximation through unfolding brackets in the question.

Questions on hours worked per week also varied across surveys. At age 33 and 55 cohort members were asked to report usual hours worked including overtime; whilst at age 42 and 50 they were first asked if they did any paid or unpaid overtime. If they reported no overtime, they were asked to report usual hours. If they reported overtime, they were asked to report usual hours not including overtime, and usual paid overtime hours and usual unpaid overtime hours. These approaches allowed calculation of the same measure of usual hours worked including overtime hours.

At age 46, when the survey was conducted by telephone, cohort members were asked to report usual hours worked **not** including overtime. The poor reporting of hours made it difficult to

compute hourly pay in this survey (Neuburger 2010) The approach was also slightly different at age 23; cohort members were asked to report actual hours worked in an average week including any paid overtime you usually do

In all surveys, cohort members were asked not to include meal breaks in the reporting of their hours worked.

Another important difference between the surveys, was in the allowable range of responses to these questions. At age 42, 50 and 55, cohort members could report up to 168 hours per week; whilst at age 46 the maximum number of hours that could be reported was 80, and at age 33 it was 99, and at age 23 if cohort members did more than 96 hours per week, they were told to code weekly hours as 96.

In our calculations of hourly earnings, we use hours as reported in each survey. For the surveys where the reporting of hours was less restrictive, less than 0.2 per cent of the sample reported hours of more than 80 hours per week. These cohort members were more likely to be men. The average number of hours reported was highest at age 23 at 39.9 hours per week, but across other ages differences are relatively small (age 33 – 36.9 hours per week, age 42 – 37.0 hours, age 46 – 37.7 hours, age 50 – 36.7 hours, and age 55 – 37.3 hours).

The exact wording of the questionnaires can be found in the documentation of the study at [https://cls.ucl.ac.uk/data\\_documentation/](https://cls.ucl.ac.uk/data_documentation/) or the UK data service under the references give below.

## **2.ii Definition of Regressor Variables, by Block**

ED:

*qual* is a set of 5 dummy variables identifying the National Vocational Qualification level of highest qualification held; NVQ levels include both academic and equivalent vocational certificates. Level 1= lower than O level : Level 2 =O level or equivalent; level 3 = A level or equivalent; Level 4 = Degree or equivalent vocational diploma; level 5 postgraduate, academic or professional. Note that we treat nursing and teaching qualifications as level 4 whether or not they were treated as degrees at the time this cohort gained them

*qualmiss* is a dummy variable indicating data on highest qualification is missing; plus the basic controls,

*obs* is a count of how many times the respondent has appeared in previous estimation samples; and *LonSE* a dummy variable for residence in London or the South East

FAM:

*partner* - a dummy variable identifying whether the cohort member currently had a partner living in the household;

*everchild* - a dummy variable identifying whether the cohort member reported a dependent child living in the household at the current or any previous surveys;

*childage* - dummy variables identifying whether the cohort member had a child in the home aged 0 to 2, 3 to 4, or 5 to 15.

EXP:

the number of months and its square of months that cohort members had worked full-time/part-time up to the time of each survey;

*tenure* - the number of months the cohort member had worked with their current employer at the time of each survey, reported in years in regression results;

*tenmiss* - a dummy variable indicating where data on the time with current employer is missing–

### **3 Supplementary Tables**

Table A1 Descriptive statistics for the wage-earning estimation sample NCDS

Table A2: Broad Decomposition of gender wage gap in NCDS by Model

Table A3.: Individual coefficients and their gender gaps, model 4

Table A4. Estimates of log female wage penalty ( $\beta_m - \beta_f$ ) for three sub-groups and whole sample, by age and model specification

**Annex Table A1 Descriptive statistics for the wage-earning estimation sample NCDS**

	Males						Females					
	23	33	42	46*	50	55	23	33	42	46*	50	55
Real log hourly pay <sup>1</sup>	1.70 (0.28)	2.18 (0.45)	2.33 (0.61)	2.46 (0.46)	2.43 (0.52)	2.35 (0.55)	1.55 (0.29)	1.84 (0.48)	1.93 (0.57)	2.10 (0.45)	2.09 (0.49)	2.03 (0.49)
% living in London or the South East	31.9	30.2	29.3	28.2	21.3	20.8	33.9	29.3	29.2	28.6	22.2	23.4
% with No qualifications	14.3	10.8	9.4	8.6	8.2	6.1	11.0	12.1	11.2	10.0	7.5	6.0
% with NVQ Level 1	11.1	14.2	12.1	11.9	11.1	9.5	10.2	14.0	12.7	10.9	9.9	9.2
% with NVQ Level 2	21.9	24.8	22.1	23.2	22.5	21.0	27.9	32.4	29.8	31.3	28.6	26.6
% with NVQ Level 3	17.2	18.7	19.9	16.9	20.0	20.3	15.2	12.7	13.5	12.5	15.3	16.7
% with NVQ Level 4	14.1	28.8	32.5	35.4	32.9	35.0	19.3	27.6	30.0	31.4	34.1	34.6
% with NVQ Level 5	0.2	2.7	4.1	4.0	5.3	6.4	0.3	1.3	2.8	3.9	4.5	5.7
% with missing qualifications data	21.1	0	0	0	0	1.7	16.1	0	0	0	0	1.3
Mean number of previous wage observations	0 (0)	0.7 (0.5)	1.4 (0.7)	2.1 (0.9)	2.4 (1.0)	3.2 (1.1)	0 (0)	0.6 (0.5)	1.1 (0.7)	1.9 (0.9)	2.0 (1.0)	2.8 (1.1)
Mean full-time experience (months)	65 (27)	165 (48)	260 (56)	321 (56)	359 (65)	415 (68)	57 (28)	113 (61)	157 (86)	197 (104)	216 (113)	252 (129)
Mean part-time experience (months)	1 (5)	2 (13)	4 (17)	4 (19)	5 (24)	7 (27)	3 (11)	28 (39)	62 (63)	77 (78)	98 (89)	118 (106)
Mean job tenure (months)	42 (30)	83 (66)	127 (103)	160 (126)	152 (136)	172 (145)	38 (29)	57 (58)	82 (80)	109 (101)	107 (99)	136 (112)
% with missing job tenure data	0.3	1.6	0.0	0.1	3.3	0.8	0.1	2.5	0	0.4	2.7	0.7



**Annex Table A1 (continued) Descriptive statistics for the wage-earning estimation sample NCDS**

	Males							Females					
	23	33	42	46*	50	55		23	33	42	46*	50	55
% with partner	42.7	80.6	84.3	81.7	83.9	84.5		53.0	78.7	81.6	76.6	79.1	77.6
% ever had child in household to date	16.3	63.2	79.3	79.3	81.6	82.1		9.0	66.0	82.6	81.1	84.5	85.0
% with child aged 0-2 in household	14.0	28.1	8.7	3.6	1.1	0.2		5.3	16.2	3.2	0.1	0.1	0.1
% with child aged 3-4 in household	3.1	23.5	8.2	2.3	1.4	0.5		3.1	16.0	4.6	0.2	0.0	0
% with child aged 5-15 in household	0.8	38.3	58.9	38.3	25.6	11.8		2.5	52.5	60.6	32.6	18.1	3.8
Estimation sample <sup>†</sup>	4263	3691	3567	871	2801	2346		3585	3050	3464	811	3108	2546

Standard deviations of continuous variables in parenthesis. \* Telephone survey. † There is no weighting of sample numbers.

**Table A2: Broad Decomposition of gender wage gap in NCDS by Model**

AGE	23	33	42	50	55
<b>Difference in Log Hourly Wage. Men -Women</b>					
	0.154 ***	0.340 ***	0.405 ***	0.339 ***	0.322 ***
<b>Accounted for by differences in Endowments</b>					
1.ED	-0.017 ***	0.042 ***	0.061 ***	0.030 ***	0.032 ***
2.ED +EXP	-0.013 ***	0.157 ***	0.216 ***	0.179 ***	0.150 ***
3.ED+FAM	-0.024 ***	0.068 ***	0.080 ***	0.024 ***	0.040 ***
4: ED+EXP+FAM	-0.022 ***	0.135 ***	0.206 ***	0.181 ***	0.162 ***
<b>Accounted for by differences in Coefficients</b>					
1.ED	0.162 ***	0.319 ***	0.362 ***	0.319 ***	0.300 ***
2.ED +EXP	0.150 ***	0.269 ***	0.172 ***	0.116 ***	0.112 ***
3.ED+FAM	0.171 ***	0.317 ***	0.361 ***	0.311 ***	0.292 ***
4: ED+EXP+FAM	0.160 ***	0.273 ***	0.18 ***	0.122 ***	0.108 **
<b>Interaction of Coefficients and Endowments</b>					
1.ED	0.009 ***	-0.020 ***	-0.018 ***	0.009 **	-0.009 *
2.ED +EXP	0.016 ***	-0.086 ***	0.017 <i>ns</i>	0.044 <i>ns</i>	0.061 <i>ns</i>
3.ED+FAM	0.007 ***	-0.045 ***	-0.036 ***	0.004 <i>ns</i>	-0.011 <i>ns</i>

4: ED+EXP+FAM	0.016	***	-0.068	***	0.018	ns	0.036	ns	0.052	ns
<b>R squared in Fully Interacted Linear Regression</b>										
1.ED	0.174		0.380		0.291		0.349		0.312	
2.ED +EXP	0.209		0.422		0.323		0.390		0.342	
3.ED+FAM	0.192		0.410		0.309		0.362		0.322	
4: ED+EXP+FAM	0.220		0.433		0.331		0.400		0.350	
<b>N (males +females)</b>										
	7848		6741		7031		5909		4892	
<sup>1</sup> Education block includes controls for region and times observed in wage sample										
significance of difference from zero: * p<.1; ** p<.05; *** p<.01										

**Table A3.: Individual coefficients and their gender gaps, model 4, part 1 ages 23, 33 and 42**

	age 23			age 33			age 42		
	males $\beta_m$	females $\beta_f$	m-f $\beta_m - \beta_f$	males $\beta_m$	females $\beta_f$	m-f $\beta_m - \beta_f$	males $\beta_m$	females $\beta_f$	m-f $\beta_m - \beta_f$
<b>EDUCATION</b>									
Highest NVQ									
0	-0.169 ***	-0.271 ***	0.102 ***	-0.504 ***	-0.577 ***	0.073 **	-0.571 ***	-0.508 ***	-0.063
1	-0.154 ***	-0.295 ***	0.141 ***	-0.408 ***	-0.536 ***	0.128 ***	-0.459 ***	-0.531 ***	0.072 *
2	-0.100 ***	-0.190 ***	0.090 ***	-0.293 ***	-0.432 ***	0.139 ***	-0.332 ***	-0.410 ***	0.078 **
3	-0.045 ***	-0.123 ***	0.077 ***	-0.222 ***	-0.298 ***	0.076 **	-0.211 ***	-0.324 ***	0.113 ***
5	-0.065	0.065	-0.130	0.057	0.106	-0.049	0.212 ***	0.232 ***	-0.019
missing	-0.110 ***	-0.192 ***	0.083 ***						
<b>other controls</b>									
Wage obs				0.026 *	.022 *	.005	0.031 **	0.050 ***	-0.019
Lon/SE	0.089 ***	0.160 ***	-0.071 ***	0.255 ***	.174 ***	.052 **	0.212 ***	0.145 ***	0.067 **
<b>EXPERIENCE</b>									
Yrs full-time	0.009	0.011	-0.002	0.003 ***	0.001 *	0.002 **	0.050 ***	0.021 ***	0.029
Yrs ft sqd	0.000	-0.003 ***	0.003 **	-0.000 ***	-0.000	.000 **	-0.001 ***	0.000 *	-0.001 ***
Yrs prt-time	-0.043 *	-0.059 ***	0.016	-0.002	-.002 ***	0.000	-0.067 ***	-0.015 ***	-0.052 ***
Yrs pt sqd	0.009 **	0.007 ***	0.002	0.000	0.000	0.000	0.004 ***	0.001 ***	0.003 ***
Job tenure-	0.017 ***	0.022 ***	0.005 **	0.007 ***	0.017 ***	-.010 ***	0.006 ***	0.009 ***	-0.002
tenure miss	-0.195 **	-0.242	-0.046	-.084	-0.167 ***	0.083	-0.143		-0.143
<b>FAMILY</b>									
Partner	0.068 ***	0.016 *	0.052 ***	0.074 ***	0.053 ***	.020	0.073 **	0.052 **	0.021
Ever parent	0.007	0.003	0.004 **	-0.007	-0.083 ***	.105 ***	0.082 **	-0.094 ***	0.176 ***
Household has									
kids<3	-0.010	-0.076 **	0.066	-0.020	0.082 ***	-.102 ***	0.028	0.215 ***	-0.187 ***
kids 3-4	-0.011	-0.097 ***	0.086 *	0.027	-0.007	.033	0.026	0.090 **	-0.064
kids 5-15	0.013	-0.130 ***	0.143	-0.007	-0.102 ***	0.096 ***	0.028	-0.010	0.039
<b>CONSTANT</b>	1.643 ***	1.640 ***	-0.003	2.044 ***	2.047 ***	-.003	1.834 ***	1.921 ***	-0.087

\* p<.1; \*\* p<.05; \*\*\* p<.01

**Table A3 Individual coefficients and their gender gaps, model 4, part 2, ages 50 and 55**

	age 50					age 55				
	males		females		m-f	males		females		m-f
	$\beta_m$		$\beta_f$		$\beta_m - \beta_f$	$\beta_m$		$\beta_f$		$\beta_m - \beta_f$
<b>EDUCATION</b>										
Highest NVQ										
0	-0.525	***	-0.510	***	-0.015	-0.539	***	-0.508	***	-0.030
1	-0.494	***	-0.508	***	0.014	-0.530	***	-0.487	***	-0.043
2	-0.375	***	-0.415	***	0.040	-0.380	***	-0.405	***	0.025
3	-0.256	***	-0.317	***	0.061	-0.296	***	-0.300	***	0.003
5	0.224	***	0.290	***	-0.066	0.214	***	0.271	***	-0.057
missing						0.476	***	0.401	***	0.075
<b>other controls</b>										
Wage obs	0.034	***	0.033	***	0.001	0.017	*	0.018	**	-0.001
Lon/SE	0.197	***	0.100	***	0.097	0.169	***	0.083	***	0.086
<b>EXPERIENCE</b>										
Yrs full-time	0.003	***	0.001	***	0.002	0.042	***	0.013	***	0.029
Yrs ft sqd	0.000	***	0.000		0.000	-0.001	***	0.000		-0.001
Yrs part-time	-0.004	***	-0.001	***	-0.002	-0.039	***	-0.011	***	-0.028
Yrs pt sqd	0.000	***	0.000	***	0.000	0.002	**	0.000	***	0.001
Yrs in current job	0.005	***	0.007	***	-0.002	0.005		0.003	***	0.002
tenure miss	-0.050		0.061		-0.111	-0.199	*	-0.214	**	0.015
<b>FAMILY</b>										
Partner	0.147	***	0.025		0.123	0.119	***	0.039	*	0.080
Ever parent to date	0.047	**	0.009		0.039	0.082	***	-0.001		0.082
Household has										
kids<3	-0.087		-0.243		0.155	-0.188		-0.351		0.158
kids 3-4	-0.031		-0.591		0.560	0.132				0.132
kids 5-15	0.048	**	0.045		0.003	0.039		0.077	*	-0.037
<b>CONSTANT</b>	1.840	***	2.012	***	-0.172	1.618	***	1.910	***	-0.292

\* p<.1; \*\* p<.05; \*\*\* p<.01

**Table A4. Estimates of log female wage penalty ( $\beta_m - \beta_f$ ) for three sub-groups and whole sample, by age and 3 models**

Age	model		Currently Full-time	Not Parent to date	Not parent by 55	Whole sample
<b>23</b>	Raw		0.144	0.132	0.090	0.154
	model 1	ED	0.153	0.139	0.088	0.162
	model 2	ED+EXP	0.149	0.143	0.082	0.150
	model 3	ED+FAM	0.161	0.153	0.111	0.171
	Model4	ED+FAM+EXP	0.157	0.149	0.105	0.160
	<b>N</b>		<b>7474</b>	<b>6829</b>	<b>1012</b>	<b>7848</b>
<b>33</b>	Raw		0.163	0.091	0.011	0.340
	model 1	ED	0.187	0.125	0.057	0.319
	model 2	ED+EXP	0.172	0.124	0.058	0.269
	model 3	ED+FAM	0.177	0.129	0.064	0.317
	Model4	ED+FAM+EXP	0.173	0.131	0.066	0.273
	<b>N</b>		<b>5351</b>	<b>2393</b>	<b>959</b>	<b>6741</b>
<b>42</b>	Raw		0.284	[0.037]	[-0.007]	0.405
	model 1	ED	0.270	[0.050]	[0.009]	0.362
	model 2	ED+EXP	0.198	[0.015]	[0.014]	0.172
	model 3	ED+FAM	0.252	0.062	[0.017]	0.361
	Model4	ED+FAM+EXP	0.189	[0.039]	[-0.004]	0.180
	<b>N</b>		<b>5513</b>	<b>1343</b>	<b>913</b>	<b>7031</b>
<b>50</b>	Raw		0.251	0.063	0.069	0.339
	model 1	ED	0.250	0.113	0.122	0.319
	model 2	ED+EXP	0.130	[0.052]	0.070	0.116
	model 3	ED+FAM	0.231	0.126	0.133	0.311
	Model4	ED+FAM+EXP	0.123	0.074	0.084	0.122
	<b>N</b>		<b>4675</b>	<b>996</b>	<b>876</b>	<b>5909</b>
<b>55</b>	Raw		0.267	0.083	0.083	0.322
	model 1	ED	0.267	0.120	0.120	0.300
	model 2	ED+EXP	0.140	[0.060]	[0.060]	0.112
	model 3	ED+FAM	0.250	0.123	0.123	0.284
	Model4	ED+FAM+EXP	0.139	0.070	0.070	0.108
	<b>N</b>		<b>3782</b>	<b>801</b>	<b>801</b>	<b>4892</b>

Estimates all not significantly different from zero  $p < 0.05$  except for those [in square brackets]

Plotted in Figures 3 and 4 of text.

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1 This is consistent with an estimate for all workers of 40% in household survey data 1968 (Davies and Joshi, 1998), and the official time series for full-time employees in manual work (Joshi Layard & Owen, 1985, Table 6)

2 The private firms, employing more than 250, which submitted returns in 2018 showed a median pay gap in favour of men, at 10% within organisations. This is less than the national estimate from survey data (18%) as it does not cover differences between firms (Colebrook, Snelling and Longlands, 2018). Neither estimate allows for gender differences in education, grade or experience.

3 The Married Women's Option to rely on their husband's contributions was abolished from 1977. Instead they could claim an allowance in the pension calculation to discount some years of labour market absence for home responsibilities.

4 Neuberger, Kuh and Joshi (2011) found some positive selection into employment for NCDS women at 23 and 33, less so at 42. In future work we intend to take this further, and into ages 50 and 55. We also intend to build on the work of Hawkes and Plewis (2006) on non-response and attrition.

5 In an earlier analysis of the wage gap at age 33, Joshi and Paci (1998) found that a set of variables covering job characteristics, including occupation, reduced the unexplained pay gap, but far from completely. We anticipate tackling issues of occupational choice and occupational segregation in future papers.

6 Full bibliographic references to the datasets are in the Annex.

7 Some children born abroad in the survey week were recruited from school at ages 7, 11 and 16.

viii Note that in contrast to data from household panels, the cohort members did not generally share households with each other. The few exceptions are not identified in the estimation sample. The women tend to have partners a little older than themselves, and the men vice-versa.

ix There would have been better access to maternity leave in the late 1990s than in the 1980s, but not as much as in the 2000s.