Occupation Flexibility and the Gender Wage Gap in the UK*

Liza Benny†

Sonia R. Bhalotra‡

Manuel Fernández§

Fan Wang¶

Yang Xun‖

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Abstract

This paper examines the importance of gender differences in labour supply and demand for job flexibility to the growth of the gender wage gap over the life cycle and over time in the UK. We document that the gender wage gap increases over the life cycle, particularly between ages 25 and 40, to approximately 20% of real hourly male earnings by age 55. The share of women working in flexible occupations has increased over the life cycle, particularly for successive cohorts, whereas men are less likely to work in flexible occupations at older ages. The wage penalty from working in flexible occupations increases both over the life cycle and over time. We estimate a model of labour supply and demand to quantify the importance of changes in preferences and relative demand for flexibility on the gender wage gap. Higher relative demand for male labour at older ages, and in inflexible occupations, explains almost all (96%) of the estimated life cycle increases in the gender wage gap, whereas women's higher preferences for working in flexible occupations drives the increases in sorting into flexible occupations over time, contributing to about 60% of the estimated increase in the gender wage gap over time.

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†University of Essex: l.benny@essex.ac.uk

‡University of Warwick: sonia.bhalotra@warwick.ac.uk

§Universidad de los Andes: man-fern@uniandes.edu.co

¶University of Houston: fwang26@uh.edu

‖University of Warwick: yang.xun@warwick.ac.uk

1 Introduction

A significant gender wage gap persists in many developed economies (about 20% in the US in 2013 and 15.5% for the UK in 2020) (Blau and Kahn, 2017; Bertrand, 2018; Bailey and DiPrete, 2016; Francis-Devine and Ferguson, 2020). Though the gender wage gap in the UK has fallen since the 1970s, reductions have been slowest at the top of the distribution, as wage convergence was slower over the 1990s for graduates and especially for the highest paid workers, which has mirrored patterns for the US (Guvenen et al., 2014; Bailey and DiPrete, 2016; Bertrand, 2018). This lack of convergence in the gender wage gap over time has been attributed to women's need for flexibility in the workplace, which has led to a 'glass ceiling' that prevents women from accessing highly paid jobs (Bertrand, 2018; Goldin, 2014). This links to an existing literature that associates flexibility with the life cycle evolution of the gender wage gap, as the gender wage gap increases over the life cycle, widening after motherhood with the 'child penalty' (Adda et al., 2017; Kleven et al., 2019a; Costa Dias et al., 2018). However, there is little research that explicitly links occupation flexibility to changes in the gender wage gap over time and across the life cycle. This paper employs a model of labour demand and supply in flexible occupations to investigate how changes in these forces have explained the changes in the gender wage gap and the share of workers in flexible occupations in the UK over time and across the life cycle.

This paper begins by summarising several key descriptive patterns related to the gender wage gap and occupation flexibility in the UK. First, we document that male wages stochastically dominate female wages for both education groups, with the gender gap varying in distinct ways across the earnings distribution. Among graduates, the male–female earnings gap is small at the bottom but increases sharply toward the top, reflecting a relatively low intercept and steep slope. Among non-graduates, the gap is substantially larger at the bottom, and its rise across the distribution is more gradual, implying a high intercept and flatter slope.

Next, we show that the importance of across-occupation inequality has risen over time for both graduates and non-graduates. Within-occupation gender inequality declines across cohorts, particularly at the top of the distribution for graduates and throughout the distribution for non-graduates. However, increases in across-occupation inequality offset these reductions and contribute to the persistence of overall gender wage inequality.

We then analyse how these distributional patterns map into gender differences over the life cycle. Among graduates, male and female wages are similar at labour market entry, but a substantial wage gap emerges and widens until at least age 45. These life-cycle patterns are consistent across cohorts and align with evidence that slower female wage growth after motherhood contributes to persistent gender inequality (Adda et al., 2017; Bertrand et al., 2010; Costa Dias et al., 2018; Kleven et al., 2019b). Among non-graduates, the gender gap is already large at age 25 and widens more gradually. The intercept is higher and the slope flatter, particularly for younger cohorts for whom the age-specific gender gap has declined.

Finally, we show that life cycle dynamics and occupational sorting jointly shape the gender wage gap. Graduates and non-graduates differ substantially in their participation in flexible occupations and in the associated earnings penalties. Flexible jobs carry substantial wage penalties for all groups. These penalties are larger for graduate women than for graduate men and similar for male and female non-graduates. The flexibility penalty has also risen across cohorts for graduates, consistent with evidence of growing long-hours premia in "greedy occupations" (Cha, 2010; Cha and Weeden, 2014; Cortés and Pan, 2019; Coser, 1974; Kuhn and Lozano, 2008) and with changes in work organisation that have increased the costs of working flexibly (Lazear and Shaw, 2007). Among graduates, the gender gap increases significantly across the earnings distribution because male wages grow faster within occupations, and men are increasingly concentrated in higher-paying, less flexible jobs. In contrast, for non-graduates, across-occupation gaps driven by occupational sorting have increased over time despite smaller flexibility penalties, reflecting more persistent gender differences in the types of jobs held by non-graduates.

The analysis in this paper employs an economic model to explain these descriptive patterns. Our model incorporates both prime-aged graduates and non-graduates, while we currently focus our analysis on graduates only.[1] Furthermore, flexibility might be an especially binding constraint for graduate women, who, despite working longer hours than non-graduate women, have also been increasingly spending more time with their children (Guryan et al., 2008; Altintas, 2016). The flexibility characteristics used to calculate the flexibility score are also more relevant for high-skilled or high-earning jobs, which tend to be dominated by workers with graduate degrees.

We propose a model of labour demand and supply that can rationalise both the cohort and life cycle patterns observed in the data and how they relate to the changes in men and women working in flexible occupations, linking these changes in working in flexible occupations with changes in labour supply to and demand for flexible occupations. We follow Johnson and Keane (2013) in using a model where individuals are differentiated into types by sex, age, education, and cohort over

[1]The results incorporating non-graduates are work in progress.

time, with each type having different labour market preferences and outcomes. On the supply side, workers of different types choose among two market occupations and home production within a random utility framework. On the demand side, workers of different types and in different occupations can be imperfect substitutes in production, with relative demand trends that can change over time.

We allow occupational choices to vary along the dimensions that we are interested in exploring: flexibility, life cycle, and gender, allowing preferences to vary along these dimensions and in response to other key life events such as marriage and fertility. We aim to capture the heterogeneity in equilibrium wages and employment over time and over the life cycle for different types of workers in the two market occupations (and home production) in this equilibrium model of labour supply and demand. We use the variation arising from demand shifts, changes in tastes and preferences, and heterogeneity across types of labour and occupations to capture changes in the wage structure and employment patterns outlined above in the descriptive trends. Capturing these trends using the model also enables us to perform equilibrium counterfactual simulations, allowing us to understand how outcomes would differ in response to changes in the parameters.

Our model and parameters of interest illustrate the importance of flexibility in explaining the gender wage gap. We find that increases in women's preferences for flexibility over successive cohorts drove the large increase in women working in flexible occupations, contributing to more than 80% of the decrease in the wage penalty associated with working in flexible occupations over the same period. This increase in women's preferences for flexibility, therefore, also contributed to a 62% increase in the model estimates of the graduate gender wage gap between 1993 and 2017. This is comparable to research that has found that close to two-thirds of the overall US gender wage gap is accounted for by the differential impacts of children on women and men (Cortés and Pan, 2020). Women's preferences for flexibility may have increased as flexible working arrangements have become more common in workplaces, leading to a more widespread cultural acceptance of flexible working. This is encouraged by legislation that enables employees to request such arrangements. This shift in preferences towards working in flexible occupations by more recent cohorts of women has not been previously documented, but is in line with previous research that has documented that parental time spent with children has increased particularly for highly educated women in the US and UK, where these increases in human capital investment and assortative matching (Guryan et al., 2008; Borra and Sevilla, 2019; Altintas, 2016; Chiappori et al., 2020, 2017; Lundberg and Pollak, 2014; Lundberg et al., 2016). This evidence on increased preferences for flexibility aligns with findings that suggest increased returns to human capital investment have led to more intensive parenting styles (Doepke and Zilibotti, 2017). This relationship between human capital investment and parenting styles is further supported by the lack of gender wage convergence over time among graduates.

We also find that the relative demand for male labour increased with age, so that men were in higher demand in both flexible and inflexible occupations at older ages compared to women, thereby increasing their wage premium in the labour market. This higher relative demand for men at older ages accounted for almost all (or 96%) of the increase in the gender wage gap over the life cycle, as well as 90% of the increase in the flexibility wage penalty over the life cycle as estimated. The increase in the relative demand for labour in inflexible occupations at older ages also explained the increase in the wage penalty from working in flexible occupations for successive cohorts and over the life cycle. This increase in relative demand for inflexible labour is higher for women, however, which contributes to them suffering a higher wage penalty from working in flexible occupations at older ages. The increased relative demand for men at older ages compared to women has been referred to in the existing literature as an 'age twist', as research has shown that firms' explicit gender requests shifted away from women to men for workers at older ages (Helleseter et al., 2020). It may also be that employers engage in taste-based discrimination against women (due to the gendered nature of employer preferences, especially in male-dominated professions) or statistical discrimination (due to expectations about lower productivity), (Stillman and Fabling, 2017; Cortés and Pan, 2020). For instance, women were perceived to have lower levels of labour force attachment, especially after motherhood, whereas fathers were seen to be the opposite, and were penalised in terms of receiving fewer call-backs for interviews in field experiments (Kuhn et al., 2020; Correll et al., 2007). Jobs geared towards men and advertising 'male' aspects of flexibility, such as shift work and travel, had higher advertised salaries in India, also suggesting that employers were more likely to advertise these more senior roles involving inflexible work towards men (Chaturvedi et al., 2021).

While motherhood reduced women's likelihood to work overall in both types of occupations, men were more likely to work after having a child, particularly in inflexible occupations, which corroborates evidence from previous research that has found that fatherhood benefited men in terms of labour market outcomes as they were seen to be more committed and to be recommended higher starting salaries (Lundberg and Rose, 2002; Correll et al., 2007; Kuhn et al., 2020), whereas women were more likely to work in lower-paying firms and family-friendly workplaces with the onset of motherhood (Joyce and Xu, 2019; Hotz et al., 2018; Pertold-Gebicka et al., 2016). We also find that motherhood reduces women's probability of working in flexible occupations more than in inflexible occupations, which suggests that women select into flexible occupations in anticipation of future fertility choices (Adda et al., 2017). Finally, while marriage was also associated with reduced labour supply for women, men reduced their participation in flexible occupations after marriage and were more likely to work in inflexible occupations after getting married, in line with existing research that older men were increasingly more likely to work long hours in recent years (Kuhn and Lozano, 2008).

This paper is structured as follows: the following section describes the data and definitions used in analysis, in particular explaining the measure of occupation flexibility that we use, Section 3 summarises the key descriptive patterns of interest, Section 4 sets out the model and estimation strategy, Section 5 presents a discussion of the results for the parameter estimates and counterfactual simulations, and Section 6 concludes.

2 Data

The main data used in our analysis are from the UK Quarterly Labour Force Survey waves from spring 1993 to winter 2019, with the analysis sample restricted to those aged 25 to 55 years (the prime-aged population). The data include measures of labour force participation, gross weekly wages, and usual hours worked per week in the main occupation, which were used to calculate data aggregates using survey weights to make them representative of the population. This is supplemented with data from the Family Resources Survey on childcare costs and child-related benefits.

Pay was measured as real hourly earnings (with base year set as 2015) in the main job, excluding missing earnings and those with missing weekly hours of work, and trimmed to exclude hourly earnings below £0.10.[2] The hourly earnings used in this analysis exclude self-employment income, as it is typically difficult to separate out labour income for the self-employed, and these are not included in the LFS measure of earnings.

The analysis in this paper examines both prime-aged graduates and non-graduates to assess how gender wage inequality and the contribution of occupational sorting vary across the skill distribution. Several considerations motivate comparing the two groups. First, the flexibility characteristics used to construct the flexibility score may be more relevant for high-skilled or high-earning jobs, which are disproportionately held by workers with graduate degrees. Second, existing evidence suggests that

[2] 0.1% of observations were trimmed from the sample.

flexibility constraints may be more binding for graduate women, who have become increasingly likely to spend time with their children relative to less educated women (Guryan et al., 2008; Altintas, 2016).

Figure 1 plots the change in the male-to-female log earnings ratio, both overall and within occupations, at the 10th, 50th, and 90th percentiles for all full-time workers.[3] The male-to-female log earnings gap is larger at higher quantiles. At the first decile and at the median, the overall gender earnings gap narrows substantially between 1990 and 2020. At the 90th percentile, by contrast, the gap between the highest-earning men and women remains largely unchanged.

To understand the sources of these trends, we compute the within-occupation gender log earnings gap for each year and percentile of the occupation-specific gender distributions, weighting occupations by their employment shares. At the first decile and at the median, the average within-occupation gender gap closely tracks the overall gap, indicating that most of the observed convergence is due to narrowing within occupations. By 2020, within-occupation gaps account for a much smaller share of the total gender gap than in the early 1990s, consistent with declining within-occupation inequality and the increasing importance of across-occupation differences. At the 90th percentile, we observe a similar reduction in within-occupation gender inequality; yet, the overall gender gap persists because across-occupation differences remain large. This pattern highlights the growing contribution of occupational sorting to gender inequality at higher earnings levels.

Building on these aggregate patterns, Figure 2 presents separate results for graduates (Panel A) and non-graduates (Panel B), with quantiles computed within each subgroup. For non-graduates, the results closely resemble the aggregate trends: within-occupation gender inequalities decline substantially across all quantiles, but widening across-occupation differences at the median offset these declines, yielding a persistent median gender gap. At the tails, overall gender inequality narrows at the first decile and remains stable at the ninetieth percentile, mirroring the aggregate pattern. Panel A shows that for graduates, the disparity between within-occupation and across-occupation gaps is even larger, and across-occupation differences have even increased over time across the earnings distribution. This suggests that occupational sorting plays a particularly prominent role in slowing pay convergence for graduates.

Together, these patterns motivate our analysis of both graduates and non-graduates.

[3]The overall log earnings ratio at a given percentile is calculated using the distributions of log male and female full-time earnings across occupations. The within-occupation log earnings ratio is calculated by averaging, across occupations, the ratio of log male and female full-time earnings within each occupation. Appendix A provides further details.

While graduate workers face especially pronounced disparities at the top of the distribution, the rising importance of across-occupation differences is evident across the entire labour market. Including both groups allows us to document how changes in within-occupation inequality and occupational sorting jointly shape the evolution of the gender wage gap.

2.1 Occupation Flexibility

A literature beginning from Autor et al. (2003) has conceptualised occupations in terms of the nature of the tasks involved in performing day-to-day work in that occupation. This strand of research has used this approach to explain how different aspects of occupations, such as social skills requirements (Deming, 2017; Cortes et al., 2018), work content (Lordan and Neumark, 2018), or gender differences in task content within occupations (Stinebrickner et al., 2018; Baker and Cornelson, 2016), affect gender segregation and other labour market outcomes.

In a similar vein, this paper follows Goldin (2014)'s definition of flexibility as an occupation characteristic, using five standardised job characteristics from the O*NET survey in the US to define occupation flexibility:

1. time pressure [scale 0-100]: how often the worker is required to meet strict deadlines. The lower the time pressure, the more flexible the occupation is, as workers do not have to be present to meet deadlines very often.

2. contact with others [scale 0-100]: how much the job requires the worker to be in contact with others in order to perform it - face-to-face, by telephone, or otherwise. The more contact the job requires, the less flexible it is, as workers are less able to determine their own schedules.

3. establishing and maintaining interpersonal relationships [importance 0-100, level 0-100]: measures how important it is to the job and to what degree the worker is required to develop and maintain constructive and cooperative working relationships with others (employees or clients). The more relationships the worker has to maintain, the less flexible their working time becomes.

4. structured versus unstructured work [scale 0-100]: the extent to which the job is structured for the worker, as opposed to the worker being allowed to determine tasks, priorities, and goals. The less structure the job imposes on the worker, the more flexibility it allows.

5. decision making freedom [scale 0-100]: measures how much decision-making freedom, without supervision, the job offers. A higher level of decision-making

freedom within the context of performing job tasks means that the job is quite uniquely specified for the worker, and therefore, other workers would not be able to cover the same tasks, reducing flexibility.

The O*NET is a database that lists detailed information about the characteristics of occupations, based on surveys of employers in the US, and has been used to study the task content of work. These measures are available for each occupation in the US Standard Occupational Classification 2000 and were matched to UK SOC2000 4-digit occupations using multiple crosswalks.[4] The flexibility score in each UK SOC2000 occupation in the data was calculated as the arithmetic mean of the reversed characteristics (as each individual characteristic is initially coded with higher values indicating lower flexibility), so that a higher flexibility score indicates an occupation with more flexibility. By definition, the flexibility score remains constant for an occupation over time, as it corresponds to O*NET characteristics for a specific US occupational classification. The binary measure of flexible occupations classifies an occupation as flexible if its flexibility score is above the median flexibility score across all occupations.

Employment and earnings across occupations are influenced by movements in labour demand and supply. Workers sort across occupations, and firms substitute between employing labour in different occupations based on their preferences for flexibility in these occupations. Much of the existing literature has considered flexibility from the demand side in terms of the motherhood penalty and women's willingness to forgo pay to reduce time spent at work (for example, by working part-time, or by being less likely to work extremely long hours). However, flexibility may vary across groups depending on the occupations they work in, due to the nature of the work involved in these occupations.

Defining flexibility as an occupational characteristic categorises occupations by whether the nature of work involved permits greater freedom for workers to schedule when and where their work takes place. For example, occupations requiring a high degree of interpersonal contact in person through meetings (such as health professionals) are less flexible than those that do not have this requirement. Previous research that has considered the labour market impacts of the evolution of occupational characteristics has found that aspects leading to relationship building (social skills) with stakeholders and those requiring a high degree of abstract thinking have been increasingly in demand (Deming, 2017; Cortes et al., 2018; Autor and Dorn, 2013). Occupations that require a higher degree of these aspects are made less flexible by these requirements, however. The management of interpersonal re-

[4]Refer to the Data Appendix B for detailed information on the construction of these measures.

lationships and higher levels of in-person contact (which are related to, but distinct from, social skills) in occupations is not explained by considering the time and place flexibility available in a particular working arrangement. Amenities, including flexible working arrangements, are more related to individual and firm-level choices, rather than required by the nature of the work involved. Furthermore, occupations that demand high levels of commitment by workers have previously been termed as 'greedy professions', driving trends in increasing overwork (Coser, 1974). These greater commitments on the part of workers are reflected in the components of the flexibility measure, which consider the frequency of interpersonal interactions, the degree to which work is structured, as well as time pressure, as determinants of flexibility in an occupation.

Table 1 describes the characteristics of the most and least flexible three-digit occupation groups in the UK SOC2000 for the sample of graduates between 2001 and 2010. An example of an inflexible occupation is health professionals, who are the least flexible in our sample, as they tend to work unpredictable hours where their presence is required at the workplace. On the other hand, administrative occupations are highly flexible, offering predictable hours and minimal requirements for workplace presence. Graduates tend to be overwhelmingly employed in less flexible occupations, and underrepresented in more flexible occupations, because of which we separately include the most flexible minor occupation groups,[5] as well as minor occupation groups that employ at least 0.4% of the graduate sample. For example, 9.18% of graduates between 2001 and 2010 were employed as functional managers (e.g., purchasing managers, marketing and sales managers), which is one of the least flexible occupations.

The panels in Table 1 indicate that lower flexibility scores are associated with managerial and professional roles that potentially involve higher levels of responsibility, whereas more flexible occupations tend to be junior or vocational roles that are less demanding in terms of work structure and responsibilities. This is consistent with work on greedy professions (defined initially in Coser (1974) as institutions that seek exclusive and undivided loyalty) and the overwork premium, that suggests that higher paying senior roles or work in industries such as law, finance and consulting, require individuals to work long or specific hours in exchange for being paid a premium (Miller, 2019; Cha and Weeden, 2014; Cha, 2010).

Barring health professionals, who scored low on time pressure, all ten of the least flexible occupations scored quite high on all five components of the flexibility meas-

[5]Minor occupation groups aggregate more detailed occupation classifications (at the four digit level for the SOC2000) into three-digit groupings, so as to present a greater variety of occupations, as well as to have sufficient graduate share within each occupation group considered.

ure, indicating that these occupations tend to be inflexible in multiple dimensions. The most flexible occupations tend to be junior roles (e.g., social welfare associate professionals are included here, compared to public service professionals, who are among the least flexible). They also tend to be more gender-segregated than less flexible occupations. The least flexible occupations exhibit highly variable scores across the five component measures of flexibility. For instance, healthcare and related personal services occupations score highly in terms of having contact with others and maintaining interpersonal relationships, but have very low scores in the other three components. However, a score that aggregates all these components is more relevant to this analysis as it is the combination of these different characteristics that defines workplace flexibility – for example, an occupation may allow work to be fairly unstructured but may require much higher than average contact with customers or colleagues, which would then make it less flexible as in the case of public service professionals.

Pan (2015) suggests that one reason for the continued gender segregation in occupations is that there is a potential tipping point for the female share of occupation employment beyond which men are likely to leave the occupation. This may be because the gender composition of an occupation conveys a signal of occupational prestige, partly due to male preferences regarding workplace composition, as suggested by the pollution theory of discrimination (Goldin, 2013). Table 1 shows that, contrary to this hypothesis, for graduates, though flexible occupations are lower-paid, they are more likely to be dominated by men compared to less flexible occupations. This is driven by occupations such as engineers, draughtspersons and architects, and metal machining and instrument trades, skilled graduate occupations that are highly male-dominated, which also tend not to require inflexible working. Individuals who start working in these occupations tend to progress into managerial roles later in their careers, which often involve more inflexible working arrangements. Flexibility is also not explained by the share of workers in part-time occupations, which varies substantially across both flexible and less flexible occupations, although more flexible occupations have more than half of their workers working part-time.

3 Descriptive patterns in the UK Labour Force Survey

This section documents several key stylised facts on the labour market outcomes of the prime-aged graduates and non-graduates in the United Kingdom, using data from the UK Labour Force Survey from 1993 to 2019.

Fact 1. Stochastic dominance of male over female wages. Figure 2 plots gender-specific earnings distributions for graduates and non-graduates between 1993 and 2019. At the 10th, 50th, and 90th percentiles, the male earnings distribution lies above the female distribution in every year and for both education groups.

Fact 2. The graduate male wage has a heavier right tail than the female wage, while the non-graduate male wage exhibits a greater mean shift compared to the female wage. Panel (a) of Figure 2 shows that among graduates, the male–female earnings gap increases sharply across the wage distribution. The gap is modest at the 10th percentile but becomes large at the 90th percentile. Panel (b) shows a different pattern for non-graduates. The gender gap at the 10th percentile is much larger than among graduates, but the increase in the gap between the 10th and 90th percentiles is smaller. In other words, the gender gap for graduates is characterised by a relatively low intercept and a steep slope, while for non-graduates it is characterised by a high intercept and a gentler slope.

Fact 3. Rising importance of cross-occupation inequality over time. For both graduates and non-graduates, within-occupation gender inequality declines over time, increasing the relative contribution of across-occupation differences. As shown in Panel (b) of Figure 2, within-occupation gender inequality was the dominant component of the total gap for non-graduates in 1990, but its contribution falls substantially by 2020. However, rising across-occupation inequality offsets these reductions and limits the decline in the overall gender gap for non-graduates. Panel (a) shows a similar pattern for graduates, although reductions in within-occupation inequality are concentrated at the top of the distribution.

Fact 4. Life cycle gender gaps reflect gender wage gaps across quantiles. Figures 3 and 4 show that differences across gender wage quantiles mirror the evolution of gender wage gaps over the life cycle. For graduates, shown in Panel (a), male and female log earnings begin at similar levels at age 25, but a gender gap emerges and widens up to at least age 45. This pattern appears across all cohorts. The steep increase in the gender gap across quantiles for graduates, therefore, reflects the rising gender gap over the working life and its persistence across cohorts. These life-cycle patterns are consistent with the "motherhood penalty" or "child penalty" literature, where women suffer slower wage growth due to career interruptions and changes to working patterns after motherhood (Adda et al., 2017; Bertrand et al., 2010; Costa Dias et al., 2018; Kleven et al., 2019b).

For non-graduates, shown in Panel (b), the male–female log earnings gap is already substantial at age 25. As both male and female wages rise with age, the gender gap persists and widens up to age 45. Older cohorts born before 1975 exhibit larger gaps than more recent cohorts. The high intercept and flatter slope of the non-graduate gender gap across quantiles are consistent with these life cycle patterns. The reduction in the age-specific gender gap for younger cohorts helps explain the observed decline in overall and within-occupation gender inequality for non-graduates over time.

Fact 5. Life cycle dynamics and flexibility jointly shape gender wage gaps. To understand the drivers of cross-quantile variation in male and female earnings inequality, we examine two channels that shape the wage distribution. First, we consider life-cycle dynamics, which influence within-occupation gender differences. Second, we study sorting into more or less flexible occupations, a key determinant of across-occupation differences.

Figures 3 and 4 show substantial variation in mean earnings across the prime-age life cycle. For both graduates and non-graduates, earnings are lowest at age 25 and peak around age 40. Among graduates, the male-female earnings gap is near zero at age 25, widens steadily with age, and reaches its maximum around age 45. Among non-graduates, the gap is already substantial at age 25 and increases more gradually. These patterns confirm that life-cycle dynamics generate important within-occupation gender differences, particularly for graduates with steeper returns to experience.

Figures 5 and 6 document systematic differences in participation in flexible occupations and associated earnings penalties. More than half of male non-graduates work in flexible jobs, compared to roughly 40% of female non-graduates, 20% of male graduates, and 15% of female graduates. Flexible jobs carry substantial earnings penalties for all groups, with similar penalties for male and female non-graduates, but larger penalties for graduate women than men. These patterns are overall consistent with evidence that women are more willing to accept lower wages for flexible schedules, particularly in the presence of childcare responsibilities (Mas and Pallais, 2017; Bustelo et al., 2020; Bertrand et al., 2010; Adda et al., 2017). Experimental evidence also shows that women are willing to forgo between 8 and 20 per cent of earnings for flexible schedules or the option to work from home, with higher valuations among mothers (Mas and Pallais, 2017; Bustelo et al., 2020).

The flexibility wage penalty for graduates has also increased across cohorts, indicating that the cost of flexibility has risen over time. Although our flexibility measure is fixed across years, this pattern is consistent with evidence that long-hours premia have grown in certain "greedy occupations" (Cha, 2010; Cha and Weeden, 2014; Cortés and Pan, 2019; Coser, 1974; Kuhn and Lozano, 2008), and with research showing that changes in work organisation, such as the expansion of group-based tasks, have raised the costs of working flexibly (Lazear and Shaw, 2007).

To see clearly how these life-cycle patterns and flexibility penalties map into gender wage gaps across the distribution, Figure 7 further plots the gap over the life cycle separately for graduates and non-graduates in flexible versus inflexible occupations. For graduates, the steep rise in the gender wage gap across the earnings distribution reflects both life-cycle divergence and patterns of occupational sorting. The gender gap is larger in flexible occupations, where wage growth with experience is more limited. Early in the life cycle, men and women in flexible jobs have relatively similar wages, but male wages grow more rapidly, even within these occupations. In addition, men are increasingly likely to be in higher-paying, inflexible jobs as they age. The combination of faster male wage growth within occupations and gender differences in occupational sorting over the life cycle produces large gaps at the top of the graduate wage distribution.

For non-graduates, the gender wage gaps in flexible and inflexible occupations are similar in magnitude. In older cohorts, the gap is somewhat larger in inflexible jobs, but the differences have narrowed in younger cohorts. Although life-cycle wage growth is flatter for non-graduates, within-occupation gender gaps remain the main source of earnings inequality, especially for those in the higher earnings quantiles. In the meantime, across-occupation gaps driven by occupational sorting have increased over time despite smaller flexibility penalties, reflecting more persistent gender differences in the types of jobs held by non-graduates. Overall, the gender gap across quantiles rises more slowly for non-graduates than for graduates.

Fact 6. Childcare costs and child-related benefits over time. Finally, we also describe other descriptive patterns related to the other variables used in modelling. Figure 8 plots the change over time in the average hourly childcare costs per child incurred by women who have children under five in the household.[6] Women in the different age groups incurred similar levels of childcare costs over time, where these childcare costs could be up to a third of hourly wages.

Figure 9 plots the change in child-related benefits over time. Figure 9a plots the share of graduates receiving child-related benefits over time, and shows that a

[6] There is a discontinuity in the data in 2004 arising from differences in how the childcare cost information was recorded - average childcare costs were previously recorded separately for term-time and holiday periods, whereas after 2004 only one average was collected.

negligible share of male graduates are in receipt of child-related benefits, most of which condition on being the primary caregiver of the child. Furthermore, the benefit most relevant for graduates is the child benefit, which close to half of all graduate women report as receiving. Child tax credits were introduced in April 2003, along with the Working Tax Credit, and are the most relevant new benefit introduced during the period of analysis. Figure 9b shows that the average weekly child-related benefit received by graduate women has increased over time in real value, though the amount is not a substantial portion of weekly wages. Women aged 35-44 receive a higher proportion of such benefits than women in the youngest or oldest age groups, suggesting that this is the age group most likely to have children for whom they are responsible and to also receive benefits conditional on having these children.

The stylised facts above suggest that gender differences in earnings reflect both labour supply and labour demand dynamics. For graduates, life-cycle decisions and the choice of flexible versus inflexible occupations interact with labour market incentives, leading to systematically different remuneration for men and women across ages and cohorts. For non-graduates, although life-cycle effects and flexibility play a smaller role, occupational sorting into higher- or lower-paying jobs continues to shape the gender earnings gap. Overall, the evidence highlights that the observed disparities arise from the joint influence of within-occupation life-cycle dynamics and across-occupation sorting, with distinct patterns for graduates and non-graduates.

4 Model

We employ an overlapping generations model, following Johnson and Keane (2013), to examine the role of demand- and supply-side factors related to occupation flexibility in explaining the gender wage gap for prime-aged individuals (aged 25 to 55) across cohorts.

Individuals in the model are differentiated by sex (indexed $s \in \{mal, fem\}$), skill (indexed $g \in \{G, NG\}$), age (indexed $a \in \{25, 26, \ldots, 55\}$), and cohort (indexed $c \in \{1945, 1955, \ldots, 1985\}$) in each calendar year (indexed $t \in \{1993, 1994, \ldots, 2019\}$). Labour market preferences and, consequently, outcomes differ across these individual types.

4.1 Labour demand

On the demand side of the model, in each period, the aggregate economy-wide production substitutes labour in flexible and inflexible occupations (indexed by $o \in$

$\{fle, inf\}$), following a nested CES production function, as follows:

$$Y_t = Z_t \left[\alpha_{1,t} L_{fle,t}^{\rho_1} + (1 - \alpha_{1,t}) L_{inf,t}^{\rho_1}\right]^{1/\rho_1} \tag{1}$$

where Y_t is total output in each year, Z_t is the scale parameter that captures factor-neutral technological change and productivity effects at time t. $L_{fle,t}$ and $L_{inf,t}$ are the aggregate labour inputs used in flexible and inflexible occupations, respectively, in each year. ρ_1 is a function of the elasticity of substitution between labour inputs in flexible and inflexible occupations ($\sigma_1 = \frac{1}{1-\rho_1}$), and $\alpha_{1,t}$ is a share parameter that captures the intensity with which labour in flexible occupations is used (as opposed to inflexible occupation labour) in each year. Both the scale parameter and the share parameters in the production technology are assumed to vary over time following time trends: i.e. $\ln Z_t = Z_0 + Z_1 t + Z_2 t^2 + Z_3 t^3$ and $\ln \alpha_{1,t} = \alpha_{1,t}^0 + \alpha_{1,t}^1 t + \alpha_{1,t}^2 t^2 + \alpha_{1,t}^3 t^3$. These time trends enable the model to flexibly capture movements in overall productivity, as well as in the relative demand for labour in flexible occupations over time.

Second nest: aggregation across skill groups. Individuals are additionally differentiated by education, indexed $g \in \{G, NG\}$ for graduates and non-graduates. Firms first aggregate labour inputs from the two skill groups within each occupation:

$$L_{o,t} = \left[\alpha_{2,o} L_{G,o,t}^{\rho_2} + (1 - \alpha_{2,o}) L_{NG,o,t}^{\rho_2}\right]^{1/\rho_2} \qquad \text{for } o \in \{fle, inf\}. \tag{2}$$

$L_{G,o,t}$ and $L_{NG,o,t}$ are the total labour inputs supplied by graduates and non-graduates in occupation o and year t. $\alpha_{2,o}$ is the time-invariant share parameter, and ρ_2 is the substitution parameter governing the elasticity of substitution between skill groups.

Third nest: aggregation across sexes within skill and occupation. Within each skill group and occupation, firms aggregate labour across the two sexes, $s \in \{m, f\}$:

$$L_{g,o,t} = \left[\alpha_{3,g,o} L_{f,g,o,t}^{\rho_3} + (1 - \alpha_{3,g,o}) L_{m,g,o,t}^{\rho_3}\right]^{1/\rho_3} \qquad \text{for } g \in \{G, NG\},\ o \in \{fle, inf\}. \tag{3}$$

$L_{f,g,o,t}$ and $L_{m,g,o,t}$ are the total labour inputs supplied by females and males in skill group g and occupation o in year t. $\alpha_{3,g,o}$ is the (time-invariant) share parameter that captures the intensity with which female labour input is used relative to male labour inputs.

Fourth nest: aggregation across ages within skill, sex, and occupation. Finally, labour is aggregated across age groups:

$$L_{s,g,o,t} = \left[\sum_{a=25}^{55} \alpha_{4,a,s,g,o} \, L_{a,s,g,o,t}^{\rho_4} \right]^{1/\rho_4} \qquad \text{for } s \in \{m, f\}, \ g \in \{G, NG\}, \ o \in \{fle, inf\}. \tag{4}$$

$L_{a,s,g,o,t}$ is the total labour input of age group a, sex s, and skill group g used in occupation o in year t. $\alpha_{4,a,s,g,o}$ is a time-invariant share parameter capturing the intensity with which this labour input is used relative to labour inputs of other age groups.[7] ρ_4 is the substitution parameter governing substitution across ages.

The demand side of the model has 42 parameters that need to be estimated.[8]

Labour demand in this framework is modelled using a constant elasticity of substitution (CES) production function in which total output Y_t depends on the labour supply $L_{\tau,t}$ of type $\tau \in \{\tau_1, \tau_2\}$ at time t:

$$Y_t = \left[\alpha_t L_{\tau_1,t}^{\rho} + (1 - \alpha_t) L_{\tau_2,t}^{\rho} \right]^{1/\rho}. \tag{5}$$

Here, α_t is the time-varying share parameter associated with each labour type used in production, and ρ is the substitution parameter. The elasticity of substitution between the two labour types is given by $\sigma = \frac{1}{1-\rho}$. Because wages equal marginal products of labour in equilibrium, the gender wage gap (expressed as the log ratio of male to female wages) is a function of the relative labour share parameters for male and female labour and the equilibrium quantities of male and female labour supplied:

$$\log \left(\frac{W_M}{W_F} \right) = \log \left(\frac{\alpha_M}{\alpha_F} \right) - \frac{1}{\sigma} \log \left(\frac{L_M}{L_F} \right). \tag{6}$$

On the demand side, therefore, relative demands for male and female labour in flexible and inflexible occupations over time and across ages determine how the gender wage gap evolves. On the supply side, however, the ratio of male to female labour supply in each occupation is determined by individual preferences over

[7]The share parameters are fixed over time within each occupation and skill group, implying that the structure of firms' relative demand for labour inputs across different ages does not vary over time, conditional on occupation and skill group.

[8]The demand-side parameters include four elasticities of substitution for each nest of the production function; parameters governing time-varying changes in technology or total factor productivity and the occupation share parameter; and parameters associated with the share parameters at each level of the production structure (skill-group shares, sex-specific shares, and age-specific shares), totaling 42 parameters.

occupations, which are modelled within a random utility framework.

4.2 Labour supply

On the supply side, each type of agent in each year chooses between three alternatives: two types of market occupations (flexible or inflexible) and home production (indexed $j \in \{fle, inf, hom\}$). Individuals of different types have different preferences for their three labour supply alternatives, as characterised by the following random utility function:

$$
\begin{aligned}
U(j \mid s,g,c,a,t) = {} & \psi_{0,s,g,a,j} + \psi_{0,s,g,c,j} + \psi_1 W_{a,s,g,o,t} \cdot \mathbf{1}[j=o] + ... \\
& + \pi_{2,s,g,j} Pr(\text{child} < 5 = 1 \mid s,g,a,t) + ... \\
& + \pi_{3,s,g,j} Pr(\text{marr} = 1 \mid s,g,a,t) + ... \\
& + \gamma_{1,o}\text{CHC}_{a,g,t} \cdot \mathbf{1}[j=o] \cdot \mathbf{1}[\text{child} < 5 = 1] \cdot \mathbf{1}[\text{s}=\text{f}] + ... \\
& + \gamma_{2,o}\text{CBEN}_{a,g,t} \cdot \mathbf{1}[\text{child} < 5 = 1] \cdot \mathbf{1}[\text{s}=\text{f}] + ... \\
& + \epsilon_{j,s,g,a,c,t} \quad \text{for} \quad j = fle, inf, hom; o = fle, inf
\end{aligned} \tag{7}
$$

$U(j \mid s,g,c,a,t)$ is the utility from labour supply alternative j obtained by an individual of sex s, education g, cohort c, and age a at time t. $\psi_{0,s,g,a,j}$ captures age-, sex-, and education-specific preferences over the alternatives j that are fixed over time. $\psi_{0,s,g,c,j}$ captures cohort-, sex-, and education-specific preferences over the alternatives j that are fixed over ages. This allows the proportion of graduate and non-graduate females working in flexible occupations for a given cohort to differ from that of previous cohorts or other education groups. ψ_1 is a parameter describing the sensitivity to age-occupation-education-specific wages in a given year $W_{a,s,g,o,t}$, with wages only available for market occupations $o \in \{inf, fle\} \subset j$.

We further explicitly include characteristics that can influence the occupational choice of agents. These include marriage, fertility, childcare costs, and child-related benefits. Labour supply preferences for the type of occupation or even for labour force participation could be affected by marriage and children, with these preferences likely to play a more significant role for women and vary by education. The age-, sex-, and education-specific likelihoods of being married and having children in a given year are therefore included as $Pr(\text{marr} = 1 \mid s,g,a,t)$ and $Pr(\text{child} < 5 = 1 \mid s,g,a,t)$. $\pi_{2,s,g,j}$ captures sex- and education-specific preferences for home production or the two market occupations, given their type's likelihood of having children, whereas $\pi_{3,s,g,j}$ captures sex- and education-specific preferences given their type's likelihood of being married.

Average childcare costs CHC are included for women of different age and education groups in each year if they have children under five in the household, and only if they are working in a market occupation. The disutility from childcare costs differs by occupation through the coefficient $\gamma_{1,o}$. The average child-related benefits ($CBEN$) received by women in each education group in each year are also included, only entering the labour supply utilities of women. The utility of receiving benefits ($\gamma_{2,o}$) only varies by occupation.

Finally, following a multinomial logit specification, $\epsilon_{j,s,g,a,c,t}$ is assumed to be distributed independently and identically extreme value, which allows the utilities to be expressed as multinomial choice probabilities. Given the utility set up as above, individuals of each type in each year choose one of the three alternatives following multinomial logit choice probabilities as below:

$$Pr(j=1 \mid s,g,c,a,t) = \frac{exp\left[U(j \mid s,g,c,a,t)\right]}{\sum_j exp\left[U(j \mid s,g,c,a,t)\right]} \quad \text{for} \quad j = fle, inf, hom \tag{8}$$

Labour supply for each type to each choice alternative is equal to the type's probability of choosing that alternative multiplied by the size of the cohort for that type of labour:

$$L^{supply}_{s,g,c,a,t} = Pr(j=1 \mid s,g,c,a,t) \times \text{LabourForce}_{s,g,c,a,t} \tag{9}$$

The supply-side parameters include 125 parameters in total, of which 96 are sex-, age-, cohort-, and education-specific preferences for occupations.

4.3 Equilibrium and Estimation

In equilibrium, wages paid to each type of worker equal their marginal products of labour, which can be obtained from the production technology, for labour of sex $s = \{m, f\}$, education $g = \{grad, nongrad\}$, occupation $o = \{fle, inf\}$, age group $a \in \{25-34, 35-44, 45-55\}$ at time t as follows:

$$W_{a,o,s,g,t} = \frac{\partial Y_t}{\partial L_{a,o,s,g,t}} \tag{10}$$

Though the marginal products of male and female labour are complex functions of many parameters in the production function, the ratio of the marginal products of male and female labour depends only on the ratios of their productivity shares and the relative size of their inputs used in production. Hence the equilibrium male–female wage ratio for age a, education g, at time t in occupation o is:

$$\frac{W_{a,o,m,g,t}}{W_{a,o,f,g,t}} = \frac{\alpha_{2,a,o,m,g} L_{a,o,m,g,t}^{\rho_2 - 1}}{\alpha_{2,a,o,f,g} L_{a,o,f,g,t}^{\rho_2 - 1}} \tag{11}$$

Therefore, the log wage ratio can be expressed (using $\rho_2 = \frac{\sigma_2 - 1}{\sigma_2}$) as:

$$\log\left(\frac{W_{a,o,m,g,t}}{W_{a,o,f,g,t}}\right) = \log\left(\frac{\alpha_{2,a,o,m,g}}{\alpha_{2,a,o,f,g}}\right) - \frac{1}{\sigma_2}\log\left(\frac{L_{a,o,m,g,t}}{L_{a,o,f,g,t}}\right) \tag{12}$$

Furthermore, the labour supply of each type in each occupation equals the labour of that type demanded in that occupation in equilibrium:

$$L_{a,o,s,g,t}^{demand} = L_{a,o,s,g,t}^{supply} \tag{13}$$

The model parameters are identified from the variation in employment and wages for individuals of each type and occupation in the data. The model has a total of 167 parameters to be estimated, comprising 42 from the demand side and 125 from the supply side. Parameter estimates are obtained by targeting the differences between observed and predicted labour supplies and wages and minimising these differences using GMM estimation. A solution is obtained by iterating over a fixed point algorithm as follows: (i) for a given set of parameter values, an initial wage vector is plugged into the occupational choice model to get the estimated occupational choice probabilities for each labour type, from which labour supplies are computed using cohort sizes; (ii) these estimated labour supplies are then plugged into the marginal productivity function to get predicted wages; (iii) if the predicted wages equal the initial wages, there is a solution for these parameters; otherwise, the iteration continues until convergence.

The model generates predictions of wages and labour supplies for (31 ages $\times$ 2 sexes $\times$ 2 education groups =) 124 types of labour in each of 27 years from 1993 to 2019. There are three labour supply predictions for each type (one for each occupational choice alternative), so there are 372 labour supply predictions for each year (10,044 in total). There are two wage predictions (one for each market occupation) for each type, so there are 248 wage predictions for each year (6,696 in total). These 16,740 predictions are optimised with respect to the 167 parameters to minimise the differences between the predictions and the observed data.

The elasticities of substitution are identified by how wages and share parameters respond to variations in labour supplies. If the share parameters ($\alpha_{1,t}$ and $\alpha_{2,a,o,s,g}$) were allowed to vary completely over time, the elasticities could not be identified, as variation in labour supplies would be entirely absorbed by variation in demand shares. Similarly, if preferences for occupations varied completely over time, they would completely capture the effect of wages on occupational choice. Therefore, both sets of parameters are constrained to vary over time following specific assumptions, which allows for the identification of the remaining parameters.

5 Results

5.1 Model Fit

Figures 10 and 11 show how the predictions of the model fit in relation to the data. These graphs plot the main outcomes that relate to the descriptive trends of interest in Section 3, but averaged over the age groups and cohorts as specified in the model in Section 4. The graphs therefore show the trends in the male-female gender wage gap, the wage penalty for working in flexible occupations relative to inflexible occupations, and the share of men and women working in flexible occupations (versus inflexible occupations).

The plots overall show that the model predictions generally fit the data well, capturing the nature of any trends in the data. Figure 10a shows that the model captures the increase in the gender wage gap over age for all cohorts in its predictions. The trends described in Section 3 indicate that the gender wage gap increased substantially over the life cycle, with levels remaining relatively constant across successive cohorts. The estimates generated by the model fit these observed patterns in the data well, particularly with respect to the large increase in the gender wage gap over the life cycle up to age 35-44 that thereafter plateaus.

The patterns described earlier established that the penalty for working in flexible occupations increased both over the life cycle and across cohorts. In Figure 10b, the model predictions mirror the nature of the increase in the flexibility wage penalty over the life cycle, as well as the increase over cohorts, though the magnitude of this latter increase is slightly overestimated. These patterns suggest that the increase in the flexibility wage penalty, similar to the increase in the gender wage gap, peaked around the ages of 35-44, after which the rate of increase declined.

Figure 11 plots the trends related to the share of men and women working in flexible occupations (as opposed to inflexible occupations). The descriptive trends showed that the share of women working in flexible occupations increased across cohorts and remained relatively stable with age, whereas the share of men working in flexible occupations declined over the life cycle, with levels remaining relatively unchanged across successive cohorts. Figures 11a and 11b show that the share of men and women working in flexible occupations is fairly closely predicted by the model on average. The share of men in flexible occupations declined substantially between the ages of 25 and 45 for all cohorts, with no further decline or slight increases thereafter, as captured well by the estimates. On the other hand, while the share of women working in flexible occupations did not increase much over age (conditional on cohorts), later cohorts of women were much more likely to work in flexible occupations than earlier cohorts. Figure 11b shows that these patterns are mirrored closely in the predicted data. These graphs demonstrate that the model accurately captures the overall trends in the outcomes of interest. Therefore, we next investigate how the estimated parameters in the model can explain these observed patterns.

5.2 Parameter Estimates

5.2.1 Demand side

Elasticities of substitution

Table 2 reports the estimates for the substitution parameters and the associated elasticities of substitution in both nests of the production function. The elasticity of substitution between labour in flexible and inflexible occupations is estimated at 1.5. Though there are no directly comparable existing estimates of the elasticity of substitution between labour in flexible and inflexible occupations, this falls in between the elasticity of substitution between physical capital and skilled labour of 0.47, and capital and skilled versus unskilled labour of 3.23, as reported by Johnson and Keane (2013) for the US. On the other hand, the estimated elasticity of substitution between labour of different age groups and sexes within each occupation is approximately 38.4, suggesting that these labour types are close substitutes in production, conditional on occupation.

From Table 3, there was an increase in the supply of inflexible relative to flexible labour by about 0.03 log points, which, combined with an elasticity of 1.5, implies that there should have been a relative fall in (inflexible–flexible) earnings of about 0.02 log points (Equation 12). However, the relative fall in earnings for inflexible labour was about 0.03 log points, suggesting that there was a larger fall in relative demand for inflexible labour that pushed the log wage ratio down. Similar calculations for male and female labour suggest that the gender wage gap (both overall and within occupations should have fallen by about 0.01 log points. However, (male/female) relative earnings increased overall, as well as within each type of occupation, suggesting that increases in relative demand for male labour within each occupation type, which outweighed the effect of the increase in relative labour supply, led to further gender disparity in earnings over this period.

Demand trends by occupation, age, and gender

Figure 12 plots the estimates of the relative demand shares of labour of different types and occupations. The plotted relative demand shares are log ratios of the labour types considered, with Figures 12a and 12b showing how these demand shares evolved over the life cycle (as the share parameters are fixed over time in the second nest of the production function). The share parameters in the first nest of the production function vary over time according to a quadratic time trend, and the associated time-varying log ratio of the relative demand for labour in flexible versus inflexible occupations is plotted in Figure 12c. Finally, Figure 12d plots the estimated evolution of total factor productivity, which also follows a quadratic time trend.

Figure 12a shows that the demand for male labour relative to female labour was increasing with age. This trend of increasing relative demand for male labour at older ages occurred in both flexible and inflexible occupations; however, the increase in relative demand for male labour at older ages was higher in flexible occupations. The relative demand for male labour increased over the life cycle by about 0.18 log points in flexible occupations, higher than the 0.15 log point increase in inflexible occupations, implying that the increase in the gender wage gap over the life cycle arising due to the increase in relative demand for male labour would have been higher in flexible occupations (by Equation 12). The graph shows that the increase in relative demand for male labour (and therefore the associated upward pressure on the gender wage gap) was strongest between ages 25 and 44, after which the rate of increase slowed in both flexible and inflexible occupations. This is in line with the pattern seen in Figure 4 that showed that male wages grew faster than women's wages till about age 40, after which wage growth stagnated for both men and women, with male wages remaining higher than women's wages throughout.

Figure 12b shows that the demand for labour in flexible occupations relative to inflexible occupations fell over the life cycle for both men and women, so that labour in inflexible occupations was increasingly demanded at older ages. The fall in relative demand for labour in flexible occupations would lead to downward pressure on relative wages in these occupations compared to inflexible occupations, resulting in an increase in the wage penalty for working in flexible occupations over the life cycle. Relative demand for female labour in flexible (versus inflexible) occupations fell by about 0.13 log points, compared to a lower fall of about 0.10 log points in the relative demand for male labour in flexible (versus inflexible) occupations, suggesting that women faced a higher life-cycle increase in the penalty from working in flexible occupations. Furthermore, the fall in the relative demand for labour in flexible occupations was concentrated before age 44, after which it stagnated for both men and women, suggesting that the increase in the wage penalty from working in flexible occupations would also be concentrated in this period, which is seen in the data in Figure 6 and more clearly in Figure 10b.

These two patterns of relative demand suggest that the demand for male labour would increase over the life cycle, especially in inflexible occupations, consistent with evidence that has found that women remain underrepresented in the top part of the earnings distribution, as there remains a glass ceiling that prevents women from accessing the highest earning positions (Guvenen et al., 2014; Bertrand, 2018). These differences in firm demand (and therefore in male and female earnings) have been previously attributed to labour market discrimination against women, and in particular against working mothers Cortés and Pan (2020); Stillman and Fabling (2017). Discrimination may be taste-based due to differences in firms' preferences for men and women (as women may be seen as contravening gender norms especially in male-dominated environments (Akerlof and Kranton, 2000)), or due to statistical discrimination arising from differences in expected productivity as women are expected to take more career breaks leading to losses of human capital (Adda et al., 2017; Azmat and Ferrer, 2017; Babcock et al., 2017; Stillman and Fabling, 2017). Other research has found that women are more willing to take on jobs with 'low promotability', and that gender differences in career aspirations and competitiveness contribute importantly to the gender wage gap, as women are less likely to select educational tracks that are perceived to be more competitive (Babcock et al., 2017; Buser et al., 2014; Machin and Puhani, 2003; Chevalier, 2007). This also suggests that institutional barriers, such as a lack of mentors and restricted support networks, help penalise women's choices in such settings and prevent them from accessing high-paying jobs at top levels.

Related research has found an 'age twist' in hiring behaviour – firms' explicit gender requests on job boards shifted away from women to men for older (versus younger) workers, where part of this twist is explained by employers' requests for older male managers and young women in customer service, and the remainder is likely related to the differential impact of parenthood by gender (Helleseter et al., 2020). Correll et al. (2007) found, using a resume audit study, that employers called mothers back to interview half as often as childless women, while fathers and childless men were called back at similar rates, suggesting that men were not penalised for (and sometimes even benefited from) fatherhood. Participants in lab experiments judged fathers to be more committed and recommended higher starting salaries, in contrast to mothers, who were seen as less competent and committed to paid work, and recommended lower starting salaries (Correll et al., 2007). A related paper by Kuhn et al. (2020) also found that women experienced a larger callback penalty of 43% compared to 24% for men when applying to jobs that were gender-mismatched.

Chaturvedi et al. (2021) studied gendered word classifications of Indian job advertisements and find that jobs that are geared towards men and have 1SD higher level of words focused on aspects of flexibility such as night shifts, relocation and travel (male-oriented flexibility) had higher advertised wages by about 2.4%, where the female applicant share was also negatively associated with words related to male-oriented flexibility. This suggests that jobs with higher levels of inflexibility are typically higher-paid and likely more senior roles, which therefore reinforces the glass ceiling on women's representation in higher management levels. Figure 13 shows the change in the share of workplaces with flexible working arrangements (as defined by the survey) over time, using Workplace Employment Relations Survey data.[9] The graph shows that the most relevant change was in the share of workplaces reporting that they used shift work, which increased from about 25% in 1998 to 41% in 2011, suggesting an increase in inflexibility. Figure 14 shows, also using WERS data, that though the average share of women in management positions has increased in UK workplaces between 1998 and 2011 to about 24%, this increase slowed down between 2004 and 2011, suggesting that demand for women in these positions slowed down in these years.

Figure 12c shows that the relative demand for labour in flexible occupations relative to inflexible occupations, estimated by the model following a cubic time trend, fell over time. The decrease in relative demand for flexible occupations would have led to a decrease in the wage penalty associated with

[9] The Workplace Employment Relations Survey is a representative national survey of UK workplaces. Data from the 1998, 2004, and 2011 waves were used.

working in flexible occupations over time. This pattern is evident in Figure 6, which also shows that the increase in the flexibility wage penalty over time has slowed for the most recent cohorts, corresponding to the relative demand for labour in flexible occupations increasing in recent years. This slowdown in demand for inflexible jobs aligns with the reversal in the growth of demand for cognitive tasks, which began with the tech bust of 2000 (Beaudry et al., 2016). In line with this hypothesised slowdown in the demand for high-skilled jobs, the returns to graduate education have become more dispersed as the participation in higher education has widened, suggesting asymmetric polarisation of employment due to high-skilled workers being pushed down the career ladder (Green and Henseke, 2016; Naylor et al., 2016; Walker and Zhu, 2008). Finally, Figure 12d shows that there was an overall increase in productivity over time (modelled as a cubic time trend) between 1993 and 2017, with a downturn around 2009, coinciding with the Great Recession in this period.

5.2.2 Supply side

Earnings

Table 4 reports the estimates of the parameters from the supply side of the model, along with the average marginal effects for the main parameters. The estimated coefficient for occupation-specific earnings is 0.7549, with an average marginal effect on the likelihood of working of 0.0119, both of which are positive, suggesting that an increase in the average hourly earnings in an occupation is likely to increase the probability of working by 0.8 percentage points[10]. The wage elasticity of labour supply refers to the change in the probability of choosing to work in market occupations resulting from an increase in the average hourly wage.[11] A 10% increase in the average hourly wage in flexible occupations in 1993 from £11.23 to £12.35 results in a 0.02 percentage point increase in the probability of working in flexible occupations, all other things equal, whereas a 10% increase in the average hourly wage in inflexible occupations from £15.54 to £17.09 would result in a 0.001 percentage point increase in the probability of working in inflexible occupations - suggesting

[10]The average marginal effects are derivatives of the probability of occupational choice with respect to the predictors in the multinomial logit model. These derivatives are computed as the changes in predicted probabilities of working in an occupation accruing from a change in the predictor for all the labour types in the model. The average marginal effects average these changes in choice probabilities over all labour types.

[11]The probabilities of choosing to work in flexible or inflexible occupations versus home production can be calculated using the multinomial choice probability equation in Equation 8.

that the estimated wage elasticity of labour supply among graduates is quite low on average.

Marriage and Fertility

The estimated coefficients for marriage and fertility indicate that both life events were negatively associated with women's labour supply, whereas fertility was positively associated with men's decision to work in market occupations. The reported average marginal effects are the changes in the probability of choosing the specified occupation associated with a 0.1 percentage point increase in the probabilities of being married or having a child, averaged across all age groups and years. These reported effects show that having a child had a greater impact on reducing women's labour supply than did marriage, with the reduction in labour supply being larger for flexible occupations in both cases. For instance, the 11.1 percentage point increase in the likelihood of a 35-44-year-old woman having a child under five between 1993 and 2017 (Table 5) was associated with 8.5 and 18.1 percentage point reductions in the probability of a woman of this age group working in inflexible and flexible occupations, respectively. This is in contrast with Cha (2013), who finds that, compared to men and childless women, mothers were more likely to exit male-dominated occupations when they worked more than fifty hours per week. However, this finding is more in line with Adda et al. (2017), who suggest that women's occupational choices are likely to have been made with expectations about future fertility and associated penalties for career breaks in mind, and therefore this is indicative of women's greater attachment to the labour market in highly paid, inflexible occupations. Furthermore, women in the UK were significantly less likely to drop out of the labour market around the time of their first childbirth in recent decades, suggesting that women's labour market attachment has increased overall (Roantree and Vira, 2018). On the other hand, fatherhood was likely to increase men's labour supply (which has been previously documented (Lundberg and Rose, 2002)), with larger increases in inflexible occupations than in flexible occupations, which corresponds with the life cycle increase in men's participation in inflexible occupations.

The probability of being married fell over time for both men and women across all age groups, as seen in Table 5. This reduction in the probability of being married led to women increasingly more likely to work, as, for example, the 13 percentage point reduction in the likelihood of being married for women aged 25-34 over the sample period was associated with 0.01 and 0.04 percentage point increases in the probability of working in inflexible and flexible occupations, respectively, suggesting that marriage did not have a large effect to draw women away from the labour force, given fertility and other factors. The reduction in female labour supply due to marriage was greater in flexible occupations than in inflexible occupations. However, men were more likely to work in inflexible occupations after marriage, and this increase was more pronounced than for flexible occupations. This corresponds with evidence that men in particular are able to enjoy a premium from 'overworking' or working inflexibly in highly paid occupations (Cha and Weeden, 2014; Denning et al., 2019), and that older men were more likely to be overworking in recent years (as opposed to previously, when overworking was more common among younger men) (Kuhn and Lozano, 2008).

Childcare costs and child-related benefits

The estimated coefficients for childcare costs show that higher childcare costs were associated with women being less likely to work in market occupations. On the other hand, the receipt of higher levels of child-related public benefits was not associated with large increases in women's labour force participation. The reported average marginal effects represent the changes in the probability of choosing the specified occupation associated with a 0.001 increase in childcare costs accrued and benefits received, conditional on having children, averaged across women of all age groups and years.

The reported average marginal effects suggest that increased childcare costs reduced women's likelihood of working in both flexible and inflexible occupations, as these costs increased the opportunity cost of working in market occupations. Therefore, as women bore most of the childcare responsibilities, they were likely to opt out of participating in the labour market to care for their children themselves. A £0.01 increase in weekly childcare costs was associated with reductions of 0.6 and 1.0 percentage points in the probability of women working in inflexible and flexible occupations, respectively. For instance, in England, the increase in childcare costs outstripped the increase in wages by about three to four times overall between 2008 and 2016(Reland, 2017a,b), and given that women's labour supply is especially dependent on the availability and cost of childcare, this rapid increase in costs would restrict their labour force participation. A lack of childcare, especially for high-skilled women, limits the labour supply, as outsourcing domestic production forms a tighter constraint on their time allocation, given that their workplaces are more likely to demand inflexible hours (Cortés and Pan, 2019; East and Velásquez, 2020). These results are in line with Adda et al. (2017), who find a positive 'utility cost' of childcare incurred when working that affects consumption decisions for German women.

On the other hand, increased provision of public benefits conditional on having children had almost no effect on the labour force participation of women. This suggests that, as child-related benefits are targeted more towards providing low-income mothers with additional income, they are not a significant factor in determining the labour force participation of graduate women in our sample. Other research looking at female labour supply in the UK has found that while the receipt of tax credits has a notable effect on the employment of women with high school or lower levels of education, increasing employment of single women and decreasing that of married women, these receipts are less important for university-educated women (Blundell et al., 2016). Research using Austrian data has also found that large increases in parental leave and childcare subsidies (termed 'family policies') have had little impact on increasing gender convergence in the labour market, attributing the lack of effect of childcare subsidies to strong norms around maternal care provision and crowding out of other types of informal childcare (Kleven et al., 2020).

Age- and Cohort-Specific Preferences for Occupations

The model estimates preference parameters that illustrate how gender-specific preferences for working in flexible and inflexible occupations change over the life cycle and across cohorts, as shown in Table 6. Figure 15 plots how the relative probability of working in flexible (compared to inflexible) occupations change with the evolution of these parameters over the life cycle and over cohorts, relative to their earliest values.[12]

Figure 15a shows that there was a large increase in women's relative preferences for working in flexible occupations over cohorts, so that women in recent cohorts had preferences that made them about 15% more likely to be working in flexible occupations (versus inflexible occupations) compared to those in earlier cohorts. Conversely, the relative preferences for working in flexible occupations did not increase women's probability of working in these occupations substantially over the life cycle, as seen in Figure 15b. Figure 5 showed earlier that the share of women working in flexible occupations increased slightly over the life cycle, but that there were more substantial increases in this share across cohorts, where the estimates of the preference parameters discussed here suggest that large increases in women's relative preferences for working in flexible occupations over time in particular have been driving these observed patterns of increases in the share of women working in flexible occupations across cohorts. It may be that women's preferences for flexibility are not very important for changing their occupational choice decisions over the life cycle if they have already taken into account their future family and fertility preferences when making their initial career choices and have therefore internalised any anticipated future costs at the start of their career (Adda et al., 2017).

A related literature has suggested that cultural factors play an important role in changing women's labour market attachment over time as increases in female employment (either in formative periods such as childhood and adolescence, or driven by neighbourhood peer effects due to exogenous changes such

[12]Under a multinomial logit specification, relative probabilities (or relative risk ratios) can be calculated using the *odds* of the estimated preference parameters for working in occupations (O_{occ}), which are equal to the exponents of these estimated coefficients. Since the change in the probability of working in the occupation (p_{occ}) associated with a particular coefficient and its odds (relative to the base category of home production) can be estimated as the ratio $p_{occ} = \frac{O_{occ}}{1+O_{occ}}$, the relative probability (or relative risk) of working in flexible (vs. inflexible) occupations is the ratio of the probability of working in flexible occupations to inflexible occupations. For instance, Figure 15a plots the change in the probability of working in flexible occupations (compared to the probability of working in inflexible occupations) that is associated with changes in cohort-specific preferences over time. Table 6 reports the estimates of the cohort-specific preferences (or the log odds of these preferences) for women for flexible occupations as -0.17 and for inflexible occupations as 0.72 in the 1990s. The odds of working in these occupations associated with these preferences, relative to home production, are the exponents of these values: 0.84 for flexible occupations and 2.05 for inflexible occupations. Therefore, the probabilities of working in these occupations (as opposed to home production) as a result of these preferences are $0.45 = 0.84/(1 + 0.84)$ for flexible occupations and $0.67 = 2.05/(1 + 2.05)$ for inflexible occupations. Therefore, the relative probability (or relative risk ratio) of working in flexible (compared to inflexible) occupations in the 1990s due to differences in preferences is 0.67, and similarly, this relative probability associated with cohort-specific preferences in the 2010s can be calculated as 0.81, so that the change in the relative probability of working in flexible occupations between the 1990s and 2010s is 0.14, which can be seen in Figure 15a.

as migration) are likely to cause changes in beliefs related to working (and reduce the stigma associated with working motherhood) (Fernandez et al., 2004; Fernández, 2013; Fogli and Veldkamp, 2011; Miho et al., 2019; Boelmann et al., 2020; Schmitz and Weinhardt, 2019; Maurin and Moschion, 2009; Olivetti et al., 2020). This suggests that as flexible working became more widespread among working women, even after legislation such as the Right to Request Flexible Working came into place in June 2014, women were able to increasingly demand this amenity and, if willing, to sacrifice pay in order to be able to make use of it (Mas and Pallais, 2017; Bustelo et al., 2020). Differences in culture around childcare and domestic responsibilities are often enhanced by institutional and policy settings that encourage different norms of behaviour around working after parenthood – in many developed countries, though men's childcare and domestic work hours have increased over time, this has not translated to changes in women's time use patterns (Altintas and Sullivan, 2017; OECD, 2019; Sayer, 2016). Furthermore, Andresen and Nix (2019) find that while Norwegian women in heterosexual and adopting couples experience similar motherhood penalties, birth mothers in same sex couples experience larger penalties relative to the other partner but catch up within two years of childbirth, suggesting that child penalties are largely driven by gender norms and differences in preferences for childcare.

On the other hand, changes in women's preferences for working in flexible occupations over time may arise due to shifts in the costs of motherhood, as policies related to and the availability of formal and informal childcare evolve Kuziemko et al. (2018). In the UK, the increase in childcare costs outstripped the increase in wages by about three to four times overall between 2008 and 2016(Reland, 2017a,b). Importantly, although Albanesi and Olivetti (2016) found that improvements in infant formula reduced constraints on women's labour force participation related to breastfeeding, recent medical advice has encouraged mothers to exclusively breastfeed infants for at least six months and discourages the use of infant formula in comparison (Cortés and Pan, 2020). Though the UK has some of the lowest breastfeeding rates in the world, with eight out of ten women stopping breastfeeding before they want to, these rates have steadily increased over recent decades (UNICEF, 2021; NCT, 2000, 2012).

These unexpected costs of motherhood may also be related to increases in the value of childcare time, as returns to human capital have increased. Browning et al. (2013) documents that though women's time spent on chores has fallen significantly in recent years, their time spent with children has increased substantially (with men also spending more time with their children than previously). For instance, educated women, in particular, are likely to favour high levels of investment in children, which has reinforced patterns of assortative mating (among white couples in the US) as the primary returns to marriage have shifted towards human capital investments (Chiappori et al., 2017; Lundberg and Pollak, 2014; Lundberg et al., 2016). These increased investments in children's human capital through both increased child-related expenditure and childcare time have been concentrated among college graduates, so that constraints related to flexibility may be even more binding for college-educated women as though they work more hours, they have also spent increasingly more time with their children compared to their less educated counterparts (Altintas, 2016; Altintas and Sullivan, 2017; Guryan et al., 2008). Borra and Sevilla (2019) document for the UK that the time that highly educated parents spent with children rose as there was increased competition for university places in the 1980s and early 1990s (mirroring US findings by Ramey and Ramey (2010)). Doepke and Zilibotti (2017) support this hypothesis, suggesting that increases in wage inequality are associated with increases in returns to education and with more intensive styles of parenting, both across countries, and over time for the US. In the UK, as the proportion of cohorts in higher education increased, the wage premium for a 'good' degree also increased over time (Naylor et al., 2016).

Figure 16 shows that there was indeed a large increase in the share of graduates over the analysis period, which coincided with this period of widening participation in higher education in the UK. As the share of graduates in cohorts increased over time, this may have led to recent cohorts of graduates being composed of lower-skilled admissions than previously, causing greater wage dispersion among graduates and a weakening of graduate status as a signal of ability (Green and Henseke, 2016; Walker and Zhu, 2008, 2011). The increase in the share of graduates over cohorts may therefore have had a compositional effect on the preferences for flexibility. It is possible that the composition of the graduate labour force has changed, such that preferences for flexibility have become more important, rather than a general overall increase in flexibility preferences among highly skilled graduates (comparable to the earliest cohorts). Figure 16 shows that while less than 20% of women in the survey had college degrees in 1993, this figure had increased to about 46% by 2017. Similarly, the share of men with college degrees increased from 23% to 41% between

1993 and 2017. Therefore, it may be that college education in the past was reserved for more highly motivated individuals who were able to secure high-paying jobs that were often inflexible in nature. However, as graduate degrees became more common, women who attended university may not have been the only career-oriented individuals, and therefore, the preferences for flexibility among graduates themselves may have increased naturally as a result.

Figure 15a shows that on average, changes to men's preferences for working in occupations did not result in changes in the relative probability of men working in flexible occupations across cohorts, which agrees with the patterns in the data. Moreover, as Figure 15b shows, changes in preferences did not lead to a substantial change in the relative probability of working in flexible occupations over the life cycle for men. This suggests that life cycle changes to preferences for working in flexible and inflexible occupations did not account for the reduction in the share of men working in flexible occupations at older ages (seen in Figure 5), and instead, the increase in men's likelihood to be working in inflexible occupations after life events, particularly as a result of the increases in fertility in more recent cohorts (as discussed earlier), may be behind these patterns.

Robustness checks of the supply side of the model are presented in Appendix C and are in line with the main patterns in the results discussed here.

5.3 Counterfactual Exercises

We have so far discussed the estimated effects of various demand- and supply-side factors on the gender wage gap and occupation flexibility, and how they relate to the trends observed in the data. This section discusses how the outcomes of interest would have changed had the parameters driving these trends been different by comparing the estimated model with counterfactual simulations. This allows us to consider how changes to specific factors, keeping all other factors constant, affect the wage and labour supply outcomes of interest.

Table 7 presents estimates summarising changes in the main outcomes of interest over the life cycle and over time for the original data, model predictions, as well as counterfactual predictions under alternative scenarios. From Column (1), the average gender age gap increased by 24.3 log points over the life cycle (across all years of the sample), with a smaller increase of 0.7 log points per year on average. The share of men working in flexible occupations fell over the life cycle by about 5.3 percentage points on average across all years, whereas the share of women working in flexible occupations fell over the life cycle by 5.6 percentage points on average across all years – averaging across all years flattens out the life cycle fall for women. On the other hand, the share of men working in flexible occupations declined over time (across all cohorts) by an average of 4.6 percentage points, while the share of women working in flexible occupations increased over time by 5.6 percentage points. Furthermore, the flexibility wage penalty increased over the life cycle by about 13.7 log points on average, and over time by about 1.6 log points on average. Column (2) presents estimates of these changes in earnings ratios and share working in flexible occupations as predicted by the model, in comparison to the observed data, showing that the model captures the general nature of the patterns, though it avoids flattening out the patterns by averaging across cohorts or over ages, resulting in underestimates of most of the outcomes except for the changes in the gender wage gap and the share of women working in flexible occupations over time.[13]

The counterfactual estimates in Column (CF1) are obtained by fixing the demand shares for men and women conditional on gender and occupation ($\alpha_{2,a,o,s}$) to remain constant at the level of the demand shares for labour aged 25-34 years, over the life cycle. Figure 12a showed that the relative demand for men increased over ages in both flexible and inflexible occupations, so this counterfactual scenario highlights how this change in the relative demand for men at older ages contributed to the life cycle patterns in the outcomes of interest. The counterfactual estimates in column (CF1) of Table 7 show that without these increases in relative demand for male labour in both occupation types over ages, the life-cycle increase in the gender gap would have fallen close to zero. This suggests that, despite the initial small disparity in wages for graduate men and women upon labour market entry, further increases in relative demand for male labour at older ages were a key driver behind the increase in the gender wage gap over the life cycle. Furthermore, the life cycle increase in the wage penalty for working in flexible occupations would also have been reduced to close to zero in the absence of these increases in relative demand for male labour in both flexible and inflexible occupations.

In Column (CF2) of Table 7, supply-side male and female preferences for working in flexible and inflexible occupations are assumed fixed over the life cycle at the levels in the 1990s over the sample period ($\psi_{0,s,c,j} = \psi_{0,s,90s,j}$). Figure 15 showed that the changes in men's and women's preferences for working in flexible and inflexible oc-

[13]The estimates of the change in the gender wage gap, flexibility wage penalty, and share working in flexible occupations are presented differently in the counterfactual estimates compared to how they are actually in the model and the raw data. While the model is estimated at the level of cohorts and age groups, the estimates are presented as the difference over the working life cycle, between ages 25 and 55, and over time, between 1993 and 2017. These estimates average the changes across all years and ages, respectively. This makes some of the patterns in the estimates different from what has been discussed earlier.

cupations over time were a major factor contributing to changes in the probability of working in these occupations over time. Counterfactual (CF2), therefore, highlights how the outcomes of interest would have changed over time had cohort-specific preferences for working in occupations not changed over time. Column (CF2) of Table 7 shows that if preferences for occupation flexibility had remained at the level of the 1990s, the increase in the gender wage gap over time would have been much smaller at about 0.7 log points, compared to an increase of 3.2 log points as predicted by the model. This would have largely been driven by the much smaller increase in the share of women working in flexible occupations over time, while the share of men working in flexible occupations would have increased over time under this scenario. This would also have meant smaller increases in the wage penalty for working in flexible occupations, both over time and throughout the life cycle.

Similarly, in the next counterfactual scenario (CF3), male and female age-specific preferences for working in flexible and inflexible occupations are assumed to have remained at the level for the 25-34 age group over the life cycle ($\psi_{0,s,a,j} = \psi_{0,s,25-34,j}$). Column (CF3) of Table 7 shows that keeping preferences for working in occupations fixed at the level of the 25-34 age group would have resulted in slightly smaller increases in the gender wage gap over the life cycle and across cohorts, in comparison to the contributions of the increase in cohort-specific preferences for flexibility. This would have been because of smaller reductions in the share of men working in flexible occupations over the life cycle, whereas the reduction in the share of women working in flexible occupations over the life cycle would have been larger, while there would have been a slightly smaller increase in the share of women working in flexible occupations over time. This would have also contributed to smaller increases in the flexibility wage penalty over time and with age.

In Columns (CF4) and (CF5), the gender- and age-specific rates of fertility and marriage, respectively, are assumed to remain at 1993 levels throughout the sample period (i.e. $Pr(\text{child} < 5 = 1 \mid s, a, t) = Pr(\text{child} < 5 = 1 \mid s, a, 1993)$ and $Pr(\text{marr} = 1 \mid s, a, t) = Pr(\text{marr} = 1 \mid s, a, 1993)$). Column (CF4) shows that if fertility rates among graduates had not increased as seen in Table 5, the gender wage gap would have increased slightly over time (compared to the original prediction), as the share of women working in flexible occupations would have increased over time (as well as over the life cycle by a smaller amount), whereas the share of men working in flexible occupations would have reduced by a smaller amount over time. This would also have contributed to a larger increase in the wage penalty from working in flexible occupations over time. The counterfactual estimates in Column (CF5) suggest that, in the absence of the reduction in marriage rates, both the decrease in the share of women working in flexible occupations over the life cycle and the increase in this share over time would be slightly smaller. There would also have been a smaller life cycle reduction in the share of men working in flexible occupations, while the reduction in the share of men working in flexible occupations over time would have been larger. The absence of a reduction in marriage rates would therefore have contributed to a smaller increase in the flexibility wage penalty over time.

In Columns (CF6) and (CF7), child-related benefits are assumed to remain at 1993 levels ($CBEN_{a,t} = CBEN_{1993,t}$) and childcare costs at zero ($CHC_{a,t} = 0$), respectively, throughout the sample period. The estimates in Column (CF6) reinforce findings by Kleven et al. (2020) that changes to family policies such as childcare subsidies and maternity leave contributed very little to changing the gender wage gap, as we find that they had very little impact on the share of women working in flexible occupations, though they did contribute to reducing the flexibility wage penalty over time. The estimates in Column (CF7) show that under a counterfactual scenario where childcare costs were assumed to stay at zero over the sample period, there would have been only a small reduction in the gender wage gap over both time and the life cycle, whereas the share of women working in flexible occupations would have reduced by a slightly larger amount over the life cycle and increased by a smaller amount over time.

6 Conclusion

This paper estimates a model of labour supply and demand to evaluate the importance of occupation flexibility for changes in the gender wage gap over the life cycle and over time for the graduate workforce in the UK. We define flexibility as a characteristic of occupations, as in Goldin (2014), such that firms substitute between labour in flexible and inflexible occupations on the demand side, and individuals make occupational choice decisions based on their preferences for flexibility on the labour supply side.

Our estimates show that increases in relative demand for male labour (versus female labour) and in inflexible occupations mainly contributed to the increase in the gender wage gap over the life cycle, with the increase in this relative demand (and the gender wage gap) especially pronounced until about age 40. Furthermore, changes to women's preferences so that more recent cohorts of women were more likely to choose to work in flexible occupations contributed to the large increase in the share of women working in flexible occupations over time, as well as a large proportion of the increase in the flexibility wage penalty and to increasing the gender wage gap over time. We also find that the higher relative demand for inflexible occupations (for both men and women) at older ages and over time contributed to increases in the wage penalty from working in flexible occupations, and therefore to increased gender wage disparity.

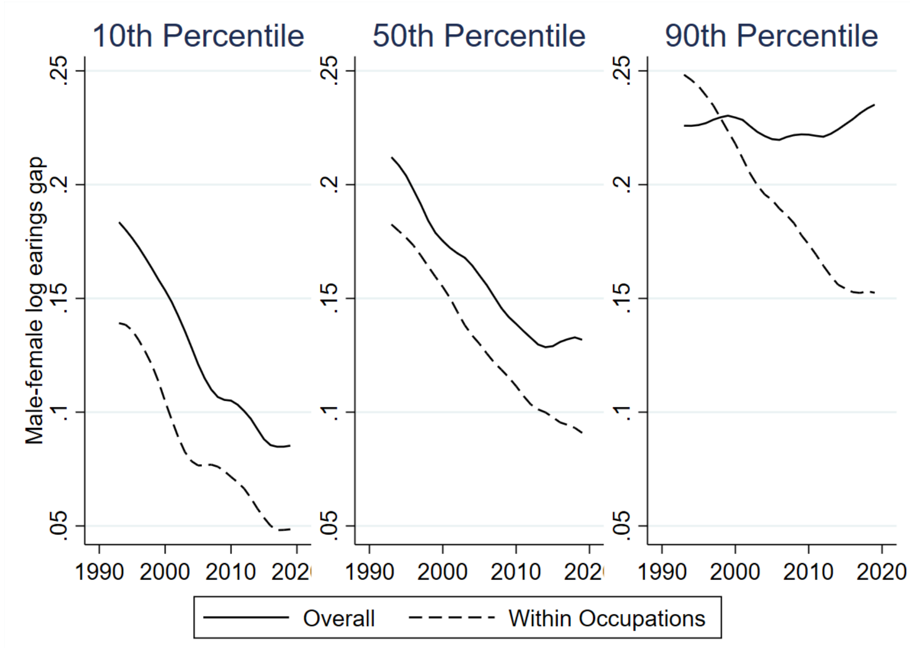
The estimates presented here also show that fertility and marriage are both negatively associated with female labour supply, supporting existing research that women's preferences for flexibility contribute to changes to women's working patterns and an expansion of the gender wage gap over the life cycle. However, the fact that these preferences have increased over time is less well established. This increase in women's preferences for flexibility over cohorts has been concurrent with an increase in the wage premium for working inflexibly (working long hours or overworking) over time. The increased returns to overworking have been especially pronounced in highly paid occupations, which has prevented women from closing the wage gap, especially at the top of the earnings distribution (Bertrand, 2018; Cha, 2010; Cha and Weeden, 2014). Bertrand et al. (2019) found that gender quotas for company boards had limited positive impact on the overall labour market outcomes of women employed in such firms in Norway, beyond the increase in the earnings for women directly appointed to these boards, suggesting that there is limited potential for gender quotas to break the glass ceiling, so that policy measures to promote flexibility in higher-paid occupations may be an alternative solution. Unlike women, men were likely to reduce their participation in flexible occupations and increase it in inflexible occupations after marriage, as seen in the descriptive trends, as graduate men in the UK were likely to move out of flexible occupations and into inflexible occupations at older ages. Finally, increased childcare costs were associated with women reducing their participation in both flexible and inflexible occupations, whereas increased tax credits and benefits related to childcare did not significantly affect graduate women's participation in the labour market, as has been documented elsewhere (Blundell et al., 2016; Kleven et al., 2020).

7 Figures and Tables

7.1 Figures

Figure 1: Gender wage gap within and across occupations, across the distribution over time

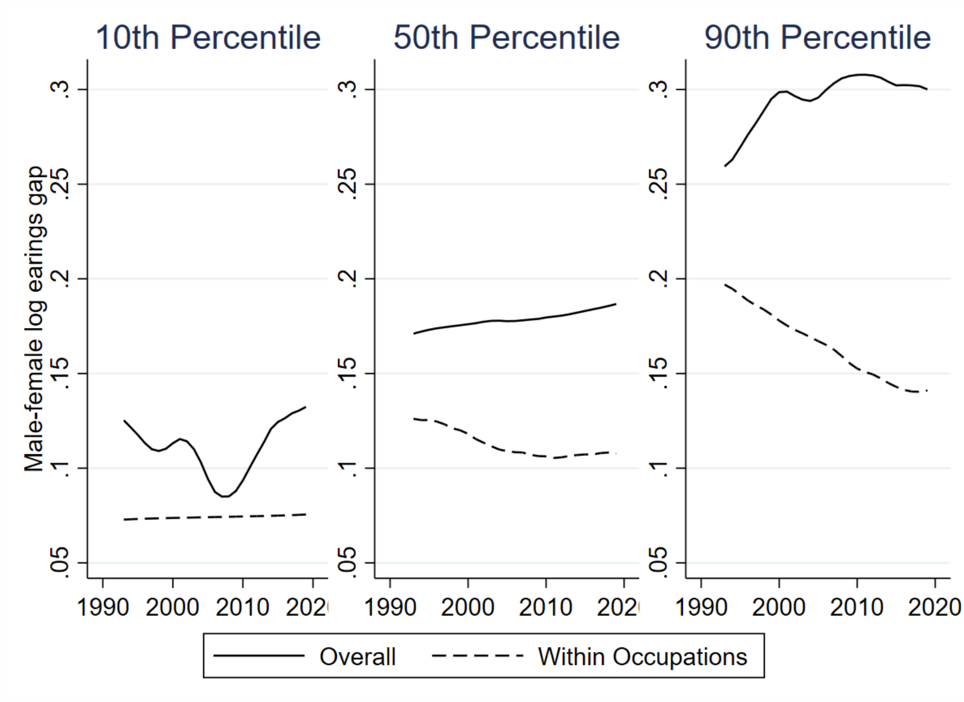
(a) All Full-Time Workers



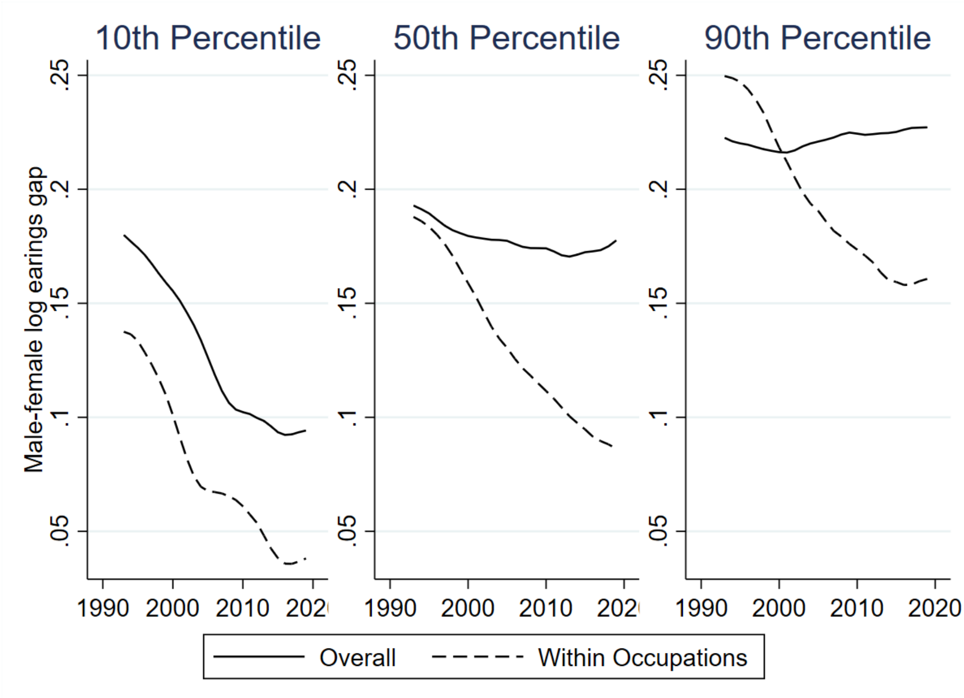
Notes: The graphs plot the difference between log male and female real hourly earnings at different percentiles of the earnings distribution, both within and across occupations - panel (a) for all full-time workers. The plotted lines are smoothed local polynomials of degree 0.

Figure 2: Gender wage gap within and across occupations, across the distribution over time, graduates and non-graduates

(a) Graduates



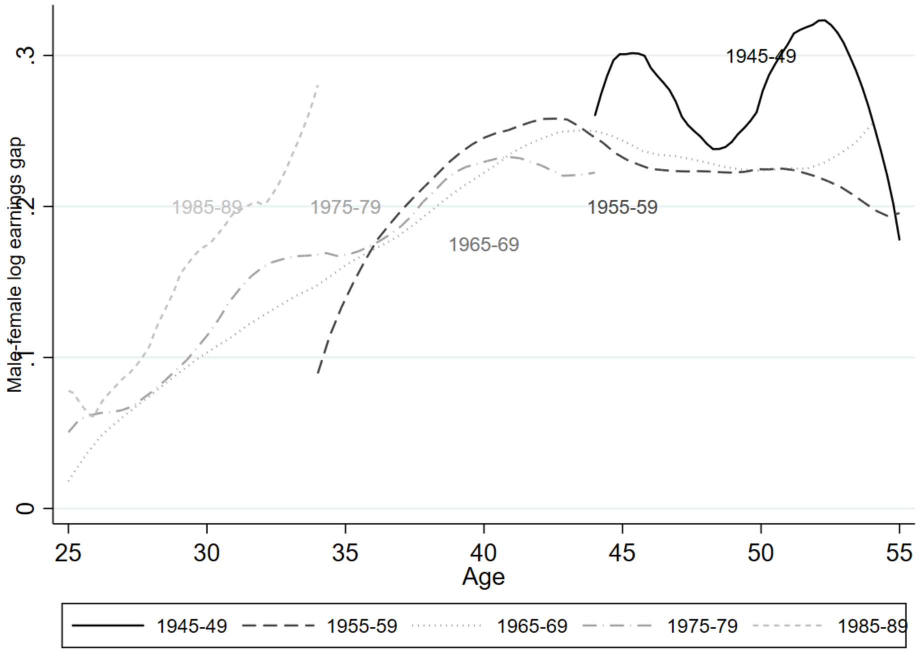
(b) Non-graduates



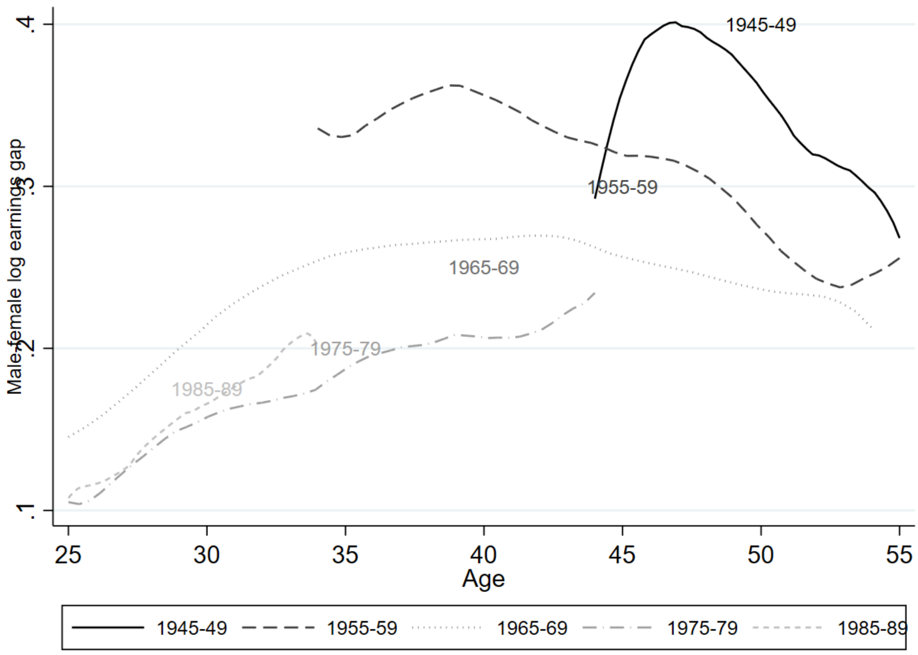
Notes: The graphs plot the difference between log male and female real hourly earnings at different percentiles of the earnings distribution, both within and across occupations. The plotted lines are smoothed local polynomials of degree 0.

Figure 3: Gender wage gap by cohort

(a) Graduates



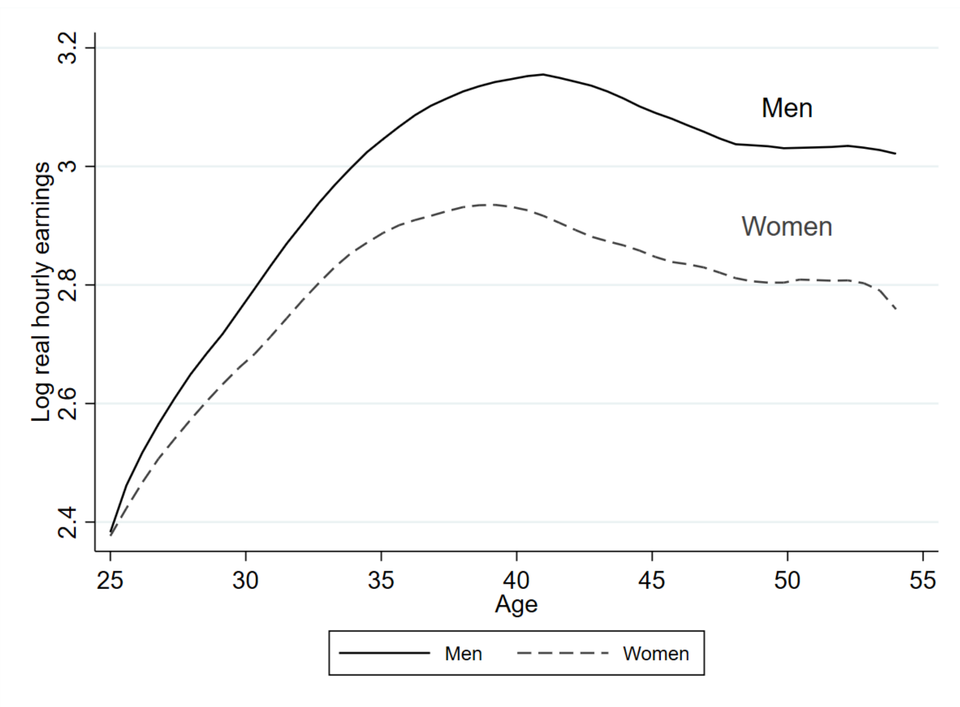
(b) Non-graduates



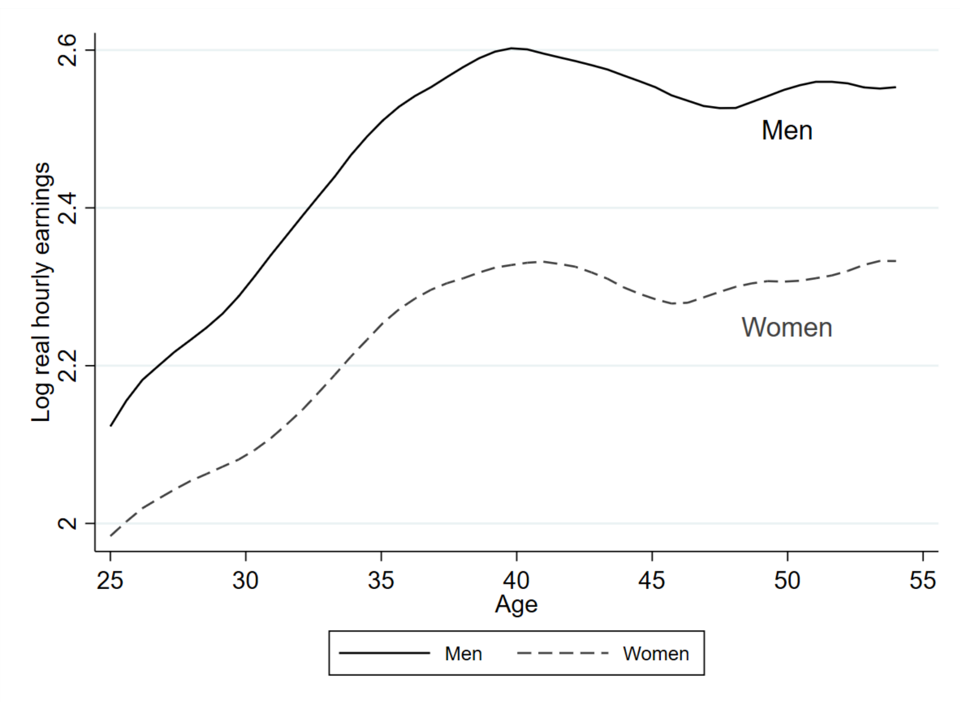
Notes: The graphs plot the difference between log male and female real hourly earnings for different cohorts between ages 25 and 55. The plotted lines are smoothed local polynomials of degree 2.

Figure 4: Male and female wages over the life cycle for cohort born 1965-69

(a) Graduates



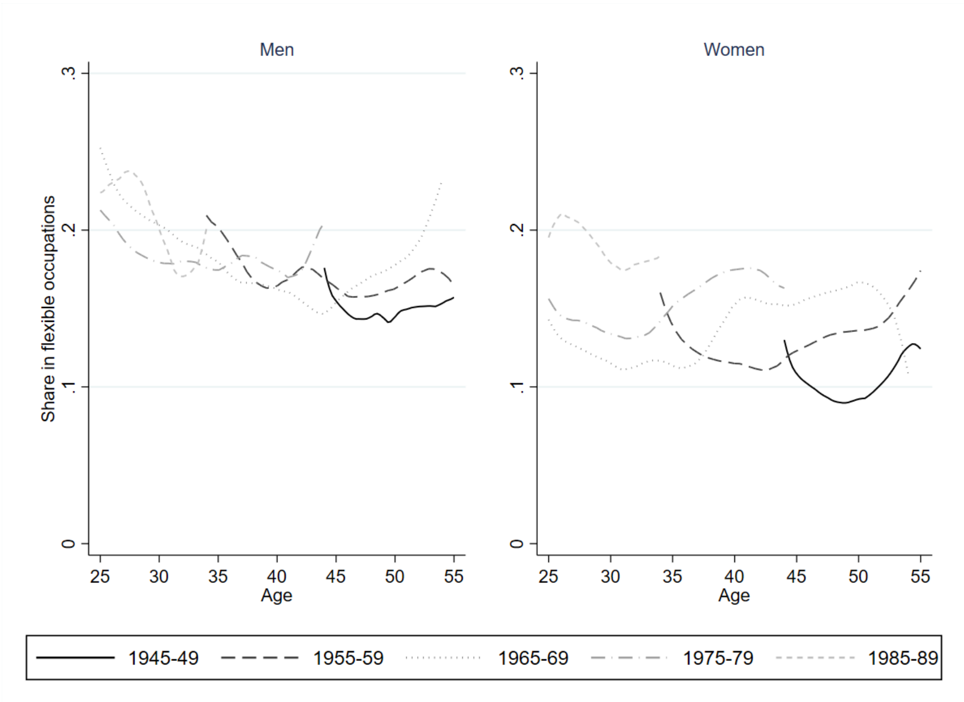
(b) Non-graduates



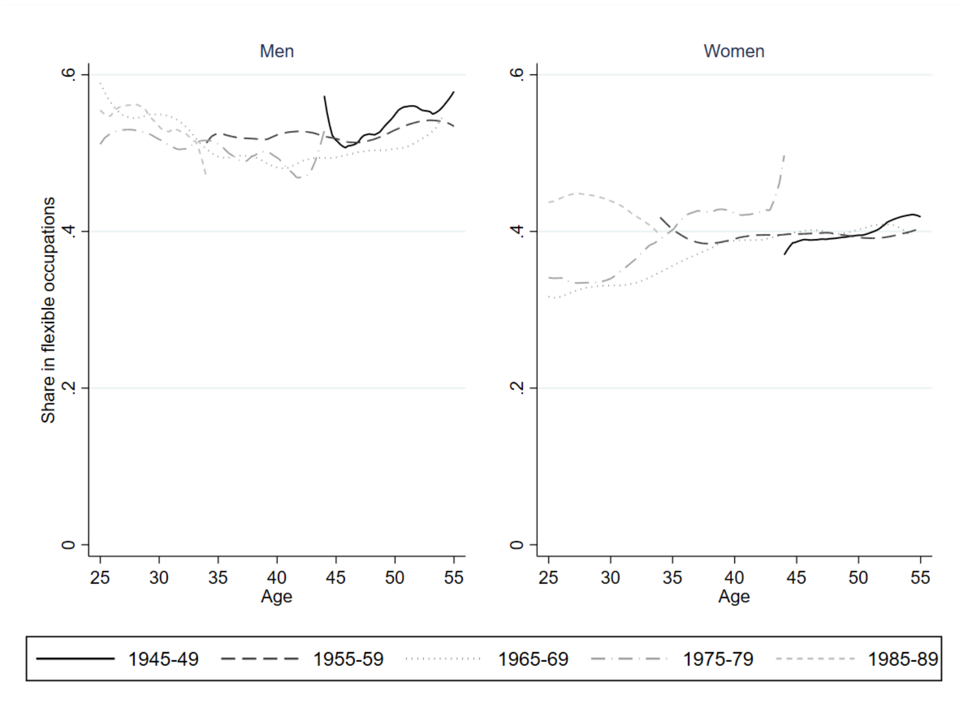
Notes: The graphs plot the evolution of log real hourly earnings between ages 25 and 52 for men and women born between 1965 and 1969. The plotted lines are smoothed local polynomials of degree 2.

Figure 5: Share working in flexible occupations by cohort, over the life cycle

(a) Graduates



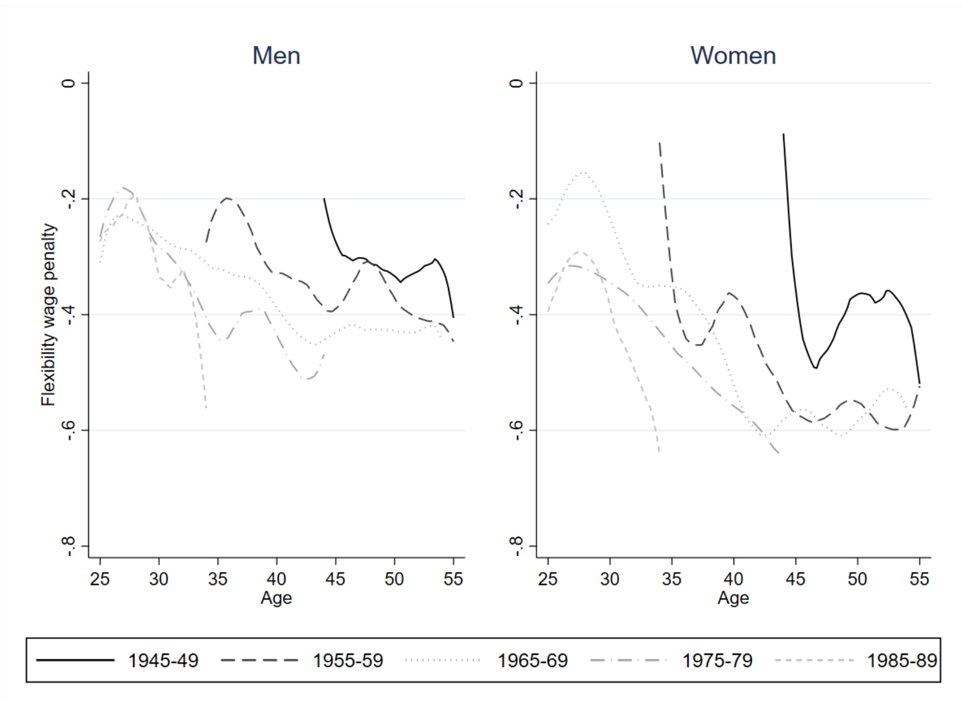
(b) Non-graduates



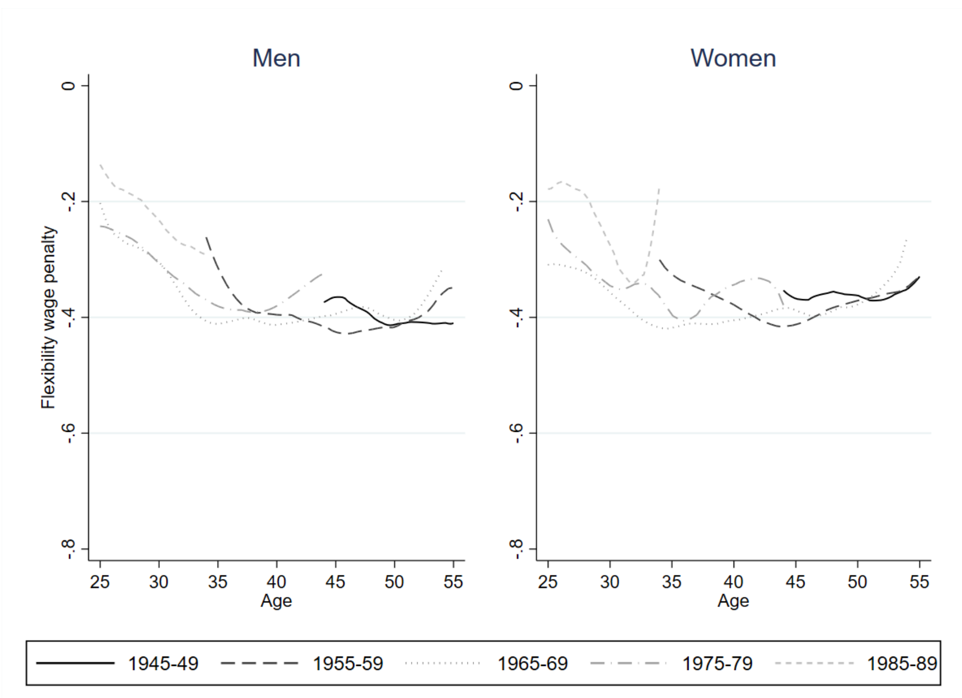
Notes: The graphs plot the share of male and female working in flexible occupations, as defined by a binary indicator, across different cohorts between ages 25 and 55. The binary indicator defines flexible occupations as those that have a flexibility score above the median for all occupations. The plotted lines are smoothed local polynomials of degree 2.

Figure 6: Flexibility wage penalty by cohort, over the life cycle

(a) Graduates



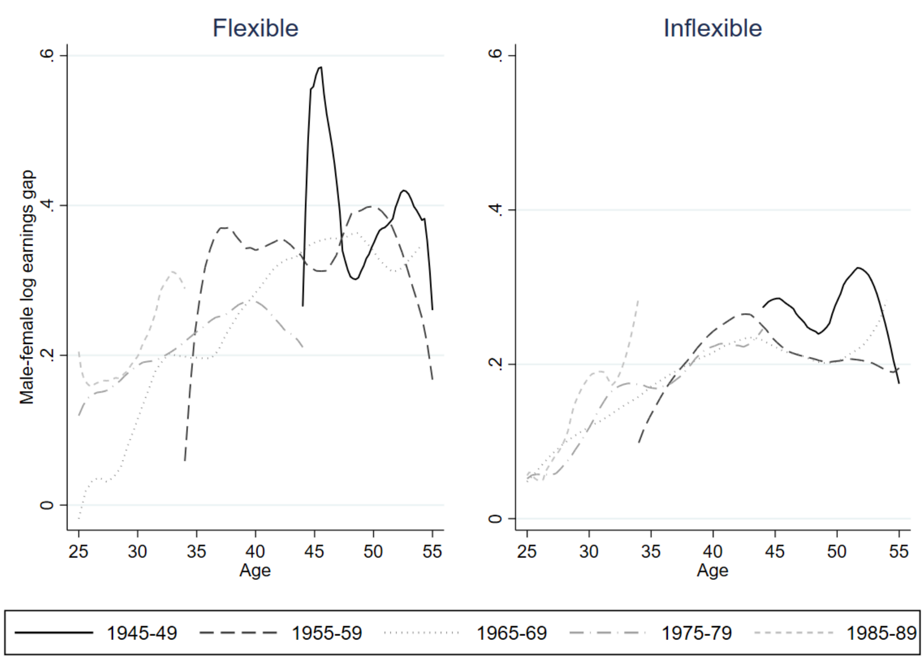
(b) Non-graduates



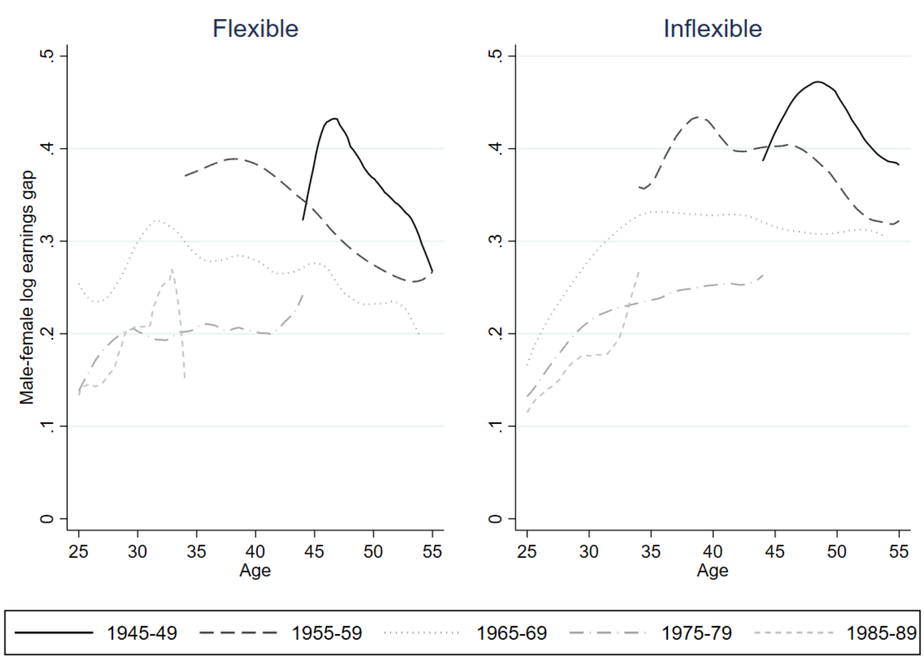
Notes: The graph plots the evolution of the wage penalty associated with a 1 SD increase in occupation flexibility score between ages 25 and 55, separately for male and female graduates vs. non-graduates in different cohorts. The plotted lines are smoothed local polynomials of degree 2.

Figure 7: Gender wage gap by cohort and occupation type, over the life cycle

(a) Graduates

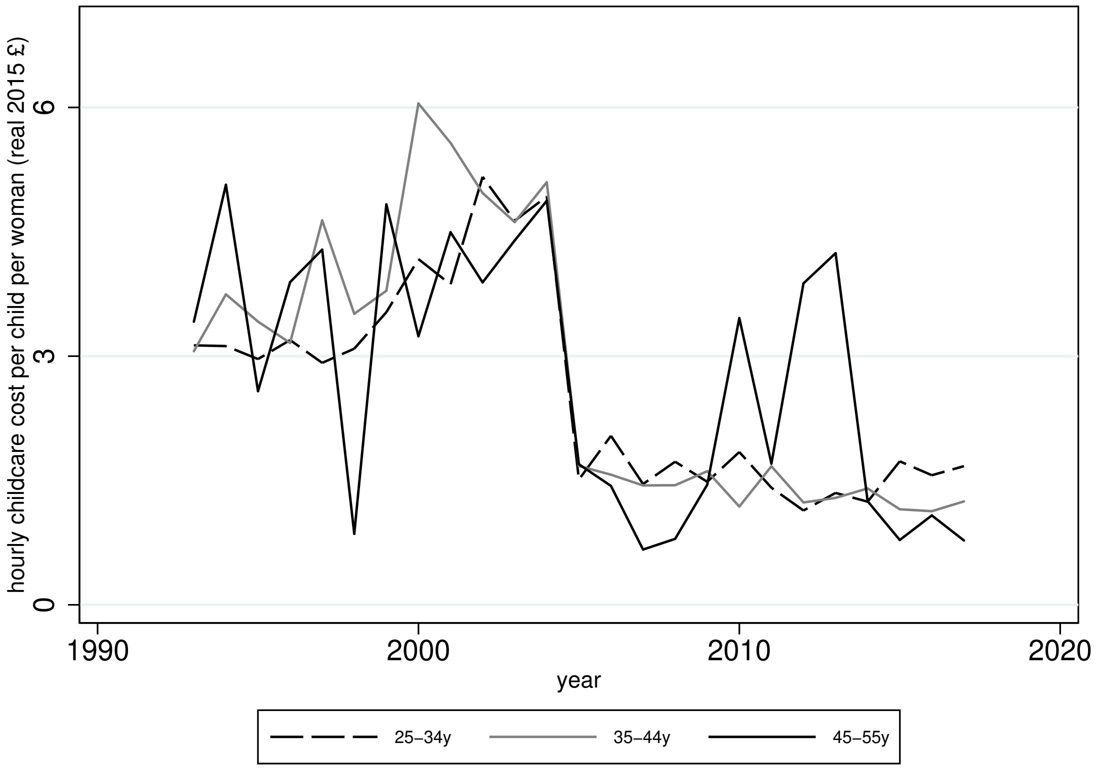


(b) Non-graduates



Notes: The graphs plot the difference between log male and female real hourly earnings for different cohorts between ages 25 and 55, separately by occupation type and by graduates vs. non-graduates. The plotted lines are smoothed local polynomials of degree 2.

Figure 8: Childcare costs over time

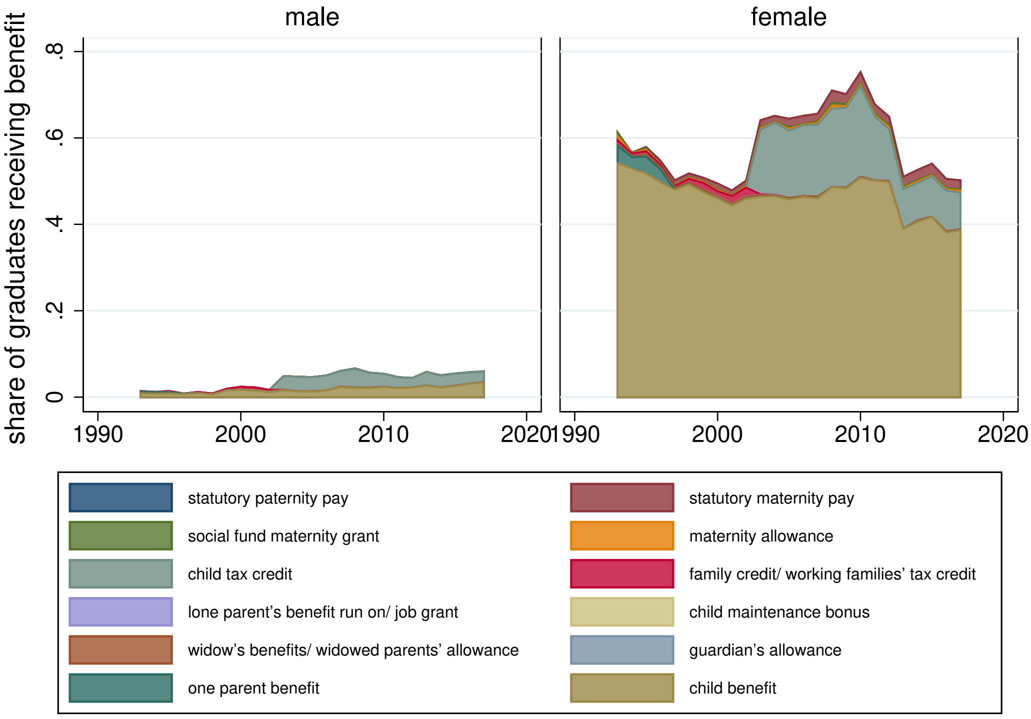


Source: Family Resources Survey.

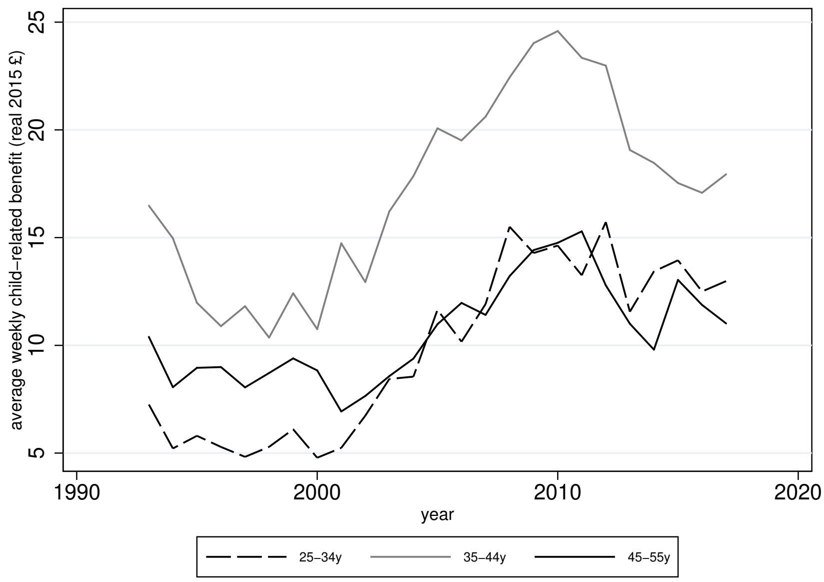
Notes: This graph plots the change over time in the average childcare costs per child in the household for women in the Family Resources Survey, in real 2015 £.

Figure 9: Child-related benefits over time

(a) Share of Graduates Receiving Child-Related Benefits



(b) Weekly Child-Related Benefit

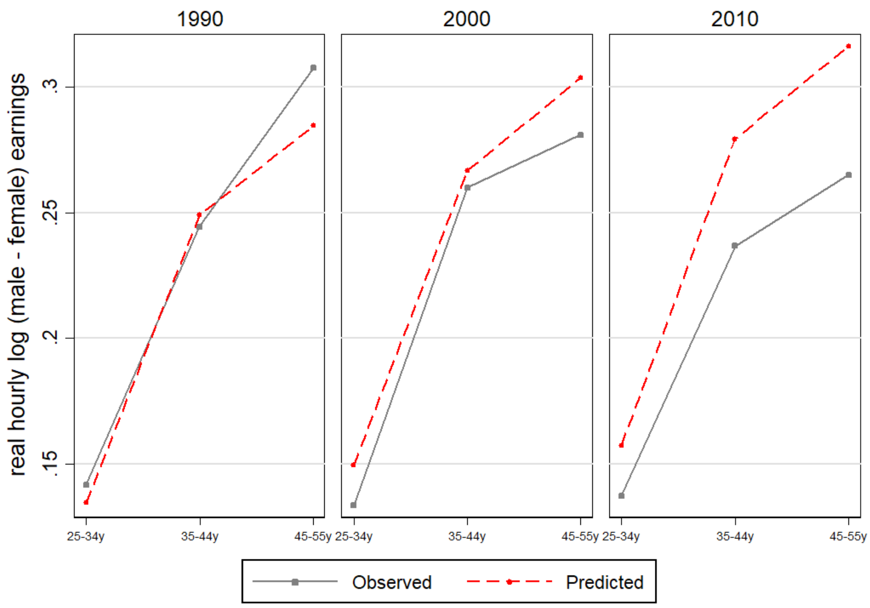


Source: Family Resources Survey.

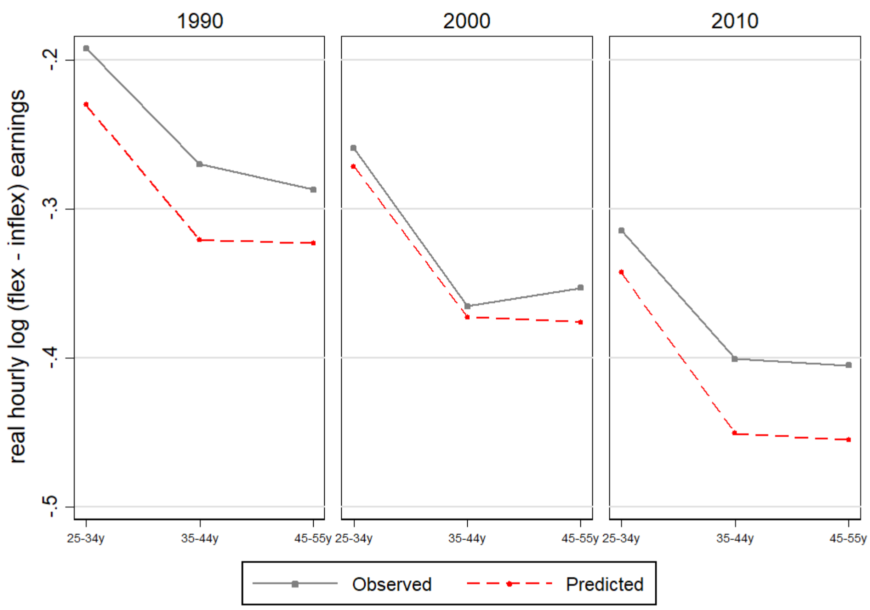
Notes: The graph in panel (a) plots the share of graduate men and women receiving child-related benefits over time. The graph in panel (b) plots the average child-related benefits received by women over time, in real 2015 £.

Figure 10: Data and Model Predictions for the Gender Wage Gap and the Flexibility Wage Penalty, By Cohort and Age Group

(a) Log (male-female) hourly earnings gap



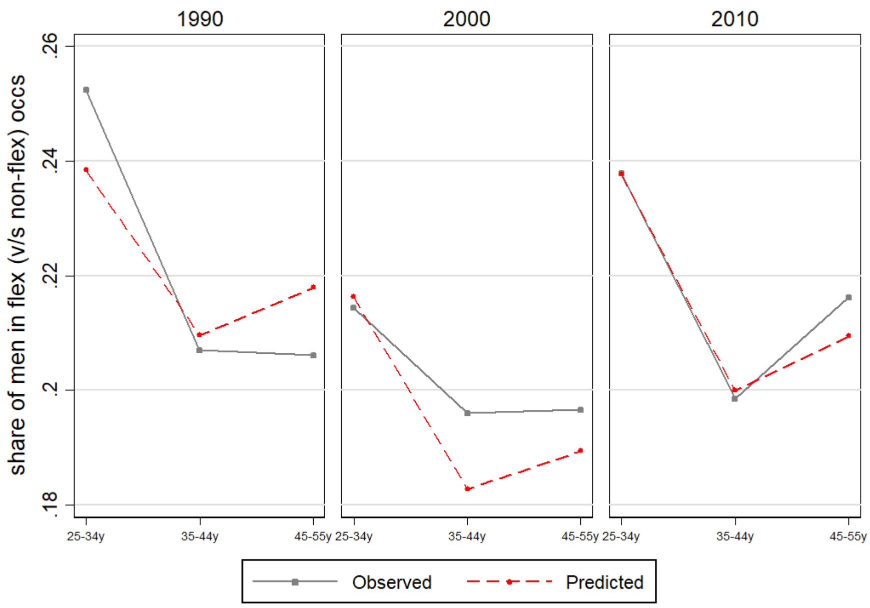
(b) Log (flexible-inflexible) wage penalty



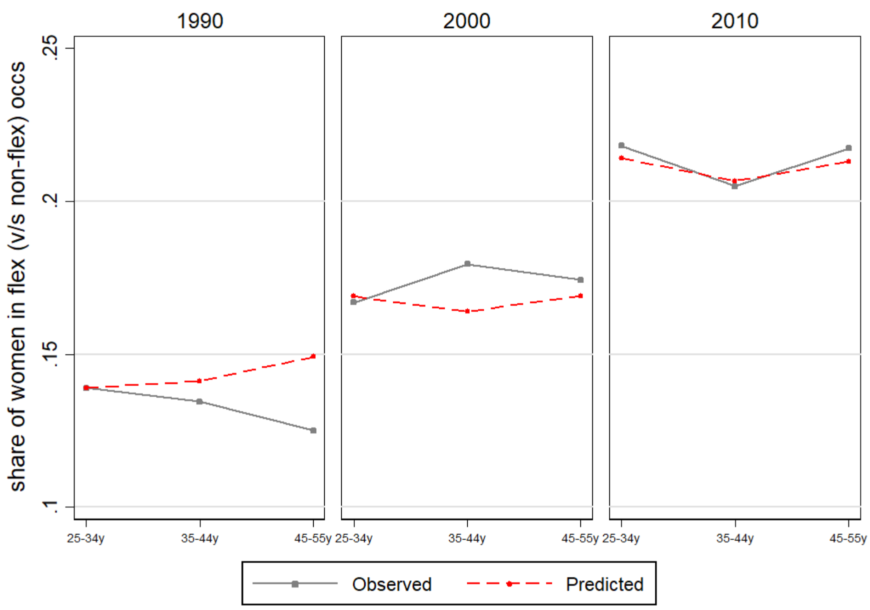
Notes: These graphs plot the trends in the outcomes of interest related to earnings (the male-female gender wage gap and the wage penalty from working in flexible occupations (relative to inflexible occupations), for the age groups and cohorts used in the model, both as observed in the data and predicted from the model.

Figure 11: Data and Model Predictions for the Share in Flexible Occupations, By Cohort and Age Group

(a) % men in flexible occupations



(b) % women in flexible occupations

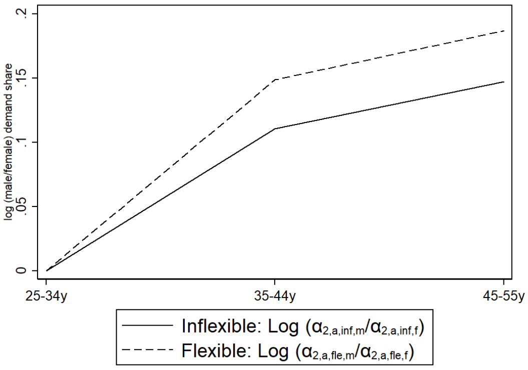


Notes: These graphs plot the trends in the outcomes of interest related to labour supply (the share of men and women working in flexible occupations (versus inflexible occupations)) for the age groups and cohorts used in the model, both as observed in the data and predicted from the model.

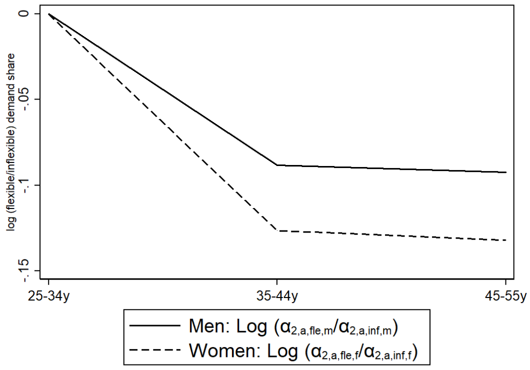
Figure 12: Estimates of Relative Demand Shares and Total Factor Productivity

Production Technology: Nest II

(a) Male vs. Female

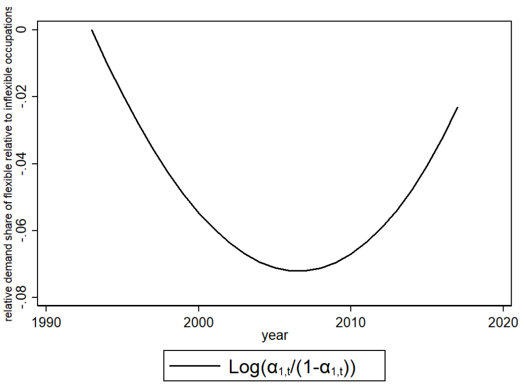


(b) Flexible vs. Inflexible

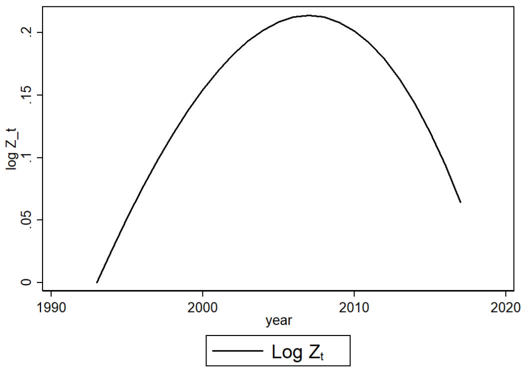


Production Technology: Nest I

(c) Flexible vs. Inflexible

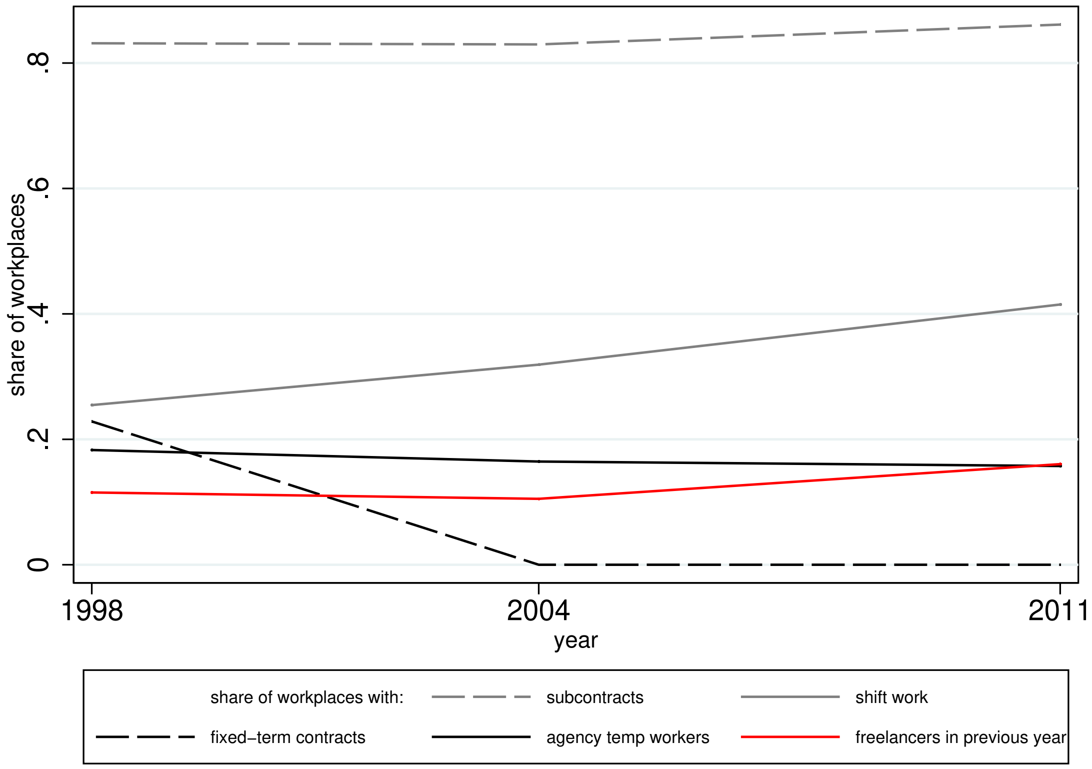


(d) Total Factor Productivity



Notes: These graphs plot the relative demand shares and total factor productivity estimated by the model. The relative demand shares, plotted in panels (a)–(c), are the log ratios of the demand shares for each labour type. The demand shares in the second nest of the production function are fixed over time (panels (a) and (b), and vary over age. The demand share (panel (c)) and total factor productivity (panel (d)) in the first nest of the production function are the natural logarithms of quadratic time trends. Each series is normalised to zero in 1993 for ease of interpretation.

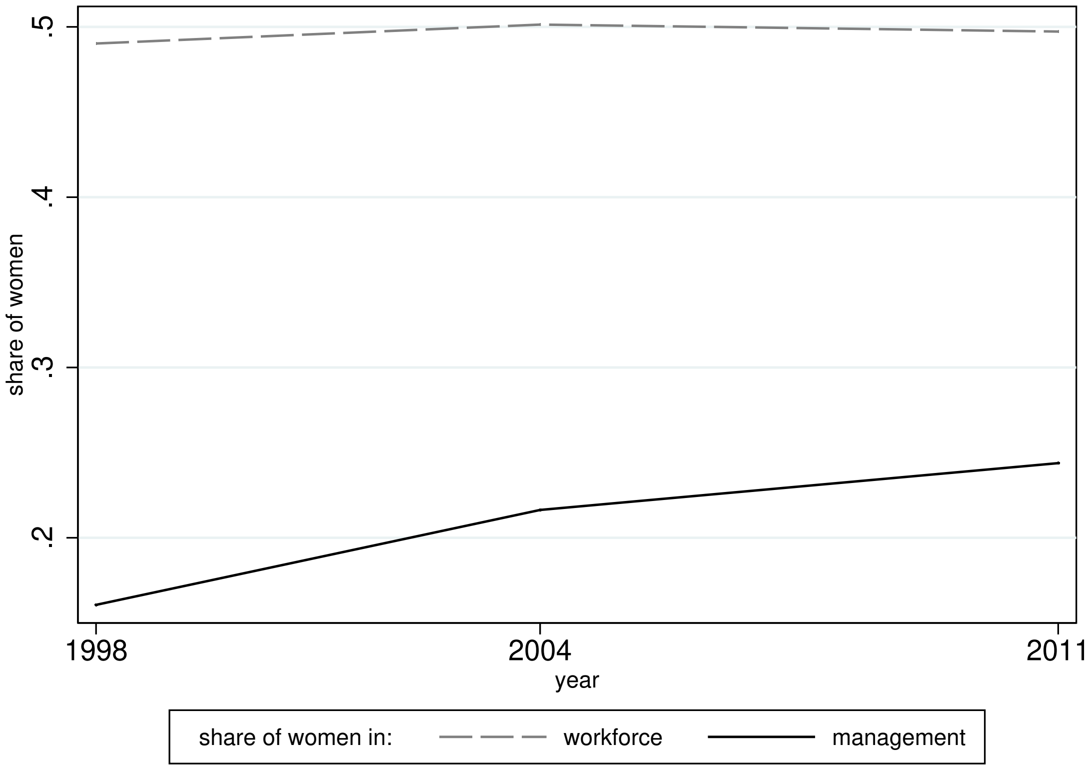
Figure 13: Share of Workplaces with Flexible Working Arrangements



Source: Workplace Employment Relations Survey, Time Series Dataset: 1998, 2004, 2011.

Notes: This graph plots the share of workplaces wih 10 or more employees sampled in the Workplace Employment Relations Survey that have employees hired under flexible working arangements of different types.

Figure 14: Share of Women in Workplaces Over Time

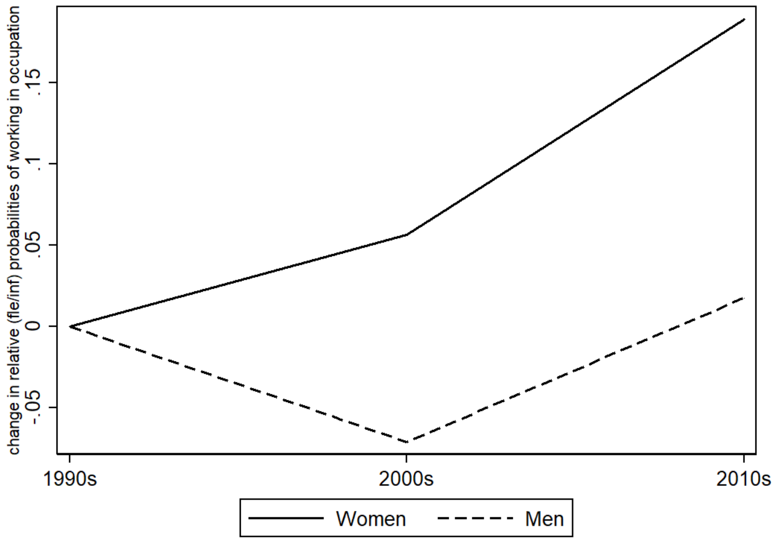


Source: Workplace Employment Relations Survey, Time Series Dataset: 1998, 2004, 2011.

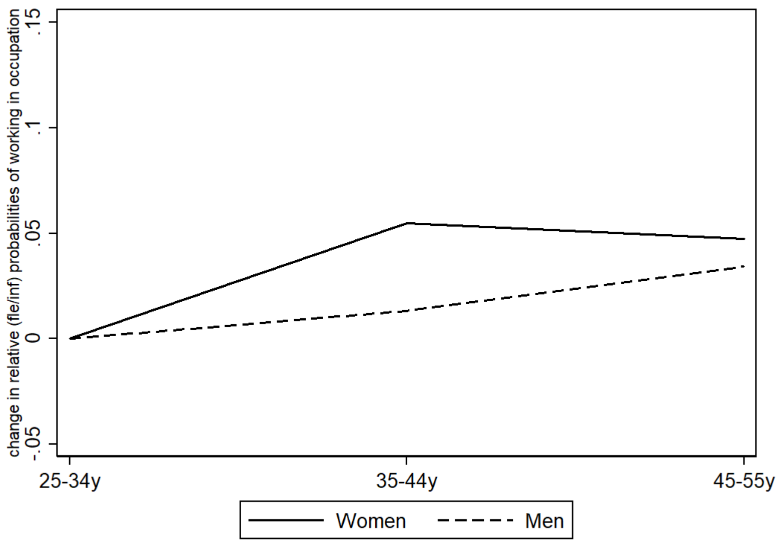
Notes: This graph plots the share of women in the workplace and in management positions in the sample of firms with 10 or more employees surveyed by the Workplace Employment Relations Survey.

Figure 15: Estimates of Changes in Relative Probabilities of Working in Flexible Occupations Over the Life Cycle and Time

(a) Cohort-Specific Preferences, Fixed over Ages

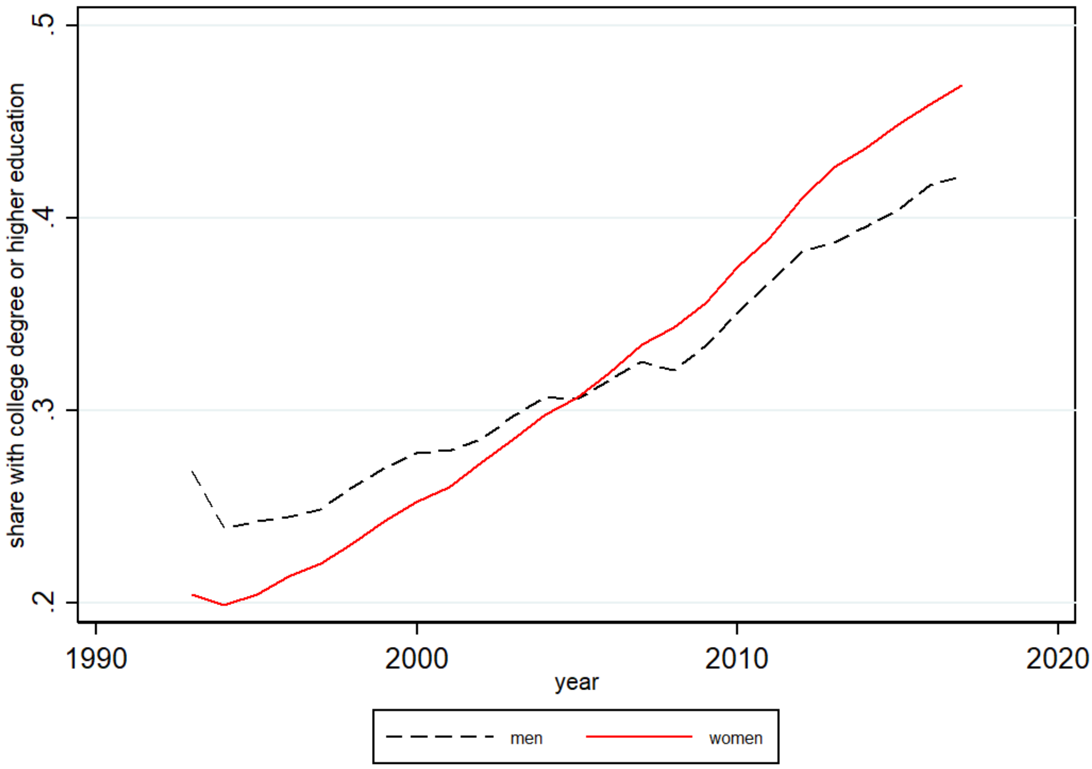


(b) Age-Specific Preferences, Fixed over Time



Notes: These graphs plot the changes in the relative probabilities of working in flexible occupations (compared to inflexible occupations) given the changes in specified preference parameters, keeping all else constant. The estimates in panel (a) plot the changes in the relative risk of working in flexible occupations for men and women over time, compared to the 1990s, following the evolution of the cohort-, gender-specific preference parameters for working in occupations that are fixed over ages ($\psi_{0,s,c,j}$). The estimates in panel (b) plot the changes in the the relative probability of working in flexible occupations for men and women over the life cycle, compared to age 25-34, following the evolution of the age-, gender-specific preference parameters for working in occupations that are fixed over time ($\psi_{0,s,a,j}$).

Figure 16: Graduate Share of Men and Women Over Time



Notes: These graphs plot the share of men and women in the Labour Force Force Survey who had a college degree, i.e. who then formed the sample for analysis over time.

7.2 Tables

Table 1: Flexibility and occupation characteristics in minor occupation groups for graduates between 2001 and 2010

Rank	SOC2000 3 digit	Occupation group title	Flexibility score [average]	Time pressure	Contact with others	Interpersonal relationships	Structured work	Decision making freedom	Occupation share of graduates (%)	Male share of occupation graduates (%)	Share working part-time (%)
Least flexible occupations											
81	221	Health professionals	-0.87	0.02	-0.87	-0.96	-1.14	-1.20	3.35	51.4	16.0
80	354	Sales & related associate professionals	-0.81	-0.16	-0.87	-0.85	-1.22	-0.69	1.83	52.4	9.3
79	244	Public service professionals	-0.72	-0.36	-1.02	-1.01	-0.54	-0.55	1.58	38.9	13.9
78	122	Managers & proprietors in hospitality & leisure services	-0.62	-0.63	-0.87	-0.37	-0.68	-0.44	0.88	57.6	8.1
77	116	Managers in distribution, storage, and retailing	-0.59	-0.95	-0.56	-0.58	-0.56	-0.27	1.32	71.5	5.3
76	115	Financial institution and office managers	-0.54	-0.47	-0.50	-0.88	-0.43	-0.40	1.71	50.7	8.8
75	123	Managers and proprietors in other service industries	-0.53	-0.42	-0.50	-0.91	-0.52	-0.40	1.71	58.9	10.9
74	112	Production managers	-0.52	-0.22	-0.39	-0.81	-0.52	-0.65	3.08	89.8	2.1
73	113	Functional managers	-0.51	-0.22	-0.56	-0.88	-0.68	-0.32	9.18	67.3	5.0
72	629	Personal services occupations n.e.c. (e.g. undertakers)	-0.50	-0.67	-0.04	-0.40	-0.89	-0.53	0.02	58.4	21.6
Most flexible occupations (employing at least 0.4% of graduate sample between 2001 and 2010)											
3	922	Elementary personal services occupations (e.g. waitresses)	0.67	0.59	-0.17	0.46	1.14	0.61	0.42	40.6	52.9
17	612	Childcare & related personal services	0.26	1.70	0.00	0.28	-0.19	-0.48	2.07	6.1	54.3
22	323	Social welfare associate professionals	0.15	-0.95	-1.35	0.27	0.89	1.87	1.50	26.3	25.1
23	312	Draughtspersons & building inspectors	0.13	0.47	0.09	0.07	0.23	-0.23	0.43	84.3	5.3
24	212	Engineering professionals	0.11	0.55	0.57	-0.38	-0.14	-0.06	3.13	92.6	1.9
25	522	Metal machining, fitting & instrument making trades	0.11	-0.53	1.01	0.61	0.25	-0.25	0.47	98.0	1.4
26	311	Science & engineering technicians	0.10	0.47	0.09	0.07	0.06	-0.23	1.10	71.4	7.9
28	821	Transport drivers & operatives	0.06	-0.38	-0.39	0.47	0.56	0.36	0.50	89.7	16.8
29	243	Architects, town planners, surveyors	0.05	-0.14	0.27	-0.51	0.31	0.31	1.44	83.5	4.8
30	531	Construction trades	0.02	-0.55	-0.13	0.46	0.15	0.19	0.58	96.6	6.0
Most flexible occupations											
1	414	Administrative occupations: communications	1.42	1.57	-1.26	-0.05	4.04	2.79	0.11	36.3	16.0
2	924	Elementary security occupations	0.69	1.74	-0.47	0.46	0.81	0.95	0.25	66.4	31.9
3	922	Elementary personal services occupations	0.67	0.59	-0.17	0.46	1.14	0.61	0.42	40.6	52.9
4	813	Assemblers and routine operatives	0.62	-0.51	0.66	0.50	0.73	1.03	0.27	67.7	10.9
5	812	Plant and machine operatives	0.57	-0.38	0.22	0.50	0.73	0.52	0.12	94.6	1.7
6	912	Elementary construction occupations	0.55	0.04	-0.04	0.60	0.97	1.20	0.08	95.6	22.0
7	521	Metal forming, welding, and related trades	0.44	-0.51	0.22	1.04	0.93	0.99	0.07	95.8	1.4
8	532	Building trades	0.43	-0.22	0.53	0.95	0.23	0.27	0.09	89.6	10.9
9	543	Food preparation trades	0.42	-0.59	0.35	0.44	0.68	1.41	0.23	60.8	22.3
10	923	Elementary cleaning occupations	0.42	-0.24	0.57	0.95	0.52	0.44	0.21	37.0	61.5

Notes: The table describes the nature of the ten most and least flexible SOC2000 minor occupation groups in the prime-aged sample of graduates in the QLFS between 2001 and 2010. For each minor occupation group, listed in order of their standardised flexibility score, the median flexibility score as well as the median score in each of the five flexibility components are shown. The occupation share of graduates is the percentage of the graduates in the sample that are employed in the minor occupation group. The male share of occupation graduates shows the percentage of graduates working in the occupation group that are male, and the final column shows the percentage of graduates in the occupation group that work part-time.

Table 2: Parameter Estimates: Production Technology

	Estimate	SE	Implied Elasticity $\frac{1}{1-\rho}$
ρ_1: flexible, inflexible occupations	0.3337	(0.1072)	1.5008
ρ_2: age group, sex	0.9740	(0.0285)	38.4334

Notes: This table reports the estimates of the substitution parameters, with standard errors included in parentheses. Implied elasticities of substitution from the production technology are also reported.

Table 3: Changes in Relative Wages and Labour Supplies between 1993 and 2017

	1993		2017		Dif-in-dif Earnings	Dif-in-dif Labour Supply
	Δ Earnings	Δ Labour Supply	Δ Earnings	Δ Labour Supply		
Occupation						
Inflexible – flexible	0.3489	1.3162	0.3764	1.2823	-0.0275	0.0339
Gender						
Male – female	0.2851	0.3525	0.2386	-0.0302	0.0465	0.3827
Gender, occupation						
Male – female, inflexible	0.2363	0.1886	0.2326	-0.0298	0.0037	0.2184
Male – female, flexible	-0.0620	-0.8292	-0.1373	-1.3130	0.0753	0.4838
Gender, occupation, age group						
Male – female, inflexible						
25-34	0.1563	0.0811	0.1451	-0.7749	0.0112	0.8561
35-44	0.1955	0.2093	0.2621	-0.9195	-0.0667	1.1288
45-55	0.3309	0.3128	0.2661	-0.7961	0.0647	1.1088
Male – female, flexible						
25-34	-0.0489	-0.0462	-0.1129	-1.2272	0.0640	1.1810
35-44	-0.1219	-0.0168	-0.0884	-1.4126	-0.0335	1.3958
45-55	-0.0181	-0.0262	-0.1994	-1.3091	0.1814	1.2829

Notes: This table reports the differences and changes in relative wages and labour supplies aggregated over types of labour, between 1993 and 2017.

Table 4: Parameter Estimates: Occupational Choice, Fixed over Time

	Estimates	SE	Average Marginal Effects
Earnings			
ψ_1: Earnings	0.7549	(0.2209)	0.0119
Fertility			
$\pi_{2,f,inf}$: Female, inflexible	0.1230	(0.0456)	-0.0077
$\pi_{2,f,fle}$: Female, flexible	-0.5480	(0.0686)	-0.0163
$\pi_{2,m,inf}$: Male, inflexible	1.0232	(0.0226)	0.0182
$\pi_{2,m,fle}$: Male, flexible	0.8260	(0.0249)	0.0147
Marriage			
$\pi_{3,f,inf}$: Female, inflexible	-0.0452	(0.0174)	-0.0006
$\pi_{3,f,fle}$: Female, flexible	-0.3263	(0.0197)	-0.0044
$\pi_{3,m,inf}$: Male, inflexible	0.5212	(0.0208)	0.0093
$\pi_{3,m,fle}$: Male, flexible	0.2372	(0.0225)	0.0042
Childcare costs			
$\gamma_{1,inf}$: Female, inflexible	-0.2213	(0.0065)	-0.0006
$\gamma_{1,fle}$: Female, flexible	-0.3860	(0.0114)	-0.0010
Child-related benefits			
$\gamma_{2,inf}$: Female, inflexible	-0.0024	(0.0015)	0.0000
$\gamma_{2,fle}$: Female, flexible	0.0225	(0.0020)	0.0001

Notes: This table reports the estimates and average marginal effects for parameters on the supply side of the model related to changes in costs, benefits, and probabilities of marriage and fertility. Standard errors for the estimates are included in parentheses. The average marginal effects for fertility and marriage are calculated for each labour type as the numerical derivative of the probability of choosing the specified occupation, with respect to the given probability of getting married or having children. These numerical derivatives are averaged across all relevant labour types and across all years for the relevant occupation to give the average marginal effects. In the case of earnings, the average marginal effects are calculated for each labour type and occupation as the numerical derivative of the probability of choosing the specified occupation with respect to earnings, and then these numerical derivatives are averaged across all labour types, occupations, and years. For childcare costs and benefits, the average marginal effects are calculated as the numerical derivatives of the probability of choosing the specified occupation, with respect to the given childcare costs and benefits for the relevant labour type, and averaged for each sex and occupation.

Table 5: Marriage and Fertility Status of Men and Women in 1993 and 2017

	1993		2017	
	Men	Women	Men	Women
Marriage				
25-34	0.4901	0.5728	0.3544	0.4429
	(0.1882)	(0.1601)	(0.2015)	(0.2031)
35-44	0.8403	0.8624	0.7578	0.7629
	(0.0427)	(0.0444)	(0.0579)	(0.0358)
45-55	0.9348	0.9250	0.8306	0.8275
	(0.0155)	(0.0111)	(0.0377)	(0.0375)
Child under five				
25-34	0.2402	0.3045	0.2139	0.3160
	(0.1530)	(0.1436)	(0.1456)	(0.1526)
35-44	0.2779	0.2202	0.3792	0.3313
	(0.1184)	(0.1425)	(0.1196)	(0.1482)
45-55	0.0334	0.0052	0.0637	0.0206
	(0.0240)	(0.0075)	(0.0459)	(0.0284)

Notes: This table reports the means of the probabilities of being married and having a child under five, for men and women aggregated by age group, in 1993 and 2017. Standard deviations are reported in parentheses.

Table 6: Parameter Estimates: Time-varying Preferences for Occupations

	Estimates	SE
Age-, sex- specific preference for occupations, fixed over time		
$\psi_{0,f,25-34,inf}$: Female, 25-34, inflexible	0.1443	(1.0984)
$\psi_{0,f,25-34,fle}$: Female, 25-34, flexible	-0.2159	(1.5282)
$\psi_{0,f,35-44,inf}$: Female, 35-44, inflexible	-0.0959	(1.0933)
$\psi_{0,f,35-44,fle}$: Female, 35-44, flexible	-0.2416	(1.5276)
$\psi_{0,f,45-55,inf}$: Female, 45-55, inflexible	-0.0723	(1.0929)
$\psi_{0,f,45-55,fle}$: Female, 45-55, flexible	-0.2439	(1.5285)
$\psi_{0,m,25-34,inf}$: Male, 25-34, inflexible	0.5906	(1.6114)
$\psi_{0,m,25-34,fle}$: Male, 25-34, flexible	0.3494	(1.7653)
$\psi_{0,m,35-44,inf}$: Male, 35-44, inflexible	0.2041	(1.6294)
$\psi_{0,m,35-44,fle}$: Male, 35-44, flexible	0.0503	(1.7630)
$\psi_{0,m,45-55,inf}$: Male, 45-55, inflexible	0.0695	(1.6400)
$\psi_{0,m,45-55,fle}$: Male, 45-55, flexible	-0.0390	(1.7595)
Cohort-, sex- specific preference for occupations, fixed over ages		
$\psi_{0,f,90s,inf}$: Female, 1990s, inflexible	0.7226	(1.1511)
$\psi_{0,f,90s,fle}$: Female, 1990s, flexible	-0.1739	(1.5105)
$\psi_{0,f,00s,inf}$: Female, 2000s, inflexible	0.4442	(1.1507)
$\psi_{0,f,00s,fle}$: Female, 2000s, flexible	-0.3112	(1.5106)
$\psi_{0,f,10s,inf}$: Female, 2010s, inflexible	0.4085	(1.1513)
$\psi_{0,f,10s,fle}$: Female, 2010s, flexible	-0.0606	(1.5108)
$\psi_{0,m,90s,inf}$: Male, 1990s, inflexible	-0.0477	(1.5238)
$\psi_{0,m,90s,fle}$: Male, 1990s, flexible	-0.5485	(1.8193)
$\psi_{0,m,00s,inf}$: Male, 2000s, inflexible	-0.3887	(1.5272)
$\psi_{0,m,00s,fle}$: Male, 2000s, flexible	-1.0641	(1.8197)
$\psi_{0,m,10s,inf}$: Male, 2010s, inflexible	-0.1467	(1.5251)
$\psi_{0,m,10s,fle}$: Male, 2010s, flexible	-0.6244	(1.8176)

Notes: This table reports the estimates for parameters on the supply side of the model related to time-varying preferences for working in flexible and inflexible occupations. Standard errors for the estimates are reported in parentheses.

Table 7: Counterfactual Exercises

	(1) Data	(2) Model	(CF1) Demand	(CF2) Cohort	(CF3) Age	(CF4) Fertility	(CF5) Marriage	(CF6) Benefits	(CF7) Childcare
100 $\times\boldsymbol{\Delta}$ log (male/female) earnings ratio									
Life cycle: Δ_{55-25}	24.3	16.0	0.6	13.5	15.2	15.9	15.8	16.1	15.7
Time: $\Delta_{2017-1993}$	0.7	3.7	2.8	1.4	2.8	3.3	3.2	3.3	3.4
100 $\times\boldsymbol{\Delta}$ share working in flexible (versus inflexible) occupations									
Women									
Life cycle: Δ_{55-25}	-5.6	-2.6	-0.1	-0.5	-5.6	-2.6	-2.0	-1.9	-3.0
Time: $\Delta_{2017-1993}$	5.6	7.9	5.7	-0.3	6.8	6.7	6.0	6.1	6.6
Men									
Life cycle: Δ_{55-25}	-5.3	-4.3	-1.5	-4.3	-6.4	-4.2	-4.2	-4.2	-4.3
Time: $\Delta_{2017-1993}$	-4.6	0.2	-1.3	-1.6	-1.0	-1.1	-1.7	-1.0	-1.1
100 $\times\boldsymbol{\Delta}$ log (flexible/inflexible) earnings ratio									
Life cycle: Δ_{55-25}	-1.6	-9.0	-0.7	-14.0	-8.4	-9.3	-9.3	-9.3	-9.0
Time: $\Delta_{2017-1993}$	-13.7	-11.7	-18.7	-2.2	-16.1	-17.2	-15.3	-15.1	-16.0

Notes: This table reports a summary of changes over the life cycle and over time using the original data, the model predictions, and counterfactual estimates under alternative scenarios. The outcomes of interest are the log (male/female) earnings ratio, the share of men and women working in flexible occupations, and the log (flexible/inflexible) earnings ratio. Column (1) summarises changes in the averages of these outcomes between ages 25 and 55 and years 1993 and 2017 using the original data, and column (2) does the same using the model predictions. Columns (CF1) to (CF7) summarise the estimates of these averages under counterfactual scenarios. In Column (CF1), the demand shares for men and women conditional on gender and occupation $\alpha_{2,a,o,s}$ are assumed to remain constant at the level of the demand shares for labour of 25-34 years, over the life cycle. In Columns (CF2) and (CF3), supply-side preferences for working in flexible and inflexible occupations are assumed fixed over the life cycle at the levels in the 1990s over the sample period ($\psi_{0,s,c,j} = \psi_{0,s,90s,j}$), and at the levels at age 25-34 over the life cycle ($\psi_{0,s,a,j} = \psi_{0,s,25-34,j}$), respectively. In Columns (CF4) and (CF5), the gender- and age-specific rates of fertility and marriage, respectively, are assumed to remain at 1993 levels throughout the sample period (i.e. $Pr(\text{child} < 5 = 1 \mid s, a, t) = Pr(\text{child} < 5 = 1 \mid s, a, 1993)$ and $Pr(\text{marr} = 1 \mid s, a, t) = Pr(\text{marr} = 1 \mid s, a, 1993)$). In Columns (CF6) and (CF7), child-related benefits are assumed to remain at 1993 levels ($CBEN_{a,t} = CBEN_{1993,t}$) and childcare costs at zero ($CHC_{a,t} = 0$), respectively, throughout the sample period.

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A Gender Wage Gap Decomposition

Overall gender wage gap At a given percentile p, we compute the overall gender wage gap by comparing the distributions of log male and female full-time earnings in the entire sample, without conditioning on occupation. The measure is defined as

$$R_{\text{overall},p} = \frac{Q_p(\log \text{wage}_{\text{male}})}{Q_p(\log \text{wage}_{\text{female}})},$$

where $Q_p(\cdot)$ denotes the pth percentile of the distribution. This statistic captures the aggregate gender wage gap at percentile p and reflects both occupational sorting and within-occupation differences.

Within-occupation gender wage gap At a given percentile p, the within-occupation gender wage gap is obtained by first computing the percentile ratio separately within each occupation and then averaging these occupation-specific ratios using occupation employment weights. The measure is defined as

$$R_{\text{within},p} = \frac{\sum_{occ} N_{occ} \left(\frac{Q_p(\log \text{wage}_{\text{male},\, occ})}{Q_p(\log \text{wage}_{\text{female},\, occ})} \right)}{\sum_{occ} N_{occ}},$$

where N_{occ} is the number of workers in occupation *occ*. This statistic captures the gender wage gap within occupations, abstracting from differences in occupational composition.

Across-occupation gender wage gap The across-occupation component is defined as the difference between the overall gender wage gap and the within-occupation component:

$$R_{\text{across},p} = R_{\text{overall},p} - R_{\text{within},p}.$$

This statistic captures the part of the gender wage gap that is explained by differences in the occupational distributions of men and women.

B Data Appendix

The occupation classifications available in the QLFS were the UK Standard Occupation Classification (SOC90) from 1993 to 2000, SOC2000 from 2001 to 2016, and SOC2010 from 2011 to 2016. SOC2000 was the main classification onto which flexibility measures were mapped. Since the data spans two UK SOC classifications, but the flexibility measure is available for US SOC 2000, a likelihood table (provided by the ONS) is used to assign UK SOC90 occupations to their most likely UK SOC2000 counterparts, in order to create a smooth UK occupation crosswalk matched over all years. The flexibility score for each UK SOC occupation in the dataset was calculated as the arithmetic mean of the reversed characteristics (since each individual characteristic is initially coded with higher values indicating lower flexibility), so that a higher flexibility score indicates an occupation with greater flexibility. By definition, the flexibility score remains constant for an occupation over time, as it corresponds to O*NET characteristics for a specific US occupational classification. The binary measure of a flexible occupation is created by defining an occupation as flexible if its flexibility score is above the median flexibility score across all occupations, which is a standard approach used in the literature to classify occupations in categories (Autor et al., 2003; Autor and Dorn, 2013).[14]

C Robustness Checks Using OLS and Multinomial Logit Analysis

As a robustness check, Table C.1 reports results from estimating the supply side of the model using OLS and multinomial logit regressions.[15] The OLS results show that the average hourly wage is positively associated with labour force participation, and negatively associated with home production in the MNL estimates. This aligns with the above discussion, although the OLS estimates are significant only for men.

The OLS and multinomial logit estimates in Table C.1 also show that having a child under five at home makes women more likely to be in home production and less likely to work in flexible occupations, both of which are in line with the parameter estimates from the structural model, though the average marginal effects from multinomial logit are only significant at 10%. Results using OLS estimates indicate that marriage makes both men and women significantly less likely to engage

[14]The main descriptive statistics related to flexibility were tested with alternate binary cutoff thresholds, but this did not affect the main patterns observed. However, using cutoffs that were above the 75th percentile of the flexibility score led to very low shares of employment in flexible occupations, as occupations that employed a high share of graduates tended to have lower flexibility scores.

[15]The OLS regressions present linear probability model estimates of the probability of being active in the labour market for male and female graduates, controlling for age and cohort fixed effects, age- and sex specific average hourly wage, indicators for being married and having children under five, as well as the average amount of childcare costs and child-related benefits for women in their age group. The table also reports p-values from tests of equality between the coefficients in the male and female regressions. In the case of the multinomial logit regressions, average marginal effects are presented for each of the control variables on the probability of being in home production or working in flexible and inflexible occupations. Reported p-values are from tests of the equality of the average marginal effects for working in flexible and inflexible occupations, as well as whether the average marginal effects for each occupational choice differ between men and women.

in home production or work in flexible occupations, and more likely to work in inflexible occupations. For women, this differs from the model's results; however, the reduced form estimation utilizes an indicator of marriage at the individual level, rather than the probability of being married within the age group, which may explain the differences in the results.

The OLS and multinomial estimates suggest that higher average childcare costs are significantly positively associated with women being inactive in the labour market, whereas higher levels of child-related benefits are not significantly associated with their participation in the labour force or in any occupation, though there are insignificant effects on working in each of the market occupations. These estimated effects are consistent with the parameter estimates reported by the model, although they are not statistically significant.

Table C.1 also confirms, using OLS and MNL estimation, that the model predictions show there were large increases in women in more recent cohorts working in flexible occupations, accompanied by significant reductions in their probability of working in inflexible occupations, both of which are not seen for men. The difference in the likelihood of working between the two types of occupations is statistically significant for women. On the other hand, both men and women in the oldest age group (45-55 years) are significantly less likely to work in inflexible occupations, a finding that does not vary by gender.

Table C.1: OLS and Multinomial Logit Regression Estimates of the Supply Side of the Model

	OLS			Multinomial Logit										
				Men				Women				*p-value m = f*		
	(1) Men	(2) Women	*p-value m = f*	(3) home	(4) inflexible	(5) flexible	*p-value inf = fle*	(6) home	(7) inflexible	(8) flexible	*p-value inf = fle*	*home*	*inflexible*	*flexible*
Age specific indicators: reference group 25-34 years														
age 35-44 years	-0.0047	-0.0237***	*0.0001****	0.0114	-0.0029	-0.0085	*0.6666*	0.0261***	-0.0291***	0.0030	*0.0073****	*0.0885*	*0.0207**	*0.1747*
	(0.0024)	(0.0030)		(0.0089)	(0.0095)	(0.0058)		(0.0037)	(0.0068)	(0.0057)				
age 45-55 years	-0.0283***	-0.0496***	*0.0081****	0.0422***	-0.0343***	-0.0079	*0.0262**	0.0508***	-0.0468***	-0.0040	*0.0254**	*0.3468*	*0.3349*	*0.7110*
	(0.0045)	(0.0058)		(0.0094)	(0.0071)	(0.0080)		(0.0074)	(0.0116)	(0.0088)				
Cohort specific indicators: reference cohort 1990s														
2000s cohort	-0.0092*	0.0130*	*0.0007****	0.0248***	-0.0147	-0.0102	*0.7775*	0.0052	-0.0517***	0.0466***	*0.0000****	*0.0257**	*0.0000****	*0.0000****
	(0.0037)	(0.0041)		(0.0071)	(0.0102)	(0.0070)		(0.0057)	(0.0067)	(0.0058)				
2010s cohort	-0.0077	0.0121***	*0.0008****	0.0005	-0.0027	0.0022	*0.6658*	-0.0079*	-0.0717***	0.0796***	*0.0000****	*0.1051*	*0.0000****	*0.0000****
	(0.0040)	(0.0031)		(0.0051)	(0.0064)	(0.0060)		(0.0033)	(0.0027)	(0.0052)				
Average wage	0.0021***	0.0021	*0.9919*	-0.0040***	0.0072***	-0.0031***	*0.0000****	-0.0050***	0.0070***	-0.0020	*0.0034****	*0.6449*	*0.3367*	*0.4860*
	(0.0006)	(0.0014)		(0.0015)	(0.0016)	(0.0011)		(0.0019)	(0.0020)	(0.0015)				
Married (indicator for individual)	0.0513***	0.0094	*0.0000****	-0.0706***	0.0831***	-0.0125	*0.0000****	-0.0310***	0.0507***	-0.0197***	*0.0000****	*0.0000****	*0.4120*	*0.0000****
	(0.0034)	(0.0062)		(0.0041)	(0.0075)	(0.0076)		(0.0081)	(0.0097)	(0.0033)				
Child under five (indicator for individual)	0.0004	-0.0836	*0.0365**	-0.0018	0.0107	-0.0089	*0.1853*	0.0823*	-0.0169	-0.0654*	*0.5968*	*0.0094****	*0.9866*	*0.0861*
	(0.0010)	(0.0381)		(0.0024)	(0.0080)	(0.0070)		(0.0338)	(0.0606)	(0.0333)				
Childcare costs (average for women with children under 5)		-0.0130*						0.0107***	-0.0116	0.0010	*0.4145*			
		(0.0054)						(0.0037)	(0.0094)	(0.0061)				
Child benefits (average for women with children under 5)		-0.0013						0.0009	-0.0020	0.0011	*0.1750*			
		(0.0009)						(0.0009)	(0.0015)	(0.0009)				
Constant	0.8939***	0.8796***												
	(0.0103)	(0.0210)												
Observations	653,287	723,508		653,287	653,287	653,287		723,508	723,508	723,508				
	0.0138	0.0302			0.0157				0.0175					

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table presents results from OLS regressions of male and female labour force participation, as well as average marginal effects from a multinomial logistic analysis of selection into flexible or inflexible occupations (relative to the base category of home production). Included in parentheses are the OLS standard errors clustered at age group, sex, and year, and the standard errors for the marginal effects are calculated using the delta method using Stata's margins command. The regressions include controls for age- and cohort-specific dummy variables that influence participation in the labour market or in the occupations (relative to the omitted categories). The average wage is the average wage for a given age group and sex in a year. In contrast, the average wage, flexible, and average wage, inflexible refer to the average wages in flexible and inflexible occupations, respectively, for a given age group and sex in a year. Married and children under five are included as indicator variables at the individual level. Childcare costs and child benefits are included as averages for women with children under five, for a given age group and year. Reported p-values are from tests of equality between the respective coefficients.