Essays in Applied Labour Economics

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Abstract

This dissertation comprises three chapters in applied labour economics. The first chapter studies the extent to which occupation flexibility explains the evolution of the UK graduate gender wage gap. It documents that the share of graduate women working in flexible occupations increased both over the life cycle and over time, whereas men increased work in inflexible occupations at older ages. The wage penalty associated with flexibility increased over time and over the life cycle. The graduate gender wage gap is small at labour market entry and widens over the life cycle. Quantile decomposition analysis shows that sorting into flexible occupations explained between 15% to two-thirds of the life cycle increase in the gender wage gap. The reduction in the gap would have been up to 150% larger across cohorts if sorting into flexible occupations had not increased over time. The second chapter estimates an equilibrium model to investigate how changes in labour demand and supply explained patterns in flexibility and the gender wage gap. Higher relative demand for male labour at older ages, and in inflexible occupations, largely explained the life cycle increases in the gender wage gap, whereas women's higher preferences for working in flexible occupations drove the increases in sorting into flexible occupations over time. The third chapter uses a difference-in-differences strategy to evaluate the effect of declines in child malaria mortality on fertility and female labour force participation in Tanzania. Exposure to the decline in child mortality led to increases in extensive margin fertility for women aged 15–25 in areas where malaria was not endemic, in line with reductions in malaria risk during first pregnancy, especially among adults with low levels of acquired immunity. Labour force participation fell for mothers aged 26–40, particularly those with children under five in the household.

Introduction

This dissertation comprises three chapters in applied labour economics. Specifically, the three chapters are all concerned to different extents with the nature of the relationship between fertility behaviour and gendered labour market choices, with Chapters 1 and 2 looking at graduates in the UK and Chapter 3 using a development economics lens to look at women's fertility and labour market decisions in Tanzania. First, Chapter 1 studies the extent to which sorting into flexible occupations explained the change in the UK graduate gender wage gap across the distribution over the life cycle and over time. Second, Chapter 2 examines the roles of labour supply and demand in explaining this sorting into occupation by flexibility and its evolution over time. Finally, Chapter 3 investigates the effect of an exogenous decline in child malaria mortality on women's fertility and labour force participation in Tanzania.

The first chapter summarises stylised facts related to gender pay inequality and occupation flexibility in the UK and uses quantile decomposition methods to understand how changes in sorting behaviour contributed to the evolution of the wage gap over the life cycle and over time. There is a large literature on the gender pay gap in developed countries (see Blau and Kahn (2017) for a recent review) with more recent research tying this to the gender divide at the top of the income distribution (Atkinson et al., 2018; Fortin et al., 2017; Guvenen et al., 2014). The first stylised fact states that while the graduate gender pay gap is small close to labour market entry, it widens over the life cycle as women's earnings growth stagnate after childbirth, in line with existing research (Adda et al., 2017; Costa Dias et al., 2018; Cortés and Pan, 2020), but also adds to this research in finding that there has been little change over time in the magnitude of the gender wage gap over the life cycle (Kleven et al., 2019b). Furthermore, women's under-representation at the top of the male earnings distribution was worse across occupations than within occupations, suggesting an important role for occupational sorting in explaining gender inequality in top earnings. Research on the gender differences of the drivers of occupational sorting has previously considered a variety of factors including occupation-level differences in social and cognitive skills requirements and degree of competitiveness (Buser et al., 2014; Black and Spitz-Oener, 2010; Deming, 2017; Cortes et al., 2018), as well as working long hours and part-time work (Wasserman, 2019; Cortés and Pan, 2016; Denning et al., 2019; Manning and Petrongolo, 2008).

This chapter bridges strands of research on the motherhood penalty and occupational drivers of the gender wage gap by studying the evolution of the distribution of the graduate gender wage gap over the life cycle and over time in the UK, and how it relates to gender differences in sorting into flexible occupations. Following Goldin (2014), and differing from most literature that has related flexible working to the gender wage gap, flexibility is defined in this thesis as an occupation characteristic that allows workers to choose their hours and location of work without being penalised. Occupation flexibility defined in this way is especially important for gender differences in labour market outcomes as women (especially graduate women) tend to place a higher value on being able to balance work with childcare responsibilities (Guryan et al., 2008). Graduate women increasingly worked in flexible occupations over the life cycle and across successive cohorts over time, whereas graduate men moved out of flexible occupations and did not change their participation patterns over time. The final stylised fact documented in this chapter is that there is a significant wage penalty arising from working in flexible occupations, conditional on education and age, for both graduate men and women (but not for non-graduates). Putting these stylised facts together raises the question of the extent to which gender differences in working in flexible occupations contributed to the evolution of the graduate gender wage gap in the UK. Using quantile decomposition methods to answer this question, results show that between a third of the life cycle change in the wage gap at the bottom of the distribution to 13% of the gap at the 90th percentile can be explained by gender differences in sorting behaviour between ages 25 and 52. Similarly, the reductions in the gender wage gap over time for graduates in any given age group would have been larger had it not been for participation differences in flexible occupations. For instance, the wage gap for graduates aged 25-34 would have reduced by between one and a half times as much more to 75% more over two decades were it not for gender differences in sorting behaviour.

Chapter 1 considers how gender differences in the share of men and women working in flexible occupations matter for the gender wage gap without considering whether these arise due to differences in labour demand or labour supply between men and women. The second chapter, co-authored with my supervisor, Sonia Bhalotra, and Manuel Fernández, addresses this question using a model where individuals in the model are differentiated into types by sex, age, and cohort over time, with each type having different labour market preferences and outcomes. Labour demand is modelled using a nested constant elasticity of substitution production function through which labour of different types are imperfectly substituted between flexible or inflexible occupations to produce output each year. Workers of each labour type observe type-specific equilibrium wages in each year and choose either labour supply in flexible or inflexible occupations or to be in home production. Graduate men and women make these labour supply decisions in a random utility framework that allows preferences for working in occupations to vary over the life cycle, over time, in response to life events such as marriage and fertility, as well as in response to the levels of childcare costs and child-related policy benefits. Model parameters are estimated using GMM estimation off the variation in the wage structure and employment patterns outlined above in the stylised facts related to the gender wage gap and flexibility.

Results show that the increase in the gender wage gap over the life cycle was primarily driven by increased labour demand over the life cycle for men, particularly in inflexible occupations and especially pronounced till about age 44, increasing their wage premium from working in such occupations at older ages. This result aligns with literature that has found an 'age twist' in firm's demand for men versus women at older ages, as well as with widespread evidence on the glass ceiling that prevents women from accessing top earning jobs (Helleseter et al., 2020; Bertrand, 2018). This result could also arise if employers engage in taste-based or statistical discrimination due to differences in preferences or expectations about productivity for men and women (Cortés and Pan, 2020; Stillman and Fabling, 2017). The results also show that more recent cohorts of women had higher preferences for working in flexible occupations, and this largely drove the increase in women's participation in flexible occupations over time (at any given age), and contributed to increasing the flexibility wage penalty and the gender wage gap over time. These increases in women's preferences for flexibility may have been driven by unexpected increases in the cost of motherhood as parental time spent with children have been documented to have risen especially for highly educated women in the US and UK (Guryan et al., 2008; Kuziemko et al., 2018; Reland, 2017a; Altintas, 2016). These increases in parental time spent with children have coincided with increased competition for university places, suggesting that the value of human capital investment in children has risen prompting more intensive styles of parenting (Chiappori et al., 2017; Lundberg and Pollak, 2014; Borra and Sevilla, 2019; Doepke and Zilibotti, 2017). Marriage was associated with women being less likely to work, so that reductions in marriage rates over the period of analysis led to increases in women's labour supply. On the other hand, men were less likely to work in flexible occupations and more likely to work in inflexible occupations after marriage. Results also show that women are less likely to work, being more likely to exit flexible occupations than inflexible occupations after becoming mothers, in line with evidence that selection into occupations arises even before fertility (as suggested by Adda et al. (2017)). Fatherhood, on the other hand, makes men more likely to work, in line with previous evidence (Lundberg and Rose, 2002), especially in inflexible occupations, also in line with overworking increasing in prevalence among older men (as opposed to younger men) in recent years (Kuhn and Lozano, 2008).

Chapter 3 considers the relationship between fertility and women's labour market outcomes through a different perspective by examining responses to changes in child mortality for a developing country context, in Tanzania. There is a long-running literature investigating the nature of the causal link between child mortality and fertility, particularly with respect to the fertility transition in the context of low levels of economic development (Galor and Weil, 2000; Galor, 2012; Doepke, 2005; McCord et al., 2017). This chapter follows on from Aaronson et al. (2014) and Bhalotra et al. (2018) who situate this question in the context of Becker and Lewis's (1973) seminal theory of the quality-quantity trade-off in fertility, also considering women's labour market responses. Aaronson et al. (2014) found that reductions in cost of child quality increased extensive margin fertility and reduced intensive margin fertility whereas Bhalotra et al. (2018) additionally consider fertility timing and find a decline in both extensive and intensive margin fertility as women delayed fertility and increased labour force participation in response to a fall in child mortality. However, both Aaronson et al. (2014) and Bhalotra et al. (2018) analyse this question for mid-nineteenth century America, with limited existing research on how these responses may vary in settings with high mortality rates, high cultural preferences for fertility and low returns to education.

This chapter exploits the quasi-experimental decline in malaria mortality rates among children under five in Tanzania resulting from national malaria control interventions to investigate the effects on fertility and women's labour force participation. Results show that fertility overall did not change in response to the decline in child malaria mortality, but that labour force participation fell for women with children, implying that increased child survival imposed additional opportunity costs on women's labour time. Separate results by women's age finds that there was an increase in extensive margin fertility for women aged 15–25, consistent with first-time mothers being more vulnerable to malaria resulting in adverse birth outcomes. This increase was also driven by women of this age group in areas where malaria was not endemic, so that some of this increase would have been arisen mechanically as the risk of malaria during pregnancy (which could lead to adverse obstetric and birth outcomes) fell for mothers in this area with low levels of acquired immunity. On the other hand, reduced malaria mortality led to reductions in higher order fertility also among young women aged 15–25, in endemic areas with high levels of malaria prevalence. This suggests that the reduction in malaria mortality rates led to a reduction in the need for child 'hoarding' or precautionary childbearing behaviour, especially in areas where such malaria mortality rates among children would have been the highest prior to the interventions. Results also show that the decline in under five malaria mortality reduced women's labour force participation, driven by women aged 26–40 with children, particularly those with children under five in the household. These reductions in labour force participation were driven by women in non-polygamous households, who would have found it harder to access informal sources of childcare (Angrist and Evans, 1998; Bhalotra and Clarke, 2019; Cudeville et al., 2017), and by women in areas with low levels of labour force participation at baseline, suggesting the importance of social norms in determining women's work.

Chapter 1

Decomposition of Trends in Occupation Flexibility and the Gender Wage Gap Across The Distribution in the UK

Abstract

This chapter investigates how gender differences in sorting into occupations based on flexibility affect changes in the gender wage gap over the life cycle and over time in the UK. Although the average gender wage gap has declined by about 10% on average between 1990 and 2015, women remain underrepresented in the the upper part of the full-time male wage distribution (as they are 7% less likely than men to earn more than the earnings of the 80th percentile man). When considering only graduates, women's under-representation at the 80th percentile is at 11.2%, though this reduces to 4.9% when comparing women and men within the same occupation, indicating that sorting across occupations matters for gender pay inequality. Although the graduate gender wage gap is small at age of labour market entry, it widens over the life cycle, and the analysis considers how changes in patterns of working in flexible occupations over the life cycle affects this. The share of graduate women working in flexible occupations increased both over the life cycle and over time, whereas men have tended to increasingly work in inflexible occupations as they got older, but this has not changed over time. Furthermore, working in flexible occupations imposes a wage penalty (for both men and women) and this penalty has increased over time (and increases with age). Decomposition analysis of the graduate gender wage gap over the life cycle as well as over time to explain these descriptive trends shows that the proportion of the total increase in the graduate gender wage gap over the life cycle explained by gender differences in sorting into flexible occupations varies from a third at the 10th percentile to 13% at the 90th percentile, and 40% at the median. Controlling for gender differences in sorting by other occupation traits such as high levels of social skills and abstract task intensity did not substantially affect the nature of these results. In the absence of differences in occupation flexibility between the most recent and older cohorts of 25-34 year

olds the fall in the gender wage gap would have been much higher - 3.2 log points instead of 1.1 log points at the 20th percentile and 4.3 log points instead of reducing by only 2.6 log points at the 90th percentile. Similar patterns hold comparing cohorts of the 35-44 and 45-55 age groups.

1.1 Introduction

This chapter investigates whether gender differences in working in flexible occupations explain changes in the UK graduate gender wage gap over (a) the life cycle and (b) over time. Flexibility is defined as an occupational characteristic that varies over occupations in how they are structured differently to allow workers to choose their time and place of work. Gender differences in sorting into occupations are considered as a function of this occupational characteristic. Allowing occupation sorting by flexibility to vary over the life cycle and across time, this chapter uses decomposition analyses to understand how this affects the evolution of the gender wage gap over the life cycle and across cohorts in time.

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), which is of concern to policymakers and has received much press attention as it raises issues of gender inequality in the workplace. Figure 1.1 shows that though the gender wage gap in the UK has fallen since the 1970s, reductions have been slowest at the top of the distribution, where wage convergence has stalled since the 1990s.[1] This chapter documents how women's under-representation in the male earnings distribution has changed from 1993 to 2017. Although there was male and female wage convergence in this period, it was slower for graduates and especially for the highest paid workers. Research from the US has also found that despite improvements to women's earnings overall, at the top of the distribution women lag behind their male counterparts and progress has been slow in recent decades (Guvenen et al., 2014; Bailey and DiPrete, 2016; Bertrand, 2018).

[1]Family Expenditure Survey data is used to show the long-term trends in the gender wage gap across the distribution in the UK.

Results show that there was greater convergence of male and female wages within occupations than across occupations, suggesting that occupational sorting is a key driver of the gender wage gap. This supports research that finds that differences in occupation and industry account for up to a third of the gender wage gap as previously important factors such as human capital differences between men and women have become less important in explaining the persistence of the gender wage gap (Blau and Kahn, 2017). A fairly large recent literature has documented various dimensions along which occupational sorting drives women into occupations with lower returns, such as differences between occupations in competitiveness (Buser et al., 2014), family friendliness (Pertold-Gebicka et al., 2016; Felfe, 2012), existing gender composition (Pan, 2015; Goldin, 2013; Goldin and Katz, 2011), non-routine tasks or skills (Borghans et al., 2014; Black and Spitz-Oener, 2010) and especially social skills (Deming, 2017; Cortes et al., 2018). Flexibility is considered to be especially important for gendered differences in outcomes as women tend to place a higher premium on being able to work flexibly (Wiswall and Zafar, 2018; Mas and Pallais, 2017; He et al., 2019) so as to be able to manage the greater burden of household responsibilities they bear alongside their careers (Bianchi et al., 2000; Ferrant et al., 2014).

This chapter follows Goldin (2014) in defining flexibility as an occupational characteristic whereby workers are more able to choose their hours and location of work in occupations that are categorised as more flexible. Goldin's definition of flexibility incorporates a variety of temporal factors including the 'number of hours worked, precise times, predictability, and ability to schedule [workers'] own hours' in determining a non-linear relationship between hours worked and pay. Goldin's 2014 article illustrates the differences in occupation flexibility for high paying occupations in the US context, with the measure of flexibility taken from the O*NET Survey of occupation characteristics in 2000. Research by Bowlus and Grogany (2009) suggests that there are substantial differences in women's labour market attachment and prevalence of part-time work across contexts, suggesting that longer maternity leave periods in the UK may encourage stronger labour force attachment for women working full-time in the UK compared to women in the US. Though the US and UK both have steep penalties for part-time work, part-time work is more prevalent in the UK than in the US (McGinnity and McManus, 2007). Moe than one in four workers worked part-time in the UK compared to fewer than one in five in the US in 2005 with employed mothers in particular more than twice as likely to work part-time in the UK than the US (Tomlinson, 2007). While this may result from more regulatory incentives for employers to provide part-time jobs in the UK than in the US, this also has implications for the definitions of flexibility used here. Part-time work in the UK is highly segregated, with employed mothers likely to concentrate in low skilled and low-paid occupations resulting in the under-utilisation of women's skills and their occupational downgrading (Tomlinson et al., 2005). This aligns with the hypothesis in this paper that women's career and pay progression over the life cycle is constrained by the degree to which their occupations are flexible. Part-time work in the UK is less prevalent among graduates than among non-graduates, with 45% of female non-graduates working part-time in 2017 compared to 32% of female graduates (Department for Education, 2021). While this occupational segregation in part-time work may be less prevalent in the US, the minimal level of welfare support available is especially financially damaging for lone mothers who are therefore more likely to be employed full-time, working more hours than they prefer (Tomlinson, 2007). This paper shows that despite the differing levels of part-time work, the constraints placed by occupation flexibility on pay progression operate more strongly in the UK than in the US, with Fagan (2001) arguing that women in the UK have to choose between long full-time hours versus short part-time hours, so that the prevalence of part-time work explains a substantial proportion of the gender pay gap. Costa Dias et al. (2021) states that while the US gender earnings gap is similar to the UK, the lower prevalence of women working part-time suggests that participation and differences in wages play a more important role.

Flexibility is thus considered an occupational trait that is affected by both labour demand, which may vary with technological change, as well as labour supply, which is affected by workers' preferences for flexibility and their willingness to pay for it (both of which are expected to vary by gender). For instance, Goldin and Katz (2011) found that many occupations have increased in workplace flexibility partly due to exogenous factors such as increases in the scale of operations, but also partly due to increased shares of women working in them. Furthermore, changes in attitudes towards work have meant that recent cohorts of workers have demanded flexibility, willing to accept pay cuts to be able to work flexibly (Mas and Pallais, 2017; Wiswall and Zafar, 2018). The measure on flexibility used in this paper is static, and therefore does not allow for a comparison of the changes in flexibility levels in different occupations over time. Therefore, this analysis is not able to speak to whether any of the observed changes in working in flexible occupations, particularly across cohorts, may result from changes in the nature of the occupations in terms of flexibility or other characteristics. This may be especially relevant as technological developments have made it so that work in white-collar professions in particular can be conducted from home. However, evidence from the Covid-19 pandemic suggests that despite the higher prevalence of working from home, there may still exist a 'flexibility stigma' as working cultures in the UK value long working hours as signs of performance and motivation, suggesting that despite changes in occupation flexibility, 'presenteeism' culture may still operate gendered constraints on occupational choice and career progression. The static definition of flexibility used here also therefore does not capture whether the degree of flexibility in these occupations has changed over time, as well as whether preferences for the nature of flexibility have changed over time. A further limitation arises from the fact that the analysis compares changes in the gender wage gap for graduates over a period where educational attainment had expanded rapidly for both men and women in the UK. The increase in education levels was faster for women, who overtook men in terms of educational attainment by the late 2000s and are more likely to have a college degree than men. This has therefore also contributed to reducing the gender wage gap as graduates earn more than non-graduates on average (Costa Dias et al., 2021). Therefore some of the changes in working in flexible occupations for cohorts over the analysis period seen in this chapter may be explained by changes in the composition of graduates. It may be that graduates in earlier cohorts were concentrated among those who had higher levels of labour force attachment whereas as college degrees became more prevalent in the population, more recent cohorts of graduate women may be more likely to have weaker preferences for working long and inflexible hours.

In this analysis, flexibility is treated as a characteristic intrinsic to occupations, such that market forces of labour demand and supply for flexibility determine gender differences in employment and wages in occupations based partly on how flexible they are. This differs from much of the existing literature that considers various channels through which flexibility may operate as a driver of sorting and gender differences in wages, such as through overwork or working long hours (Felfe, 2012; Wasserman, 2019; Cortés and Pan, 2016; Cortes and Pan, 2017; Denning et al., 2019), part-time work (Fernández-Kranz and Rodríguez-Planas, 2011; Manning and Petrongolo, 2008), or through selecting job amenities enabling flexible working such as being able to work from home or cut one's hours in occupation (where these amenities are not characteristic to the occupation) (Goldin and Katz, 2011; Goldin, 2014; Herr and Wolfram, 2012), and working in the public sector (Pertold-Gebicka et al., 2016). Manning and Petrongolo (2008) find that the majority of the part-time pay penalty in the UK is explained by these workers segregating into low paying occupations, which aligns with the analysis in this paper that finds that a substantial portion of the increase in the gender gap over time occurs due to sorting across occupations (as determined by flexibility). Denning et al. (2019) found for the US that women sorting into occupations with lower average hours explained a large and increasing share of the gender wage gap in the US, closely related to the findings in this chapter. This chapter makes a contribution to this literature that relates occupational characteristics to gender differences in labour market outcomes by characterising occupation flexibility and demonstrating that graduates are under-represented in the most flexible occupations, which is in line with previous evidence that flexibility may be more binding as a constraint for highly educated women over their life cycle, as they tend to spend more time at home with children than low-skilled women (Guryan et al., 2008). This analysis concentrates on the graduate gender wage gap, and finds that graduate women tend to increase their participation in flexible occupations over the life cycle, as well as over time, whereas graduate men tend to shift out of flexible occupations as they age, with no significant patterns over time.

Previous research has found that the earnings premium for working long hours has been rising consistently since the 1980s, with the largest increases taking place for college-educated workers (Kuhn and Lozano, 2008; Cortés and Pan, 2018; Bertrand, 2018, 2020). In line with this, this chapter documents that there is a wage penalty associated with working in flexible occupations for both graduate men and women, but largest for graduate women. This penalty has increased over time and increases over the life cycle for both men and women, with changes over time and ages slightly more pronounced for women than for men. For instance, a 40 year old graduate woman born in 1975-1979 faced a flexibility wage penalty close to 30% higher than a similarly aged graduate woman born in 1955-59, indicating changes to the flexibility wage penalty over time. On the other hand, compared to a 25 year old graduate woman, a 40 year old graduate woman from the 1975-79 cohort faced a flexibility wage penalty that was 40% larger, which indicates changes to the flexibility wage penalty over ages for the same cohort of individuals. Since jobs that are more flexible are on average worse paid, women's higher demand for flexibility would prevent their wages from fully converging to those of men. This chapter adds on to recent experimental evidence that shows that women have higher willingness to pay for flexibility, as they are more likely to apply for flexible jobs conditional on the offered salary, more willing to accept lower reservation wages in exchange for flexibility (He et al., 2019; Wiswall and Zafar, 2018; Mas and Pallais, 2017), and especially valued avoiding irregular work schedules if they had young children (Mas and Pallais, 2017).

This chapter also contributes to analysis of other occupational traits that the literature has considered in explaining trends in the gender wage gap and employment, especially at the top of the distribution, such as social skills and abstract skills in the workplace. For instance, Deming (2017) and Cortes et al. (2018) find that occupations that demand greater social skills are increasing in importance, slowing pay growth in highly paid occupations. This chapter compares the two measures in terms of changes in employment over the life cycle and over time, and whether the observed increases in working in flexible occupations are in fact captured by increases in social skills (which have also been called people skills or non-cognitive skills (Borghans et al., 2014)). However, evidence suggests that the life-cycle and cohort patterns related to occupation flexibility are not completely explained by social or abstract skills, which are both negatively correlated with occupation flexibility.

Much of the literature linking flexibility to the evolution of the gender wage gap over the life cycle is concerned with the child penalty, as it has been documented that the gender wage gap increases over the life cycle, and especially opens up after motherhood (Kleven et al., 2019a; Costa Dias et al., 2018). Bertrand et al. (2010) found that though earnings at the start of careers were nearly identical for male and female MBA graduates, the gender earnings gap reached about 60 log points ten years after graduation, with a large share of this difference accounted for by gender differences in career interruptions and weekly hours, as well as differences in training prior to the MBA. As traditional factors such as discrimination and gender differences in workforce composition faded in importance, the fraction of gender earnings inequality caused by child penalties in Denmark increased in importance over time - from explaining about 40% in 1980 to about 80% in 2013 (Kleven et al., 2019b). Evidence from Germany finds that having children imposes costs on women's careers throughout the life cycle because of skill deterioration, lost earnings opportunities, and selection into (lower-paying) child-friendly work and occupations, with fertility accounting for about a third of the gender pay gap in Germany (Adda et al., 2017).

Existing research on the gender wage gap has shown that the gender wage gap has remained especially persistent at the top of the distribution. This paper tries to bridge the work on the child penalty with the literature on women's under-representation at the top of the earnings distribution to understand the extent to which working in flexible occupations mattered differently across the distribution for changes in the gender wage gap. This chapter uses quantile decomposition methods to understand whether differences in sorting by flexibility or differences in pay by flexibility can explain the evolution of the gender wage gap over the life cycle across the distribution. Findings suggest that between 13% of the increase at the top of the distribution to a third of the increase in the 20th percentile of the gender wage gap over the life cycle is explained by women sorting into flexible occupations as they grow older, in contrast to men moving out of flexible occupations at older ages.[2] The share working in flexible occupations explains a significant proportion of the gender wage gap over the life cycle, across all points considered in the distribution, in contrast to the insignificant shares working in occupations categorised exclusively by high levels of social skills and abstract thinking requirements. This is novel evidence as it explicitly links work in flexible occupations to the evolution of the gender wage gap over the life cycle.

The reductions in the gender wage gap that occurred for cohorts of individuals in the same age group would have been substantially larger in the absence of changes in working in flexible occupations, and returns in these occupations. For instance, in the absence of increased working in flexible occupations by younger cohorts of 25-34 year olds in 1985-89, the fall in the wage gap for them compared to 25-34 year olds born in 1965-69 would have been larger at about 4.3 log points compared to the actual reduction of 2.4 log points, had it not been for the increased sorting into flexible occupations over time. Similarly, the reduction in the wage gap at the 20th percentile would have more than doubled from 1.1 log points to 3.2 log points had sorting into flexible occupations not increased over time. These patterns

[2] A more general decomposition analysis of the gender pay gap at the mean shows that up to a quarter of the life cycle increase in the graduate gender pay gap can be explained by gender differences in sorting into flexible occupations.

held similarly comparing cohorts of the older age groups, and suggested that the increase in women in particular working in flexible occupations over time contributed to ameliorating the reduction in the gender wage gap across the distribution over time. This pattern also suggests that the changes to occupational sorting due to flexibility were more important in explaining changes to the gender wage gap at the top of the distribution over time rather than over the life cycle, as occupational choice decisions within the life cycle of cohorts may have already factored in expectations of needs for flexibility at the start of graduates' careers (Adda et al., 2017; Machin and Puhani, 2003; Chevalier, 2007).

The next section describes the data used in analysis, especially focussing on the measure of occupation flexibility and Section 1.3 continues to describe the data used in analysis. Section 1.4 presents stylised facts related to the gender wage gap and flexibility. Section 1.5 describes the decomposition methodology used to analyse how flexibility relates to the evolution of the gender wage gap in the UK, and Section 1.6 presents results from the decomposition analysis. Section 1.7 places this analysis and results in the economics literature related to the gender pay gap and flexibility, and finally, Section 1.8 concludes.

1.2 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. Autor et al. (2003) and related research sought to understand how rapid computerisation and the consequent decline of routine tasks as part of human work impacted the wage structure, by changing the demand and supply of labour across occupations (Autor and Dorn, 2013; Acemoglu and Autor, 2011; Acemoglu and Restrep, 2019; Goos and Manning, 2007; Autor et al., 2008; Lemieux, 2006). An associated 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 chapter follows Goldin (2014)'s definition of flexibility as an occupation characteristic. 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 by the occupations they work in because of the nature of the work involved.

Defining flexibility as an occupation characteristic categorises occupations by whether the nature of work involved permits greater freedom for workers to schedule where and when their work takes place. For example, occupations requiring a high degree of interpersonal contact through meetings (such as health professionals) are less flexible than those that do not have this requirement. Our definition of occupation flexibility follows Goldin (2014), who uses 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 around to finish tasks for 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 that 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 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.

Previous research that has considered labour market impacts of the evolution of occupational characteristics has found that aspects that lead to relationship building (social skills) with stakeholders and that require 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. Management of interpersonal relationships and higher levels of in-person contact (which are related to, but not the same as social skills) in occupations are 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 of 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 considers the frequency of interpersonal interactions and the degree to which work is structured, as well as time pressure, as determinants of flexibility in an occupation.

Table 1.1 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 would be health professionals, who are the least flexible occupation 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 very flexible with predictable hours and low 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,[3] 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

[3]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.

of the least flexible occupations.

The panels in Table 1.1 show that lower flexibility scores are associated with managerial and professional roles that potentially involved higher responsibility, whereas more flexible occupations either tend to be junior or vocational roles that may not be quite as demanding in terms of work structure or 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 measure, indicating that these occupations tend to be inflexible in multiple dimensions. The most flexible occupations tend to be more junior roles (e.g. social welfare associate professionals included here compared to public service professionals being one of the least flexible), and also tend to be more gender segregated than less flexible occupations. The least flexible occupations have highly varying scores for the five component measures of flexibility - for instance, healthcare and related personal services occupations score highly on having contact with others and maintaining interpersonal relationships, but have very low scores on the three other 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 continued gender segregation in occupations is that there is a potential tipping point for female share of occupation employment beyond which men leave the occupation. This may be because the gender composition of an occupation may convey a signal of occupational prestige; partly because of male preferences regarding workplace composition as suggested by the pollution theory of discrimination (Goldin, 2013). Table 1.1 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 to not require inflexible working. Individuals who start off working in these occupations tend to progress into managerial roles later into their careers, which would also involve more inflexible working. Flexibility is also not explained by the share working part-time in occupations, which varies substantially across both flexible and less flexible occupations, though more of the flexible occupations have more than half of their workers working part-time.

Individuals make occupational choices based on their preferences related to managing their career and family, choosing among occupations that vary along different dimensions. While flexibility is one of the occupation traits that has been considered in the literature, other traits such as social skills and cognitive ability have also received attention, and it is important to consider how these traits are related to occupation flexibility. Jobs requiring high levels of social skills have become increasingly important (Deming, 2017; Cortes et al., 2018). When documenting the descriptive trends relating changes in gender wage inequality to occupation flexibility the following analysis also considers whether these trends can instead be explained by changes to social skills or abstract thinking requirements in occupations.

Table 1.2 describes the minor occupation groups that have the highest and lowest social skills intensity scores for graduates between 2001 and 2010. Occupations with the highest social skills scores tend to be highly paid occupations that are also less likely to be flexible, such as professional and managerial occupations, as seen in Figure 1.2 which shows that flexibility and social skills are negatively correlated. On the other hand, graduates tend to be underrepresented in occupations that score low on social skills, and when restricted to occupations that employ more than 0.4% of all graduates in this period, the occupations with the lowest social skills include elementary manufacturing and administrative occupations. Occupations such as secretarial and administrative occupations score low on social skills because even though they seem to involve substantial amounts of interpersonal interactions these may not require social skills such as persuasion and negotiation.

Table 1.3 describes the minor occupation groups that have the highest and lowest abstract task intensity scores for graduates between 2001 and 2010. Occupations with the highest abstract scores tend to be highly paid occupations with low flexibility scores, such as science and business professionals and managerial occupations. Abstract task intensity in occupations is also negatively correlated with the occupation flexibility score, as seen in Figure 1.3. These patterns are similar to those observed for social skills, as graduates also tend to be underrepresented in the occupations with the lowest abstract task intensity scores, and when more than 0.4% of the graduate sample is employed in these occupations, they tend to be highly flexible occupations, such as elementary personal services, construction, and administrative occupations, which are more routine and manual occupations.

1.3 Data

Data for this analysis is taken from the UK Quarterly Labour Force Survey from summer 1993 to winter 2017, consisting of the prime-aged graduate population (aged 25-55y). Pay was measured as log real hourly earnings (base year = 2015) in the main job, trimmed to exclude hourly earnings below £0.10.[4] The hourly earnings used in analysis exclude self-employment income, as it is typically difficult to separate out labour income for the self-employed. The graduate sample used in the decomposition analysis consists of 1,500,047 observations over 25 years, with 72.9% of this sample working full-time. The Quarterly Labour Force Survey (LFS) is a survey of households living at mostly private addresses in the UK, with a rotational sampling design, whereby households are retained in the sample for a total of five consecutive quarters. Since the LFS collects data on a sample of the population and some of the questions of interest in this analysis may be particularly affected by non-response bias due to differential non-response among sub-groups, the analysis uses person- and income- weights calculated by the ONS to calibrate the sample close to the UK population in each year. This is particularly relevant for the decomposition analysis and the calculation of the gender pay gap as income questions suffer higher non-response - 334,462 observations are included in the decomposition analysis. Further details on the LFS sampling design and weights are available in the LFS user guide provided by the Office for National Statistics (Office for National Statistics, 2021).

The measure of occupation flexibility used in analysis constructs occupation-level averages of five standardised job characteristics from the O*NET survey in the US (following Goldin (2014)), which are then matched to the Labour Force Survey data. The O*NET is a database listing detailed information about the characteristics

[4] 0.1% of observations were trimmed from the sample as a result of this.

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 likelihood tables provided by the ONS and crosswalks provided by the International Standard Classification of Occupations.[5] This definition of flexibility is tied to the rigidity of requirements related to structure and presence at the workplace, and as such, incorporates both place and time flexibility, as the ability to structure work schedules and determine place of work depends on how much the job requires workers to be present and work to set deadlines at specific locations.

The measure of social skills follows Deming (2017) and calculates an occupation's social skill intensity as an average of the items in the O*NET module on social skills: coordination, negotiation, persuasion, and social perceptiveness. The measure of abstract task intensity is derived from Autor and Dorn (2013)'s database of occupational classifications and task intensity.[6] Analysis uses both the continuous measures of the occupation traits as well as a binary measure for each occupational trait alternatively. The binary measure for occupation flexibility classifies occupations as flexible if they have a flexibility score higher than the median across all occupations, and likewise for social and abstract occupations.

Analysis in this chapter focuses on the sample of prime-aged graduates as it considers the lack of convergence in male and female wages at the top of the distribution. The flexibility characteristics used to calculate the flexibility score also may be more relevant for high skilled or high earning jobs which tend to be dominated by

[5]Full details of the calculation of the flexibility score are available in the Data Appendix A.

[6]The task intensity scores were matched to the UK data using crosswalks, analogously to the matching of O*NET measures for flexibility and social skills, as described in the Data Appendix A. The task intensity measures used in Autor and Dorn (2013) are available online mapped to US Standard Occupation Classification at www.ddorn.net/data.htm.

graduate workers. It has also been found in the literature that flexibility constraints may be more binding for graduate women who have been increasingly more likely to spend time with their children than less educated women (Guryan et al., 2008; Altintas, 2016). Table 1.4 shows that graduate women's labour force participation was fairly stable over the sample period considered, because of which changes in extensive margin participation are not of too much concern in this analysis. Both full-time and part-time workers are included in analysis, as flexibility is defined to be more a characteristic of the occupation regardless of the actual hours worked by employees. However, results are not sensitive to the removal of part-time workers from analysis.

1.4 Descriptive patterns

This section describes a series of trends related to how the gender wage gap and occupation flexibility develop over the life cycle for successive cohorts of UK graduates. Documenting and exploring trends in flexibility and the gender wage gap sets out a foundation for the remaining empirical analysis.

1. *For cohorts from 1945-49 to 1985-89, the graduate gender wage gap increased over the life cycle, from nearly zero close to labour market entry to about 20% of real hourly male earnings by age 50-55, remaining similar in magnitude across cohorts at any given age, shown in Figure 1.4. Women's under-representation in the male earnings distribution also fell between 1995 and 2015, though slower for graduates and for the highest paid workers. The convergence of male and female wages over time was faster within occupation than across occupations, indicating the importance of occupational sorting for the changes in the gender wage gap.*

Panel (a) of Figure 1.4 shows the difference between graduate male and female log hourly earnings for different cohorts between ages 25 and 55. Each cohort is represented by a line showing the gender wage gap for that cohort from ages 25 to 55 (or whenever observed). The oldest cohorts are plotted towards the right of the graph with cohorts decreasing in seniority moving from right to left. The full working life cycle from ages 25-55 is not available for all cohorts, due to the short time span of the LFS data. The gender gap in hourly earnings increases over the life cycle for all cohorts, with the magnitude somewhat similar across cohorts. Comparing individuals of similar ages, the gender wage gap has fallen in later cohorts compared to the earliest cohorts. Especially at the youngest ages (which are only observed for more recent cohorts), the graduate gender wage gap close to labour market entry at age 25 is fairly small at about 3-8 log points. However the gender wage gap increases sharply over the life cycle to become about 25 to 30 log points by age 50. This increase in the gender wage gap is especially steep at younger ages and plateaus after about age forty. This is consistent with other evidence from the UK that states that the gender wage gap (for individuals of all education levels) increases for the first twelve years after childbirth, after which it remains stable at around one third (Costa Dias et al., 2018; Kleven et al., 2018).

The increase in the gender wage gap over the life cycle can be examined in detail in Figure 1.4b, which plots the log hourly earnings of men and women for the cohort born in 1965-69 between ages 25 and 55. This cohort is observed in the data over most of their working life. Though the wages of graduate women and men in this cohort were similar at age 25, women's wages grew much slower than those of men until they levelled off in their late thirties, which corresponds to the timing when women potentially start to require more flexibility at work due to increased childcare responsibilities. Men's wages continued growing and only stabilised later into their careers at about age forty-five. Graduate men and women of this cohort therefore faced a stable and substantial wage gap of about 20 log points that did not widen any further after age forty-five. This pattern of women's wage growth being slower and stopping at an earlier stage in their career than that of men demonstrates how the gender wage gap increases over the life cycle.[7] These patterns suggest that life-cycle changes in women's working patterns, which could happen through reductions in labour force participation at both the extensive and intensive margins, and resulting loss of human capital, as well as post-motherhood changes in occupation (Adda et al., 2017; Costa Dias et al., 2016), are potential explanations for these patterns of relative female versus male wage growth over the life cycle.

Table 1.4 replicates Bertrand (2018)'s analysis of women's labour force participation and under-representation in the male earnings distribution, using UK LFS data from 1995 to 2015. Though women as a whole increased their labour force participation and full-time work substantially over this period (by 9.1 and 10.4 percentage points respectively), the corresponding increases for graduate women were much smaller (0.5 and 1.3 percentage points, respectively). This is despite graduate women having initially higher labour force attachment in terms of both labour force participation and full-time working and suggests that changes in extensive margin labour force participation are not driving the results related to women's increased participation in flexible occupations.

The earnings of women and men converged between 1995 and 2015, though there was variation in the degree of this convergence across the distribution and by education level. In 1995, women as a whole tended to be under-represented at the top of the full-time male earnings distribution – and this under-representation is of somewhat similar magnitude for full-time women, and when comparing graduate

[7] Appendix Figures B.1a and B.1b show the evolution of the gender wage gap across the life cycle plotted for full-time workers and look qualitatively similar.

women's earnings to graduate men's earnings. However, this under-representation at the top of the male earnings distribution reduced over time as the female earnings distribution shifted closer to the male earnings distribution by 2015 - as a whole and for the subgroup of graduates. For instance in 1995, 27% of women earned more than the median man, but by 2015, 36.7% of women earned more than the median full-time working man, an increase of 9.7 percentage points. This increase was smaller for the highest paid workers, as compared to 3.4% of women who earned more than the 90th percentile of full-time men in 1995, 4.5% of women did so by 2015, a 1.1 percentage point increase. The increases across the distribution were larger when restricting analysis to full-time workers, as there was a 13.3 percentage point increase in the share of full-time women earning more than the median full-time man between 1995 and 2015, and a 2.2 percentage point increase in the share of full-time women earning more than the 90th percentile of the full-time male earnings distribution over this same period. This reinforces that an important mechanism through which pay inequality operates is through differences in male and female hours worked, as women sacrifice higher pay for greater flexibility in hours.

Convergence of women's earnings to the male distribution was slower for graduates, especially at the top of the distribution. For example, 28.1% of graduate women earned more than the median full-time graduate man in 1995, and by 2015, this was 34.8% of graduate women, representing an increase of 6.7% percentage points. The share of (all) women earning more than the 80th and 90th percentiles of full-time graduate men increased only by 0.3 percentage points over the same 20 years. In comparison to this, though the increase in the share of female top earners was larger when comparing graduate women with graduate men, the magnitudes of the increases especially at the 80th and 90th percentiles were still fairly small. In 1995, only 6.2% and 2.5% of women earned more than the 80th and 90th percentiles of full-time graduate male earnings respectively. By 2015, these proportions had only risen slightly so that 8.8% and 3.6% of graduate full-time women earned more than the 80th and 90th percentiles of graduate full-time men – increases of 2.6 and 1.1 percentage points, respectively.

Comparing graduate men and women within the same occupation, levels of female under-representation in 1995 were similar to those for the whole distribution, as described above - 28% of full-time graduate women earned more than the median full-time graduate man within their occupation, and 7.3% of graduate full-time women earned more than the 80th percentile of graduate full-time men within their occupation. By 2015, 42.2% of full-time graduate women earned more than the median full-time graduate male within their occupation and 15.1% of full-time graduate women earned more than the 80th percentile of earnings of full-time graduate men within their occupation. This indicates that graduate women's earnings caught up to those of their male counterparts *within the same occupation* faster than they did to all graduate men, suggesting that there was greater wage convergence within occupations than across all occupations. This pattern implies that an important explanation for the gender wage gap is in occupational sorting, whereby graduate women and men select into different types of occupations, with women working in lower-paying occupations on average.

This can also be seen in Figure 1.5, which plots the change over time in the male to female log earnings ratio across and within occupations at the 10th, 20th, 50th, 80th, and 90th percentiles for all and graduate full-time employees.[8] Both panels (a) and (b) show that the gender wage gap across (and within) occupations is highest at the top of the distribution, and has also fallen the least towards the top of

[8]The across-occupation log earnings ratio at a given percentile is calculated using the distributions of log male and female graduate full-time earnings across all occupations. The within-occupation log earnings ratio is calculated at a given percentile by averaging across all occupations the ratio of log male and female graduate full-time earnings within occupations.

the distribution. Looking at all full-time employees in panel (a), the gender wage gap fell both across and within occupations at similar rates at the bottom of the distribution. The gender wage gap remained greater across occupations than within occupations, though the difference between the gender wage gap across and within occupations was largest at the 90th percentile. Notably, across all full-time employees, the reduction in the gender wage gap over time was much more muted across occupations compared to the reduction within occupations, especially at the 80th and 90th percentiles, which is consistent with the above mentioned pattern of occupational sorting driving the persistence of the gender wage gap. Looking closer at graduate full-time employees in panel (b), there were significant reductions in the gender wage gap within occupations over time across the distribution, with larger reductions at the top of the distribution. However, despite these gains in gender pay equality *within* occupations, the average graduate full-time gender wage gap across occupations did not fall by much across the distribution, again suggesting that women increasingly sorted over time into lower-paying occupations.

The patterns observed here relate very closely to what has been found for the US – IPUMS harmonised data is used to document this in Figure 1.6, which plots the gender wage gap in log real hourly earnings for US graduates over the life cycle for the cohorts born at the same time as for our UK analysis.[9] Panel (a) shows similar patterns in terms of increasing gender wage inequality over the life cycle for all cohorts, but little difference between cohorts in the magnitude of the wage gap. Panel (b) shows that the patterns of slower growth and earlier stagnation of wages (compared to men) observed for UK graduate women born between 1965-69

[9] IPUMS CPS is a dataset consisting of harmonised microdata from the monthly US labour force survey, the Current Population Survey (CPS). Data from 1990 to 2015 is used to mirror the analysis conducted for the QLFS in the UK for cohorts of prime-aged graduates. Details on the construction of the harmonised dataset can be found on the IPUMS CPS website: https://cps.ipums.org/cps/technical_documents.shtml.

can also be seen for their US counterparts. Since 1981, the share of females among top earners in the US income distribution has more than tripled, but despite these massive improvements in women's representation in the upper parts of the earnings distribution, in 2012, women comprised only 11% of the earnings of all individuals in the top 0.1 percent, and only 18% of the earnings of the top 1 percent (Guvenen et al., 2014). Furthermore, at the very top of the distribution, most of the increase in the female share of top earners happened in the 1980s and 1990s, with little progress in recent decades (Bailey and DiPrete, 2016; Bertrand, 2018). Blau and Kahn (2017) has also found that as human capital differences between men and women have shrunk over time, gender differences in occupations accounted for about a third of the US gender wage gap in 2010, and was the largest component explaining the gap.

2. *The share of women working in flexible occupations increased over the life cycle and across cohorts. On average over all cohorts, the share of women working in flexible occupations increased about 2 percentage points over the life cycle, and on average across all ages increased by about 8 percentage points over successive cohorts. On the other hand, men increasingly moved into non-flexible occupations at older ages, with an average increase of about 10 percentage points over the life cycle in each cohort, but did not change their participation in flexible occupations much over cohorts.*

Figure 1.7 plots the share of graduates working in flexible occupations (as opposed to non-flexible occupations) for cohorts of individuals born in five-yearly groups, over the life cycle. The graph shows that for every cohort, women tend to increase their participation in flexible occupations over the life cycle. Other than for the latest cohort (for whom data is noisier in the latest years of the sample because of the smaller sample size), any given cohort of women was more likely to be working in flexible occupations at older ages compared to the age at which they were first observed, after a small initial decrease until age thirty. There are no marked differences in this pattern by cohort. Women moving into flexible occupations as they get older, and particularly after the age of thirty, is consistent with women's additional childcare responsibilities that lead to their increased demand for flexibility upon childbirth (Bertrand et al., 2010; Costa Dias et al., 2016, 2018; Adda et al., 2017). Appendix Figure B.2 shows that the pattern persists even when excluding part-time workers, consistent with Bianchi et al. (2000) who found that even when employed full-time, women tended to shoulder a disproportionate share of responsibilities at home. The presence of overwork and inflexible working conditions in corporate and other more 'inflexible' occupations and sectors has been cited as a key reason for reducing the share of young married women in these occupations due to responsibilities at home (Goldin and Katz, 2011; Cortés and Pan, 2016).

The pattern for men is markedly different - men in any given cohort moved out of flexible occupations in the mid-career period though the flexible share of employment plateaus (and even increases at the oldest ages) for the oldest cohorts. This remains true even after excluding part-time workers, and is consistent with men taking on more senior positions as they progress in their career without interruptions. Men's initial movement out of flexible occupations over the life cycle is more pronounced than women's movement into flexible occupations and does not differ markedly by cohort. As described in Table 1.1, some of the most flexible occupations tend to be very male dominated (such as engineering, construction trades, architecture), with such flexible occupations also tend to be lower in the organisational hierarchy than inflexible occupations in managerial roles, so that a higher proportion of men than women work in flexible occupations at the youngest ages.

The graph also shows that at every age, higher proportions of women in later cohorts worked in flexible occupations, so women's participation in flexible occupations increased both over the life cycle and over cohorts[10]. This marked pattern is not observed for men, whose participation in flexible occupations stayed at similar levels for all cohorts at any given age, except for a small increase at the youngest ages in the most recent cohorts.[11] These patterns of women's increased participation in flexible occupations in more recent cohorts could be explained by increasing demands for flexibility over cohorts, which is consistent with recent cohorts facing increased unanticipated costs of motherhood as proposed by Kuziemko et al. (2018). Evidence using time use data from 11 Western countries found that childcare time increased for both mothers and fathers from 1965 to 2012 (Dotti Sani and Treas, 2016), suggesting that there were increases in childcare-associated time pressures in more recent cohorts, which could lead to increased demand for flexibility. In England, for example, 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 and increase their need for occupation flexibility.

It may also be that though women are more likely to be in inflexible occupations at the start of their careers than men, assortative matching would mean that they are more likely to marry men in similar non-flexible occupations, which would further reduce their own ability to work longer hours over time, due to their partners

[10]Separately plotting those with and without dependent children living in the household did not change the general nature of how women and men moved into flexible occupations though those with children were more likely to be working in flexible occupations at any age.

[11]Appendix Figures B.3 and B.4 show that non-graduate women, like graduate women, do increase their participation in flexible occupations over the life cycle and across cohorts, though there is no marked change in non-graduate men's participation in flexible occupations over the life cycle. These patterns can be seen both when excluding and including part-time workers.

also not being able to shoulder responsibilities at home (Cha, 2010; Cha and Weeden, 2014).Chiappori et al. (2020) finds for instance that there has been an increase in assortative matching in the UK increasing income inequality. In the US, as returns to human capital increased (especially for women), white couples at the top of the income distribution spent more time with their children, reinforcing assortative matching (Chiappori et al., 2017). This has occurred as the primary motives for marriage have shifted towards investments in children, where such increased investments in children's human capital through both increased child-related expenditure and childcare time have been concentrated among college graduates (Chiappori et al., 2017; Lundberg and Pollak, 2014; Lundberg et al., 2016; Altintas, 2016). Guryan et al. (2008) state that constraints related to flexibility may be even more binding for college-educated women as though they work more hours, they also spend increasingly more time with their children than their less educated counterparts. This is also related to the observation by Goldin (2006) and Goldin et al. (2006) for the US that the most recent cohorts of women are less likely than those in previous cohorts to defer childbirth, and are more likely to want both career and family at the same time. Figure 1.8 shows using IPUMS data, that similar to the above patterns for the UK, there has been an increase in the share of both male and female graduates in the US working in flexible occupations over time, with US graduate men reducing their participation in flexible occupations over the life cycle. The change in the share of graduate women in the US working in flexible occupations over the life cycle is more ambiguous, however.

Appendix Figure B.5 plots the change in the share working in flexible occupations over the life cycle and over time, defined using the individual components of the flexibility measure instead of the average. Similar to the average flexibility measure, the binary measure of flexibility for each component is also defined using a cutoff at the median. Not all the components of the flexibility measure show the same kind of patterns of women increasing their share in these occupations over the life cycle and men reducing their participation, as well as the changes over cohorts – occupations with high levels of managing interpersonal relationships, decision-making freedom, and structured work show the strongest patterns of this kind (even after excluding part-time workers in Appendix Figure B.6). This further supports the evidence in Table 1.1 that though occupations may score highly on one aspect of flexibility, their lower scores on other aspects may actually contribute to making them an inflexible occupation, as in the case of health professionals, who have low time pressure, but are otherwise quite inflexible.

Figure 1.9 plots the share of men and women working in occupations that score high on the social skills measure, and each of its components, for cohorts over the life cycle. The shares of graduates working in 'high social skills' occupations are much higher than in flexible occupations, and both male and female graduates (of all cohorts) increased their participation in these occupations over the life cycle. Women were more likely to work in high social skills occupations than men were. However, women (and men, to a smaller degree) of more recent cohorts reduced their participation in these high social skills occupations over time – which differs from the findings by Deming (2017) and Cortes et al. (2018) for the US that occupations requiring high levels of social skills accounted for an increasing share of employment in recent years.[12] As high social skills occupations also tend to be less flexible occupations, this agrees with the cohort pattern observed for flexibility but not the life cycle pattern, which suggests that the occupation trait measures pick up different dimensions along which occupations are differentiated in the labour market and do not fully correspond.

[12]This pattern holds similarly for definitions of 'high social skills' occupations based on the individual components as well, and when excluding part-time workers in Appendix Figure B.7.

Figure 1.10 shows how the share in flexible occupations varies by cohort and age, when controlling for the standardised social skills measure and each component of social skills. The pattern for men becomes slightly less about an overall decrease, and more of a mid-life decrease in participation in flexible occupations, followed by an increase in participation again post age 40. The pattern of women increasing their participation over the life cycle remains after controlling for social skills.[13] This suggests that the changes in employment in flexible occupations over the life cycle and over time cannot be explained by the social skills in these occupations.

Figure 1.11 plots the share of male and female graduates working in occupations with high abstract, routine, and manual task intensity scores. There are strong life cycle patterns as both male and female graduates increase their participation in abstract task-intensive occupations (and reduce their participation in routine and manual task-intensive occupations) as they age. The increase in the share working in abstract occupations is higher for men than for women over the life cycle though they start at similar levels, and conversely, the reduction in participation in routine occupations is starker for men than for women. For this sample of graduates, the share working in manual occupations is low (though slightly higher for men than for women throughout their lives) and declines over the life cycle (though it increases over cohorts for both men and women). There is no noticeable increase in the share working in abstract occupations across cohorts for both men and women, whereas the share working in routine occupations decreases over cohorts for women, but not for men.

Figure 1.12 shows how the share of graduate men and women working in flexible occupations over the life cycle and across cohorts varies after controlling for abstract, routine, and manual task intensity in occupations. Controlling for abstract

[13] Appendix Figure B.8 confirms that these patterns remain after excluding part-time workers.

task intensity removes the life cycle decline in male share working in flexible occupations, whereas the female share in flexible occupations continues to increases over life cycle and across cohorts. Similarly, controlling for routine task intensity does not change the pattern for females much, but almost completely explains the share of men working in flexible occupations over the life cycle, except in the latest cohorts. Controlling for manual task intensity also does not change the life cycle patterns of working in flexible occupations for both men and women, though there are less marked cohort patterns, suggesting that a part of the increased work in flexible occupations over time is driven by reduced work in manual task-intensive occupations.[14] Overall, these patterns suggest that the reduction in men's participation in flexible occupations over the life cycle can be somewhat explained by their increased participation in abstract task intensive occupations at the expense of routine task-intensive occupations, though this does not explain women's increasing participation in flexible occupations.

3. *There is a strong wage penalty associated with flexibility, which only remains for graduates, once age and education are controlled for. The unconditional wage penalty on hourly earnings associated with a one standard deviation increase in flexibility score ranges from 30.2% for non-graduate men to 43.2% for graduate women, and is higher for graduates and women. However, after controlling for education level and age, the wage penalty associated with flexibility only remains for graduates being 7.1% for men and is almost twice as high for graduate women (13.4%).*

Figure 1.13 plots the unconditional wage penalty associated with working in a more flexible occupation. This is done by plotting the median log hourly wage in an occupation (averaged across all sample years) against the occupation flexibility

[14] Appendix Figures B.9 and B.10 show that restricting the sample to full-time workers does not change these results by much, suggesting that these patterns are not being driven by differences in full-time and part-time work between workers in different types of occupations.

score, with the line of best fit describing how wages are related to flexibility on average. The flexibility wage penalty is the slope of the regression line, which was negative for all groups, indicating that there was a strong unconditional wage penalty associated with flexibility. A one standard deviation increase in the flexibility score was associated with wages that were 45.1% lower for all workers. The size of the wage penalty varied by gender and education, with women and graduates facing larger penalties, and the penalties being more severe for graduates than for women overall, with non-graduate men facing the smallest wage penalty. The largest wage penalties were faced by graduate women (on average 43.2% of median log hourly wage), where both graduate men (40.3%) and non-graduate women (32%) faced smaller penalties.[15]

It is likely that employment in occupations with higher or lower flexibility is related to an individual's education and age, both of which are associated with wages independently of occupation flexibility. Figure 1.14 plots the wage penalty associated with flexibility conditional on age group and education levels (as well as interactions between age and education), to compare the wage penalty for individuals of similar age and educational characteristics. Conditional on being within a five-year age band and having similar levels of education, the wage penalty for a one standard deviation increase in flexibility only remains for graduates, with graduate women facing a wage penalty (13.4%) double that of graduate men (7.1%). The slopes for non-graduate men and women are flat, suggesting that conditional on age and education, men and women without college degrees did not face a wage penalty

[15] Excluding part-time workers in Appendix Figure B.11, the penalty for working in flexible occupations was largest for graduate men (36.5%), followed by graduate women (32.7%), and smaller for non-graduate men and women at about 30%, which suggests that part of the higher wage penalty from working in flexible occupations for graduate women operates through the lower wages faced by working part-time in these occupations.

from working in more flexible occupations.[16] The fact that women face larger penalties from working in flexible occupations is supportive of evidence from Germany that suggests that provision of flexible working arrangements increased the working hours of both men and women, but only resulted in increased incomes for men (Lott, 2015).

Graduate women facing a larger wage penalty associated with flexibility is also consistent with evidence from a lab experiment suggesting that women reported a higher willingness to pay (in terms of taking a larger pay cut of about 7.3% compared to only 1% for men) for the option to work part-time (Wiswall and Zafar, 2018). The experiment by Wiswall and Zafar (2018) reported that people on average needed to be compensated an additional 1.13-5.1% of their annual earnings to work one extra hour per week, with men demanding lower compensation than women. Mas and Pallais (2017) also report estimates of the reported additional compensation required by employees for reduced flexibility to be between 8-20%. The magnitude of these estimates are all roughly in line with the size of the wage penalty that we find associated with a one standard deviation increase in the flexibility score.

4. *The flexibility wage penalty increased over cohorts and over the life cycle. The flexibility wage penalty for women (which followed similar patterns to that faced by men, though slightly higher) born between 1965-9 close to labour market entry was about 20% but increased to about 50% by age 50-55. On the other hand, compared to a 40 year old woman born in 1955, who faced a flexibility wage penalty of about 25%, a 40 year old woman born in 1975 faced a much higher wage penalty from working in flexible occupations of about 55%.*

[16] Excluding part-time workers in Appendix Figure B.12, non-graduate men and women did face a small wage penalty of 1-2% from working in flexible occupations (conditional on age and education levels), whereas graduate men and women faced a wage penalty of about 6% – where, once again, the fact that graduate women's wage penalty from working in flexible occupations halved when excluding part-time workers suggests that a part of this penalty operates through lower hourly pay in part-time work.

Figure 1.15 plots the evolution of the flexibility wage penalty for graduates of different cohorts over the life cycle. The flexibility wage penalty is defined as the slope of the regression line relating the median log hourly wage in the occupation to the occupation's flexibility score. The more negative the level, the larger the wage penalty associated with flexibility. There are no marked gender differences in the evolution of the wage penalty across cohorts and over the life cycle. For both men and women in every cohort, the flexibility wage penalty increased over the life cycle (becoming more negative at older ages). This means that the penalty associated with working in a more flexible occupation was higher at age forty-five than it was at age twenty-five, for example. This is consistent with (higher-paying) occupations that are further along the career progression ladder being less flexible.[17]

At any given age, the flexibility wage penalty was higher in later cohorts compared to earlier cohorts, indicating that the wage penalty associated with flexibility increased with successive cohorts of the workforce. The measure of flexibility used here does not, however, capture changes in occupations' flexibility levels, which are likely to have changed over time due to changing work environments as well as regulations. However, this pattern would be consistent with the nature of workplaces changing across all occupations such that it was increasingly more costly to work flexibly. This has been suggested both by the increasing prevalence of group work in modern workplaces (Lazear and Shaw, 2007), as well as the findings by Kuhn and Lozano (2008) and Cortés and Pan (2019) that the premium for working long hours (as measured by the elasticity of annual earnings with respect to weekly hours) has increased consistently for all education groups from 1980-2010, with college educated workers experiencing the largest increase over time. The flexibility wage penalty is also more severe for female graduates compared to male graduates

[17] Excluding part-time workers from analysis in Appendix Figure B.13 does not change the nature of these patterns related to the flexibility wage penalty.

overall, and particularly in the latest cohorts, which is likely due to women being more likely to work in flexible occupations than men (Cortés and Pan, 2019).[18]

Cha and Weeden (2014) consider several reasons for the increase in the returns to overwork, which is related to the increase in the flexibility wage penalty. A mechanical increase in the returns to overwork may occur if overworking became increasingly concentrated among those working in high-paying 'greedy professions'. On a related vein, productivity differences may emerge between overworkers and the rest of the workforce, if either overworkers most benefited from new productivity enhancing technologies (for instance, through facilities that enable work away from the workplace), or if rising demand for skilled labour created incentives for the most productive workers to put in long hours or work inflexibly. They also refer to the business management literature, suggesting tournament theory (recently reviewed in Connelly et al. (2014)) as a potential explanation for large and growing differences in pay between workers at different levels of seniority. According to tournament theory, in contexts where differences in actual output and productivity between workers are hard to measure, employers are likely to more effectively incentivise workers to 'win' competitions against their co-workers by putting in long hours at work, relying on work hours as a proxy for productivity. This is consistent with the evidence presented in Table 1.1, which shows positions that have higher career ranks (such as public service professionals) having lower flexibility scores than those that are lower ranked (e.g. public service associate professionals). One final theorised reason for growing premiums to inflexible working is that macro-structural shifts such as de-industrialisation and globalisation may have pressured

[18] Appendix Figure B.14 shows that there is a flexibility wage penalty for male and female non-graduates as well, though it is increasing over the life cycle only for the most recent cohorts or at younger ages, and does not seem to be increasing over cohorts. This aligns with evidence from the US of recent increases in irregular or unpredictable hours in low-paid occupations as well (Lambert, 2008; Boushey and Ansel, 2016; Bertrand, 2020).

employers to stratify workforces into 'core' employees who work long hours for relatively high pay, and contingent workers who work part-time, under sub-contracts, or in temporary positions, for lower pay. In contexts where actual productivity is hard to observe, as in many white collar professions, a 'rat-race equilibrium' may result due to adverse selection in the determination of work hours, without alternative methods of signalling productivity to employers (Landers et al., 1996). Even in the absence of signalling behaviour, rising wage inequality may increase the returns to long work hours as workers are incentivised to gain more job skills to be able to gain access to better, higher-paying jobs (Michelacci and Pijoan-Mas, 2012). As long as any of these mechanisms increase the returns to inflexible working, then given that men are more likely to work in occupations that are dominated by inflexible work, this is likely to contribute to the increase in the gender earnings gap, and would particularly affect gender differences in pay for the highest paid occupations.

The IPUMS data in Figure 1.16 shows that there exists a flexibility wage penalty for both male and female graduates in the US, which is increasing over the life cycle and larger in magnitude for female graduates than for male graduates, which is similar to the patterns observed for the UK above. However, in contrast to the UK patterns, the flexibility wage penalty does not increase in magnitude for successive cohorts of US graduates, and may have indeed reduced in severity for the latest cohorts of male graduates. Though the penalty from working in flexible occupations does increase as workers age, later cohorts of graduates faced similar penalties to their older counterparts, which is in contrast to the evidence in the literature on the increase in the overwork premium increasing over time. However, this evidence may be picking up life cycle effects and not increases over time for individuals of a given age for the US.

Figure 1.17 plots the wage penalty associated with increases in the standardised components of the flexibility score, for cohorts of men and women over the life cycle. Barring the contact with others component, for the four other individual components of the flexibility measure, the patterns of the increase in the wage penalty over time and over the lifecycle mostly align with the patterns for the average measure, though the increases were not as clear for the most recent cohorts and for men. Since each of the individual components of the flexibility score are associated with wage penalties, this suggests that each of these components are amenities for which individuals are willing to sacrifice earnings, representing different dimensions of flexibility that are desirable for workers.[19]

Figure 1.18 plots the wage premium associated with a one standard deviation increase in the social skills score and each of its components. Occupations with higher social skills have a wage premium rather than penalty and this premium generally increases over the life cycle (especially until about age 40, after which it remains stable, or even falls) and over time.[20] These patterns correspond well with the findings in the literature that the returns to social skills have increased over time (Deming, 2017; Cortes et al., 2018). Figure 1.19 shows how the flexibility wage penalty changes when controlling for the standardised social skills measure and each component of social skills. Note that these plots are quite noisy as the correlation is on an occupational level and cell sizes may be small. There is not a very clear pattern over the life cycle and in some cases, the penalty is now a premium as there is a positive association between flexibility score and median wages in occupation, conditional on social skills. This indicates that though occupations penalise flexibility, this penalty

[19] Appendix Figure B.15 finds similar patterns for full-time workers only.

[20] This pattern is generally quite similar for individual components of the measure, though much clearer with the overall measure, and similar when excluding part-time workers in Appendix Figure B.16.

may not exist if the occupations score high on social skills.[21] However, since the occupation flexibility and social skills measures are negatively correlated on average, this also suggests that the wage penalty associated with flexibility is not completely explained by social skills.

Next, consider the wage premium (or penalty) associated with working in occupations as defined by the task intensity measures. Figure 1.20 shows that working in abstract occupations endows a premium on workers, but working in routine occupations mostly imposes a penalty on workers.[22] While graduate men working in manual occupations tend to suffer penalties that increases in severity as they age, women tend to enjoy a premium which increases over the life cycle from working in such occupations, which likely points towards women working in more service- and craft-focused occupations which are not as low-paid as most elementary manufacturing occupations. The wage penalty from working in routine occupations is mostly flat over the life cycle for both men and women, though it may have reduced for the most recent cohorts. On the other hand, the wage premium from working in abstract occupations increased over the life cycle for both men and women, with some evidence that it also increased for more recent cohorts of men, but not for women. This is consistent with evidence that there have been increasing returns to working in highly-paid cognitive occupations that reward long hours, which would disproportionately benefit men (Kuhn and Lozano, 2008). Controlling for task intensity measures does not seriously affect the nature of the changes to the flexibility wage penalty over time, as Figure 1.21 shows that there is a wage penalty associated

[21] This is most marked when restricting analysis to full-time workers in Appendix Figure B.17, as controlling for social skills measures reduces the magnitude of the flexibility wage penalty for full-time workers especially when controlling for the persuasion and negotiation components. This suggests that given that an occupation has a high social skills score, higher flexibility may not have a large wage penalty for full-time workers, though this is still less true for full-time women.

[22] This is also seen when excluding part-time workers in Appendix Figure B.18.

with working in flexible occupations that increases over the life cycle and across cohorts (though this latter pattern is noisy).[23]

1.5 Decomposition Methodology

Decomposition methods have been widely used in economics, most notably in labour economics, where Oaxaca (1973) and Blinder (1973) introduced these methods to analyse changes in the average gender pay gap. Since the work of Oaxaca (1973) and Blinder (1973), this research area has expanded to analysing changes in other distributional parameters of the pay gap, beyond the mean. This chapter considers how changes to the gender wage gap across the life cycle and over time (across cohorts) at different points in the distribution were affected differently by changes to working in occupations as characterised by traits including flexibility, social skills, and abstract thinking skills. Results considering the changes in the mean gender pay gap are presented as a special case. The primary focus is on effects across the distribution of the gender pay gap as the descriptive evidence presented in Table 1.4 as well as the stylised facts discussed previously suggest both that the changes in the gender wage gap over time, as well as the changes to working in different occupations both differed across the earnings and skills distributions.

The main analysis uses quantile decomposition methods detailed in Firpo et al. (2007), Firpo et al. (2009) and Fortin et al. (2011) to examine changes in the gender

[23]It remains true that controlling for task intensity measures does not affect the nature of the changes to the flexibility wage penalty over time when considering only full-time workers in Appendix Figure B.19, though there is a more clear increase in the flexibility wage penalty over cohorts when excluding part-time workers.).

wage gap at different points in the distribution, by running a regression of a transformation of the outcome variable (the pay gap) on the explanatory variables (occupations defined by occupation traits). The outcome variable of interest is the difference between male and female log real hourly earnings, where quantiles (denoted q_τ) of the marginal (unconditional) distribution $F_Y(y)$ of this difference over the life cycle (between ages 25 and 52) and over time (between birth cohorts) are used for the analysis. The explanatory variables of interest are occupations defined as binary variables as described earlier. The changes in these binary explanatory variables over time therefore represent the changes in the shares of the employed population who are working in such occupations. For instance, where variable $Flex = 1$ if the individual works in a flexible occupation, and 0 otherwise, this analysis considers how changes in $f = Pr[Flex = 1]$, the proportion of men and women working in flexible occupations, affects changes to the pay gap at the τth quantile of the earnings distribution.

This chapter uses unconditional quantile regressions of the re-centred influence function (RIF) (as described in Firpo et al. (2009)) to consider the effect $\frac{dq_\tau(p)}{dp}$ of changing the proportion working in occupation $o = f, a, s$ (flexible, abstract and social, respectively) over time, on the τth quantile of the marginal (unconditional) distribution of the gender pay gap. Since the analysis uses unconditional quantile regressions, there are no controls used in the re-centred influence functions.

The influence function is a measure of the the robustness of any distributional statistic to outlying data, or alternatively, the influence of any individual observation on that statistic. The re-centred influence function (RIF) is obtained by adding the influence function back to the distributional statistic, and its expectation equals the original statistic. The influence function $IF(Y; q_\tau, F_Y)$ for the τth quantile is defined as $IF(Y;_\tau, F_Y) = \frac{\tau - \mathbb{1}(Y \leq q_\tau)}{f_Y(q_\tau)}$ so that $RIF(Y; q_\tau, F_Y)$ is equal to $q_\tau + IF(Y; q_\tau, F_Y)$.

The conditional expectation of the RIF as a function of the explanatory variables is the RIF regression model, which in the case of quantiles can be seen a an unconditional quantile regression:

$$\mathbb{E}\left[RIF(Y; q_\tau, F_Y) \mid X\right] = X'\beta \tag{1.1}$$

Equation 1.1 can be implemented using ordinary least squares (OLS) regression, as the average derivative of this unconditional quantile regression, corresponds to the marginal effect on the quantile of a small shift in the distribution of covariates. This result can therefore be used to extend the Oaxaca-Blinder decomposition methodology to the case of quantiles.

The example below demonstrates how analysis using the decomposition methods detailed above can be used to interpret changes in working in different occupations to changes in the gender wage gap. From a life cycle perspective, the patterns of the increasing cost of working flexibly at older ages, women increasingly moving into flexible occupations and men moving out of flexible occupations at older ages, should all contribute to the increase in the gender wage gap over the life cycle. However, since these are descriptive patterns it is not possible to disentangle whether the relative increase in labour supply in flexible occupations or the relative changes to the wage penalty over the life cycle would matter more for how the gender wage gap evolves over ages.

To understand how much of the change in the wage gap over the life cycle can be attributed to differences in life cycle patterns of occupational sorting as opposed to changes in returns to occupations over the life cycle, a decomposition analysis is conducted of the change in the wage gap between age 25 and age 52 for the cohort of individuals born in 1965-69, for whom almost the full working life cycle is included in the data. The wages for an individual i of gender g at age a in cohort c can be expressed as:

$$W_{igac} = \beta_{0,gac} + \beta_{1,gac}\mathbb{1}(occ_{igac} = flexible) + \epsilon_{igac} \tag{1.2}$$

For each gender, we conduct an Oaxaca-Blinder decomposition of the average change in wages for the cohort born in 1965-69 over the life cycle, i.e. from when they were 25 (t_0) to when they were 52y (t_1) into:

$$\begin{aligned}\overline{W}^g_{t_1} - \overline{W}^g_{t_0} = & \overbrace{\left[\overline{\beta}^g_1 \left(ShareFlexible^g_{t_1} - ShareFlexible^g_{t_0}\right)\right]}^{\triangle \text{ shares}} \\ & + \overbrace{\left[\left(\beta^g_{1,t_1} - \beta^g_{1,t_0}\right) \overline{ShareFlexible^g}\right]}^{\triangle \text{ returns}} \\ & + \overbrace{\left[\beta^g_{0,t_1} - \beta^g_{0,t_0}\right]}^{\triangle \text{ residuals}}\end{aligned} \tag{1.3}$$

The difference in the wage gap over the life cycle can therefore be attributed to:

Shares: changes in male versus female shares working in flexible occupations between 25 and 52y (multiplied by average returns to flexible occupations)

Returns: changes in male versus female returns to working in flexible occupations between 25 and 52y (multiplied by average shares working in flexible occupations)

Residuals: changes in male versus female average returns to working in non-flexible occupations and other unexplained factors

Therefore the (double) difference between the decomposition results for men and women gives the decomposition of the change in the wage gap over the life cycle:

$$\triangle\overline{W}^{M-F}_{t_1-t_0} = \left(\overline{W}^M_{t_1} - \overline{W}^M_{t_0}\right) - \left(\overline{W}^F_{t_1} - \overline{W}^F_{t_0}\right)$$

The primary analysis considers how changes in the share of men and women working in flexible occupations over the life cycle relates to the changes in the gender wage gap over the life cycle across the distribution, but the analysis also considers whether occupation traits other than flexibility also affect the nature of the patterns related to flexibility. This is done using two approaches, where the first approach includes additional controls for occupations defined as requiring high abstract and social skills, and the second approach includes interactions between the three occupation traits as well. Though this analysis provides information on whether the changes in the gender wage gap attributed to differences in sorting into flexible occupations can be explained by other types of sorting behaviour, it does have a drawback in that the differences in returns between different occupations cannot be identified separately. This is a standard problem for wage decompositions, where the detailed decomposition of the wage structure effect cannot be interpreted as the interpretation is dependent on the choice of the omitted group, and tends to be group- or sample-specific, and unstable otherwise.

The main analysis in the following section focuses on the factors associated with the change in the distribution of gender wage gap over the life cycle, in relation to working in flexible occupations, within a given cohort for which we have the most information. In addition to differences in the gender wage gap over the life cycle, the descriptive trends showed that there was also substantial heterogeneity across cohorts over time, indicating that cross-cohort changes in factors associated with the gender wage gap, for any given age, are another potentially interesting dimension to consider. Oaxaca-Blinder decompositions of the gender wage gap at the mean for both life-cycle and cohort analyses are included as special cases in Appendix B.2.

1.6 Decomposition of the gender wage gap

1.6.1 Decomposition of the change in the gender wage gap over the life cycle

Figure 1.4 shows that the gender wage gap increased over the life cycle, pointing to the importance of life cycle changes in preferences that determine the supply of labour into flexible versus non-flexible occupations, as women and men face different life trajectories especially post-childbirth that mean that the gender wage gap is differently affected by their labour market choices. Table 1.4 also showed there was still substantial variation to the changes to the gender wage gap within and across occupations at different points in the earnings distribution. This section uses decomposition analyses to consider whether the impact of the above documented changes in flexibility on the gender wage gap varied across the wage distribution. For instance, an increase in the share of women working in flexible (lower-paying) occupations over the life cycle would imply that the gender wage gap would increase at the bottom of the distribution. On the other hand, men increasingly sorting into non-flexible occupations as they grow older would increase the gender wage gap at the top of the distribution.

Results from decomposition analysis of the changes in the gender wage gap over the life cycle across the distribution and how they related to flexibility are shown in Table 1.5 and Figure 1.22. Both male and female wages increased between ages 25 and 52 almost monotonically across the distribution, with the highest life cycle wage growth experienced by men and women at the top of the distribution. Men's wage growth between ages 25 and 52 is much higher than that of women, at every point in the distribution. Across the distribution, men's wages increased and women's wages fell as they moved out of and into flexible occupations, respectively.

Men across the distribution experienced similar increases in wages (of about 2.2 to 3.4 log points) from sorting into more non-flexible occupations as they grew older, with the smallest increases in wages at the top of the distribution. This is consistent with men at the 90th percentile of earnings being more likely to already have been in non-flexible occupations at age 25. Therefore, the sorting effect would be less prominent for men at the top end of the earnings distribution. Similarly, women earning below median wages suffer larger reductions in wages over the life cycle for sorting into flexible occupations as they grow older, compared to women at the top of the graduate hourly earnings distribution. This may be again because women at the top of the earnings distribution are more likely to be in higher-paid non-flexible occupations, and therefore more able to afford labour substitutes at home (Cortés and Pan, 2019), enabling them to continue to work in non-flexible occupations through ages 25 to 55.

The share of the increase in the gender wage gap between ages 25 and 52 that is explained by differential sorting into flexible occupations by gender varies from close to a third at the 10th percentile to about 13% at the 90th percentile, with about 40% explained at the median. This suggests that it is not the most highly paid graduates for whom changes in shares worked in flexible occupations matter the most - both because the sorting effect for men and the wage penalty effect for women are both smaller at the 90th percentile.[24]

The changes in the returns to working in flexible occupations from ages 25 to 52

[24]When excluding part-time workers from analysis in Appendix Table B.1 and Appendix Figure B.20, the differences in sorting explain only about 5% of the gender wage gap at the bottom of the distribution, compared to 30% for all workers. This suggests that a large share of the changes in sorting that explain the gap for all employees at the 10th percentile are due to changes to full-time working over the life cycle. However, the results for the rest of the distribution are similar to those when including all workers, suggesting that part-time work only plays an important role at the bottom of the graduate distribution.

were negative but mostly not significant across the distribution except for the highest earning women, for whom the reductions in wages arising from the flexibility wage penalty increasing over ages is the most substantial. However, the net effect on returns to working in flexible occupations is not significant across the distribution. This suggests that the wage penalty associated with flexibility is an important factor that contributes to women's continued under-representation at the very top of the male earnings distribution. Existing research has presented evidence that the premium for working long hours is one mechanism that locks women out of highly paid occupations and roles, as women's higher demand for flexibility constrains them from being able to work in occupations that reward long hours, where the flexibility wage penalty may be the highest Cortes and Pan (2017); Cortés and Pan (2016); Cortes et al. (2018); Denning et al. (2019); Cha and Weeden (2014). Guvenen et al. (2014) found that there remains a glass ceiling that prevents women from being top earners in the US (as there has been almost no increase in the share of women in the top 0.1 percent of the earnings distribution), but the likelihood of women falling out of the top earnings distribution over the life cycle has fallen, which is consistent with the results presented here. The evidence here is novel in suggesting that the wage penalty associated with flexibility may be a key reason underlying this persistent lack of earnings mobility for women.

It is also important to consider how changes to sorting by, and returns to occupation characteristics other than flexibility affected the evolution of the gender wage gap over the life cycle. However, it is not possible to identify the contributions of the different occupation characteristics to changes in returns to occupations, due to the 'omitted group' problem associated with detailed wage decompositions, both across the distribution as well as at the mean (Firpo et al., 2009; Oaxaca and Ransom, 1999). Therefore it is only possible to consider the total share of the changes that are explained by changes in returns to occupational characteristics, and compare this to the changes in the returns to flexible occupations.

Table 1.6 and Figure 1.23 consider how occupations classified as highly social or requiring high levels of abstract work, as well as flexible occupations, explained by changing returns and shares working in occupations, across the earnings distribution. At all points considered in the distribution, the share working in flexible occupations explains a significant and sizable proportion of the increase in the gender wage gap over the life cycle, whereas the shares in abstract and social occupations only contributed insignificantly to the changes in the gender wage gap over the life cycle. The difference in the share working in flexible occupations contributed most at the bottom of the earnings distribution, explaining more than half of the increase in the gender wage gap between ages 25 and 52, and the proportion explained by the share working in flexible occupations fell higher along the distribution, explaining 21.5% of the increase in the wage gap at the 20th percentile, 34.4% of the increase at the median, and 14.1% and 15.2% of the increases at the 80th and 90th percentiles. The proportion of the increase in the gender wage gap explained by changes in returns to occupations was only significant for the highest earners at the 80th and 90th percentiles, where about 80% of the total increase in the wage gap over the life cycle was explained by men's wages increasing by substantially more and almost the double the increase in women's wages between ages 25 and 52.[25]

It is likely that interactions of the occupation characteristics with flexibility may be more important in explaining the changes in the wage gap, as it may be that

[25]Excluding part-time workers from analysis in Appendix Table B.2 and Appendix Figure B.21, the share working in flexible occupations explains comparatively smaller proportions of the change in the gender wage gap over the life cycle at the bottom of the distribution, and is statistically insignificant at the 10th percentile, but significant at other percentiles of the earnings distribution. Sorting into abstract and social occupations do not explain changes in the gender wage gap over the life cycle, even after excluding part-time workers from analysis. The proportion of the change in the gender wage gap over the life cycle explained by changes in returns to occupations also remains highest towards the top of the distribution, even after excluding part-time workers.

occupations that are highly paid and less flexible are also characterised by high abstract and high social skills, especially as we have already seen that these traits are strongly correlated with occupation flexibility. Table 1.7 and Figure 1.24 show the results from a detailed quantile decomposition of the increase in the gender wage gap over the life cycle - however, due to cell sizes being smaller in more disaggregated groups of occupations, most of the detailed decomposition results showing the effect of sorting into occupations are statistically insignificant. However, though insignificant, at the bottom of the distribution, sorting into occupations that are defined as flexible (and have low levels of abstract and social skills) is most important, explaining half of the increase in the gender wage gap over the life cycle at the 10th percentile. Higher along the distribution, sorting into occupations with high flexibility, whether or not in conjunction with other occupation characteristics, remains the most important type of sorting that determines the increase in the wage gap over the life cycle. Sorting into occupations defined by high flexibility (with or without high levels of the abstract and social skills) explained more than a third of the total change in the gender wage gap at the 20th percentile and the median, and 12-15% of the change at the 80th and 90th percentiles. Changes in returns to occupations and other characteristics explained more than half of the changes in the gender wage gap towards the top of the distribution (while the proportion explained at the bottom of the distribution was small and insignificant).[26] Factors other than sorting into occupations that led to men's earnings increasing by much more than women's earnings explained more than three quarters of the total change in the gender wage gap over the life cycle at the 80th and 90th percentiles, and also explained a substantial proportion at the 20th percentile and the median.

The decomposition results shown above indicated that changes in sorting into

[26]Excluding part-time workers from analysis does not substantially change the nature of these results, as seen in Appendix Table B.3 and Appendix Figure B.22.

flexible occupations between ages 25 and 52 explained a substantial proportion of the increase in the gender wage gap, and that this remained an important explanation for the increase in the wage gap over the life cycle even after controlling for other characteristics that defined occupations, either on their own, or when interacted together, though it was most important at the bottom of the distribution. Changes in returns to occupation characteristics mattered for the changes in the gender wage gap over the life cycle, especially when considering characteristics in addition to flexibility, as returns for women in these occupations increased by much less over the life cycle than they did for men, especially at the top of the distribution.

To summarise, the patterns of the increase in the wage gap over the life cycle were similar across the distribution. Across the distribution, men's wages increased and women's wages fell as they moved out of and into flexible occupations, respectively. However, a larger proportion of the portion explained by flexibility was attributed to changes in sorting into flexible occupations over the life cycle, at the bottom of the wage distribution compared to the top. This is because the increase in the wage gap was larger at the top of the distribution, as the magnitudes of the decomposition effect attributed to changes in occupational sorting over the life cycle remained similar across the distribution. However, taking the net effect of the changes in men's and women's wages over the life cycle, there is no clear monotonic pattern across the distribution. Sorting into flexible occupations was the most important type of sorting contributing to changes in the gender wage gap over the life cycle, when controlling for other occupational traits, especially at the top of the distribution, suggesting that flexibility has an especially important role to play at the top of the distribution, as more of these jobs are structured inflexibly, disadvantaging women Bertrand (2020).[27]

[27] Results from decomposition analysis at the mean are included in Appendix B.2. They show that differential sorting into flexible occupations explains more than a quarter of the total observed change

These results suggest that though women's higher demands for flexibility, which imposes a wage penalty, are indeed costly for their wages,as they suffer a reduction in wages over the life cycle from choosing to work in more flexible occupations. However, men's increasing participation in non-flexible occupations as they grow older means that they are able to enjoy a relative premium from not working in flexible occupations, and both these factors contribute to the increase in the gender wage gap between ages 25 and 52. Therefore, as workplaces change such that firms demand longer and more unpredictable hours of work (particularly in more senior or higher-paid positions) (Lazear and Shaw, 2007) and employers become more 'greedy' over time so that they reward overwork (Cha and Weeden, 2014; Cortes and Pan, 2017), men are able to take advantage of the changing nature of workplaces in such a way that the gender wage gap increases in their favour.

This is also consistent with evidence from Germany that men are disproportionately rewarded when 'flexible working arrangements' are provided as though both men and women increased their hours worked, only men get higher incomes as a result (Lott, 2015). This is likely because flexible work arrangements enable men better to work more unpredictable hours, which are rewarded with higher wages, whereas women may be using flexible hours to adapt around their own schedules, which may be penalised by firms. Research has indicated that women's educational and occupational choices are affected by expectations of future career breaks (Chevalier, 2007), which are especially discouraged in more male-dominated (and higher-paying) occupations (Swaffield, 2000), which means that women may preemptively lock themselves into a career path that stays below that of men even in the absence of future occupational sorting behaviour (Fitzenberger and Kunze, 2005). Furthermore, research has also found that current hours are linked to future wage growth

in the gender wage gap between ages 25 and 52, with this proportion not significantly affected by the inclusion of controls for sorting into occupations with high abstract and social skills.

(Gicheva, 2013), and if occupations are changing such that employees that are able to spend more time 'present' in the workplace are rewarded, women who demand more flexibility as they grow older (and potentially eligible for promotions) may be penalised not just in terms of current wages, but also in their future career prospects and wage growth. It also seems to show that controlling or other occupations does not matter much for explaining the average changes in the gender pay gap, as it is primarily changes in flexible working over the life cycle that contributes to the widening of the gender pay gap.

1.6.2 Decomposition of the change in the gender wage gap for a given age group across cohorts

In addition to the life cycle (or age) dimension, successive cohorts may face different constraints due to changes in the nature of firm technology or even changes in preferences in successive cohorts. Therefore, for any given age group, changes in preferences and technologies over time could also lead to changes in the gender wage gap over cohorts, which is a dimension we analyse in this coming section. Though data on wages across the life cycle are not available for all cohorts in the data, for particular age groups, multiple cohorts can be compared against each other. Therefore, this next section aims to explain the differences in the wage gap across cohorts, for age groups 25-34, 35-44, and 45-55.

Tables 1.8, 1.9, and 1.10 and Figure 1.25 show the results from the quantile decomposition analysis of the changes to the gender wage gap across cohorts for men and women in age groups 25-34, 35-44, and 45-55 years respectively. For all cohorts and age groups and at all points considered in the earnings distribution, the reduction in the gender wage gap would have been larger had not there been sorting into flexible occupations. Though both men and women in later cohorts in all age groups were more likely to work in flexible occupations, the earnings loss suffered by women in later cohorts through increased participation in flexible occupations outweighed the loss suffered by later cohorts of men. Men also did not shift to flexible occupations as much in later cohorts, seen previously in Figure 1.7. Furthermore, it has also already been shown that the flexibility wage penalty increased for later cohorts in Figure 1.15, so that changes in returns to flexible occupations mostly contributed to increasing the gender wage gap for later cohorts, except at the bottom of the distribution.

Figure 1.25 and Table 1.8 also show that differential sorting into flexible occupations by men and women was especially important towards the middle and top of the distribution, as in its absence, the decrease in the gender wage gap for cohorts of 25-34 year olds born in 1965-1969 to 1985-1989 would have been larger by 150% at the median, more than 180% at the 20th percentile, and more than three quarters as large at the 80th and 90th percentiles. In Table 1.9 and 1.10, we see that this is also true for cohorts of 35-44 year olds and especially for 45-55 year olds born from 1945-1949 to 1965-1969, for whom the gender wage gap would have been more than twice as large at the 20th percentile, and more than seven times and more than nine times as large at the median and 80th percentiles, respectively.[28]

At the top of the distribution, changes in both the shares working in and returns to flexible occupations mostly contributed to increasing the gender wage gap across cohorts for all age groups considered, but the gender wage gap actually fell for later cohorts. This suggests that factors other than working in flexible occupations were important in explaining the changes in the gender wage gap across cohorts, especially at the top of the distribution. To this end, controls for other occupation characteristics ar introduced into the decomposition analysis.

[28] Appendix Tables B.4, B.5, and B.6 and Appendix Figure B.23 confirm that removing part-time workers from the analysis does not change the nature of these results.

Tables 1.11, 1.12, and 1.13, and Figure 1.26 show the results of the quantile decomposition of the change in the gender wage gap across cohorts for age groups 25-34, 35-44, and 45-55, controlling for other occupational characteristics in addition to flexibility. As in the previous analysis, the absence of sorting into flexible occupations would have reduced the gender wage gap by a substantially larger amount at all points of the earnings distribution considered. On the other hand, sorting into occupations with high abstract and social skill requirements contributed to reducing the gender wage gap across cohorts, and at a smaller scale than the sorting into flexible occupations contributed to increasing it (especially small and insignificant in the case of occupations with high social skills). Figure 1.26 also shows that the changing patterns of sorting into flexible occupations across cohorts played an especially important role in increasing the gender wage gap at the bottom of the distribution for all age groups considered. Though the relative importance of changing returns in each of the occupations cannot be distinguished separately due to the omitted group problem, but the residual is increasingly important towards the top of the distribution, indicating that unaccounted factors explain more of the changes in the gender wage gap for the highest paid individuals[29].

Tables 1.14, 1.15, and 1.16, and Figure 1.27 show the results of the quantile decomposition of the change in the gender wage gap across cohorts, controlling for flexibility and other occupation characteristics, as well as the interactions between them. Increased sorting into occupations that score high on flexibility (regardless of combinations with other occupation characteristics) by later cohorts tended to always increase the wage gap across the earnings distribution, for all age groups considered. On the other hand, increased sorting into occupations that scored high on abstract skills tended to reduce the wage gap across the earnings distribution

[29] These patterns hold when including only full-time employees in the analysis in Appendix Tables B.7, B.8, and B.9, and Appendix Figure B.24.

for later cohorts of individuals aged 35-44 and 45-55 years, but only for those earning median and lower levels of earnings for the youngest age group. For 25-34 year olds, increased sorting into occupations with high abstract skills (in combination with other characteristics) increased the earnings gap at the 80th and 90th percentiles across cohorts. Similarly, increased sorting into all occupations requiring high social skills by later cohorts generally increased the wage gap throughout the distribution for all age groups (except at the 90th percentile of earnings for youngest age group, where it only reduced the wage gap slightly overall).[30]

These patterns are consistent with a hypothesised relationship between increased wage inequality and increased returns to education, therefore increasing the prevalence of more intensive styles of parenting that has been documented cross-sectionally across countries as well as over time for the USA (Doepke and Zilibotti, 2017). It has been documented for both the UK and the USA that parental time spent with children has increased especially for highly educated parents, as the competition for university places has increased (suggesting higher returns to education) (Borra and Sevilla, 2019; Ramey and Ramey, 2010). Furthermore, these patterns of increased investments in children's human capital by educated parents have been reinforced by increased assortative matching as marriage is increasingly motivated by investments in children(Chiappori et al., 2017, 2020; Lundberg and Pollak, 2014; Lundberg et al., 2016; Browning et al., 2013).[31]

[30]When restricting analysis to full-time employees in Appendix Tables B.10, B.11, and B.12, and Appendix Figure B.25, the patterns described above generally held true with increased sorting into occupations requiring high levels of abstract skills having contributed to reductions in the gender wage gap for later cohorts of individuals across all groups considered, whereas increased sorting into combinations of occupations characterised by high levels of flexibility and social skills by later cohorts exerted upward pressure on the full-time gender wage gap over cohorts.

[31]Results from decomposition analysis at the mean are included in Appendix B.2. In line with the above results, they show that in the absence of differential sorting into flexible occupations, the reduction in the gender wage gap across cohorts would have been larger for the three age groups considered.

1.7 Discussion

The analysis in this chapter fits into an extensive literature on the gender wage gap in many developed economies. The steady decline in the gender pay gap steadily declined in the latter half of the 20th century, coinciding with increases in female labour force participation, was observed both in the UK and in other developed economies. However, despite the gender pay falling greatly in the post-war period of the 1950s and continuing to fall through to the 2000s, there remains a significant gender pay gap in the UK and other developed economies, and this persistence has become extremely relevant in the press and for policy. This section discusses how these findings contribute to the wider literature on the gender wage gap, and surveys the main findings on the gap for the UK.

Policy implications for targeting the gender wage gap differ based on the timing of analysis of the gender wage gap. The majority of the literature on the gender pay gap has focused on cross-sectional analysis of the gender pay gap, i.e. decomposing the average gap in wages between men and women into observed differences in individual characteristics, differences in the payoff to these characteristics and an unexplained share (Blau and Kahn, 2017; Bailey and DiPrete, 2016). Similar to analysis in this chapter, this has been valuable in understanding the factors that were most associated with the gender gap at a point in time, and therefore also tie down whether changes in these characteristics contributed to changes in the wage gap. For instance, Harkness (1996) found using GHS and BHPS data that a large share of the fall in the average gender wage gap in the UK between the 1970s and 1990s from around 40% to around 30% were due to changes to the gender differences in returns to characteristics such as human capital, occupation and industry, as opposed to differences in these characteristics themselves, because of which this reduction has been interpreted as reduction in discrimination. Measuring 'direct discrimination' as different returns to the same unit of human capital (Mincer and Polachek, 1974), Wright and Ermisch (1991) reported that in 1980, women's pay would be about 20% higher in the absence of discrimination. Manning (2004) found that the average gender wage gap fell from about 34% in the early 1990s to about 29% in the late 1990s and that a significant proportion of the gender wage gap is attributable to differences in pay at labour market entry given that wage growth among those in continuous employment is similar for men and women. However, Blau and Kahn (2017) reports that though discrimination and differences in composition of the workforce were historically important factors in explaining the gender pay gap, as women and men in the workforce became more similar in terms of education and experience, other human capital factors such as differences in labour market sorting by industry and occupation became more relevant in recent years. This chapter has mostly abstracted away from discussions of human capital differences and selection by comparing cohorts of graduates over the life cycle, for whom gender differences in terms of participation and wages at labour market entry are minimal. It instead concentrates on differences in occupations and returns within occupations that contribute to gender pay inequality.

Analysis of the graduate gender wage gap immediately upon entry to the labour market focuses on men and women with expected strong levels of labour market attachment, who are similarly selected and mostly comparable, so that differential sorting into firms and occupations (arising from differences in preferences) are likely to be more important. This chapter has focused on one aspect of this by looking at gender differences in sorting into flexible occupations, as well as differences in how men and women are paid within their respective occupations. Francesconi and Parey (2018) find that immediately upon entering the labour market, the gender gap in full-time log earnings among university graduates in Germany was about

20 log points, with men and women working similar numbers of hours per week. They find that the single most important factor explaining the gender wage gap among university graduates immediately upon entry to the labour market is university field of study. This is echoed in other findings that suggest that women tend to be over-represented in occupational (and educational) fields that have the lowest returns (Machin and Puhani, 2003; Livanos and Pouliakas, 2009; Buffington et al., 2016), with Zafar (2013) finding that these differences in field choice could be attributed to differences in preferences, which are likely related to women's differential preferences for managing a career over the life cycle. Other research has found that gender differences in education, career expectations and aspirations, as well as willingness to take on tasks with 'low promotability' are important in explaining this gap (Babcock et al., 2017; Chevalier, 2007; Machin and Puhani, 2003; Fielding-Singh et al., 2018). Gender differentials in competitiveness contribute significantly to these differences in track choice as women are less likely to pick educational fields of study that lead to careers that are perceived to be more competitive (Buser et al., 2014). They are also more likely to work in lower paying firms than men (Joyce and Xu, 2019). In addition to differences in occupation and education, differences in personality traits and characteristics have also been found to contribute to the gender wage gap. Chevalier (2007) found that expectations of future career breaks for family reasons explained 10% of the gender wage gap in the UK for individuals who graduated from higher education in 1995, even among those who had not had children yet. These expectations of future career breaks is also linked to women tending to concentrate in female-dominated, lower-paying occupations (Baker and Fortin, 2001) as they face a higher wage penalty for time taken out of the labour market in male dominated occupations (Swaffield, 2000). Evidence from Sweden also suggests that women are more likely, compared to men, to be divorced after

being promoted to top jobs (Folke and Rickne, 2020). The gender composition of occupations is expected to matter for the gender wage gap as male-dominated occupations tend to be higher paid (Pan, 2015; Goldin, 2013), but as gender differences in sorting into occupation occur due to many reasons, considering solely whether occupations are male dominated or not may in fact ignore the other reasons why women and men tend to flock toward different kinds of occupations with varying returns. This chapter presents evidence that working in occupations that are characterised as more flexible tends to impose a penalty on earnings, with this flexibility wage penalty tending to be higher in less flexible (which are also more highly paid and more male-dominated) occupations.

This chapter shows that despite a narrow gender wage gap at labour market entry for college graduates in the UK (as in Costa Dias et al. (2016)), the gap between male and female wages expands over the life cycle. At later ages, constraints to labour force participation and employment decisions arise differently for men and women over the life cycle. Life events such as marriage and childbirth constrain women's labour market decisions, as they start to take on a majority of childcare and home responsibilities, spending up to twice as much time on unpaid care work as men, for instance (OECD, 2019). In addition to these differential constraints, which may lead to women choosing to work fewer hours, opting out of the labour market, or working in different firms or occupations, gendered changes in preferences also affect labour market decisions over the life cycle. Relevant research on the gender wage gap over the life cycle therefore sheds light on how women's labour force participation at both the extensive and intensive margin, as well as their occupational and firm choice, vary over the life cycle and therefore contribute to the gender wage gap evolving over ages. Given a positive relationship between working hours and career outcomes (including career progression and earnings), women's choices to work fewer hours later into their working life tends to penalise their wages, especially at the time when men's careers accelerate. For instance, Gicheva (2013) finds that for young highly educated workers who put in 47 or more hours at the start of their careers, working five additional hours per week is associated with 1% higher annual wage growth, and that differences in hours worked between men and women account for up to half of the gender gap in wage growth in white collar occupations. Bertrand et al. (2010) similarly found that though earnings at the start of careers was nearly identical for male and female MBA graduates, the gender earnings gap reached about 60 log points ten years after graduation, with a large share of this difference accounted for by gender differences in career interruptions and weekly hours, as well as differences in training prior to the MBA. Blundell et al. (2019) find that subsidising training would most help women with high school education to reduce the wage gap that arises post childbirth as it compensates for some of the lost human capital accumulation during post-childbirth breaks from work. For women with college education, the gap in human capital accumulation would remain large even after systematic policies to train them, implying that it would be difficult to solve the problem of reduced human capital accumulation due to career breaks arising from childbirth and family-related reasons through policies such as retraining.

Looking at research on the gender pay gap over the life cycle, for instance, panel data analysis in Denmark shows most of the gender inequality in earnings could be attributed to the arrival of children, which results in a gender gap in earnings of about 20% that persists through the life cycle in 2013 (Kleven et al., 2019b). Kleven et al. (2019a) also found that as traditional factors such as discrimination and gender differences in workforce composition faded in importance, the fraction of gender earnings inequality caused by child penalties increased in importance over time -

from explaining about 40% in 1980 to about 80% in 2013. Child penalties affect the gender wage gap through multiple channels including labour force participation, hours of work, and wage rates, as well as occupational choice, career progression and firm choice. In another Scandinavian context, even *within* Swedish couples there is a long-term negative effect on women's wages relative to their partners upon entering parenthood, as compared to before having children, there is a ten percentage point increase in the difference between women's monthly wages relative to their husbands fifteen years after first childbirth (and a 32 percentage point increase in the difference between incomes), with the increase in the gap in wages being gradual, likely attributed to childcare responsibilities at home. In the US, motherhood reduced women's probability of employment by about thirty to forty percentage points, with most of the reduction occurring in the one year immediately after childbirth and recovering very little in the subsequent five to ten years (Kuziemko et al., 2018). This chapter conducts a longer term life cycle analysis to find that working in more flexible occupations at older ages accounts for more than a quarter of the increase in the gender wage gap between ages 25 and 55. There is no separate analysis of when the timing of the movement into flexible occupations matters most for the gender wage gap, but these results are indicative of a longer term effect of flexibility than has been previously explored in the literature. Though these motherhood effects are smaller for college graduates, who are more attached to the labour market than lower educated women (Guryan et al., 2008), they are still of substantial magnitude. This reduction in employment for college educated women is especially notable because it is associated with these women facing 'unanticipated' costs of motherhood in terms of having to manage both a career and family, that lead them to update their beliefs about being able to do so. This pattern is in sharp contrast to earlier cohorts of women, who were more likely to underestimate their future labour supply, and a potential explanation for this is that the employment costs of motherhood have risen unexpectedly in recent years (after first declining from the mid-20th century). This chapter does not look at the evolution of the gender wage gap pre– and post-childbirth, instead looking at the gender wage gap for comparable groups at different ages to consider how differences in labour market decisions at these ages contribute to the gender wage gap differently across the life cycle.

The widening of the gender pay gap over the life cycle has been associated with increased gender differentials in human capital and productivity as women leave the workforce as they age, as well as with differences in offered wages, with policies that reduce gender differences in job turnover, gender segregation in jobs and gender differences in parental leave eligibility most effective in reducing the gender wage gap (Amano-Patiño et al., 2019). Costa Dias et al. (2016) and Costa Dias et al. (2018) find for the UK that the gender wage gap (which exists but is relatively stable before motherhood) widens over the life cycle as women's working patterns change after motherhood as women change where and how much to work. This is supported by evidence from Germany that finds that having children imposes costs on women's careers throughout the life cycle because of skill deterioration, lost earnings opportunities, and selection into (lower-paying) child-friendly work and occupations, with fertility accounting for about a third of the gender pay gap in Germany (Adda et al., 2017). Related research from Denmark using IVF data finds that fertility has long-lasting negative effects on earnings, driven mainly by reductions in hourly earnings as women moved to lower-paying jobs closer to home (Lundborg et al., 2017). Part of the increase in the gender wage gap post-childbirth can be associated with women working less as they fully take on childcare responsibilities, whereas women who do continue working after motherhood do still have to take on a higher share of childcare and responsibilities at home meaning that they may either work part-time or may prefer more flexible jobs. Cortés and Pan (2019) find that increases in low-skilled immigrant labour in the US reduced the costs associated with working long hours and therefore reduced the wage gap, moving a large share of women to higher percentiles of the male wage distribution as the share of women in occupations that rewarded long hours increased. All of this evidence suggests that central to the discussion around the gender wage gap is women's ability to manage both career and a family, as traditional gender roles (even in the most developed countries) mean that women spend more time on responsibilities at home (including unpaid care work) compared to men (Ferrant et al., 2014). Though policies such as maternity pay and subsidised public childcare have all contributed to reducing some of these additional pressures on women's time (Brewer et al., 2006, 2012; Chevalier and Viitanen, 2002; Attanasio et al., 2008), demands on women's time from both the workplace and family have changed such that there remains a strong wage penalty associated with working after motherhood. The analysis in this chapter found that more than a quarter of the increase in the gender wage gap over the life cycle could be attributed to women sorting into more flexible occupations at older ages, as men increasingly sorted into less-flexible (and higher paying) occupations as they got older.

This chapter also considers how flexibility is associated with changes in the gender wage gap across the distribution, and find that though patterns across the distribution remain qualitatively similar, the wage penalty associated with working in flexible occupations is important in explaining the life cycle increase in the gender wage gap for women at the top of the distribution. Research concerned with inequality across the earnings distribution has found that earnings convergence has mostly stalled towards the upper end of the distribution (Guvenen et al., 2014; Granados and Wrohlich, 2019), though there is limited evidence on factors that may be preventing women from accessing the highest-paid jobs. The results presented in this chapter suggest that women's higher demand for flexibility (as they tend to work in occupations that impose a wage penalty that increases over time) may be a reason for their continued under-representation at the top of the earnings distribution. This relates to literature that states that the earnings premium for working long hours in occupations has increased in recent decades (Kuhn and Lozano, 2008; Cortés and Pan, 2019), but explicitly links the wage penalty from working in occupations that are characterised as more flexible to women's inability to fully surpass the glass ceiling effect. This analysis also consider how flexibility has been associated with changes in the gender wage gap for successive cohorts over time, and find that though the gender wage gap has mostly reduced overall for cohorts of all age groups, the reductions in the gender wage gap that took place would have been larger in the absence of changes in flexibility, especially for the most recent (and youngest) cohorts of 25-34 year olds between 1965 and 1985. Though existing research has looked at factors associated with changes in the gender wage gap across the distribution and over time (Fortin et al., 2011; Firpo et al., 2009; Blau and Kahn, 2017; Granados and Wrohlich, 2019; Guvenen et al., 2014), there has been limited evidence considering how a specific occupational characteristic (as opposed to general differences in occupation and industry) is associated with changes in the gender wage gap over the life cycle and over time.

A related strand of the literature links the gender wage gap to the part-time pay penalty, however, this is not directly relevant to the question explored in this chapter. For instance, Manning and Petrongolo (2008) report that though the gender wage gap declined for full-time working women between 1975 and 2001, this was not true for part-time working women, with most of the difference in the pay between full-time and part-time women explained by occupational segregation, as jobs that offer part-time work tend to be lower quality. Liu (2016) found using SIPP data that preferences for part-time work increased with marriage and the number of children for women but not men, and that these demographic factors explained a sizable proportion of the gender employment gap, but only about 6% of the gender wage gap in the US. Recent research has also shown for the US that though within occupation returns to hours are small or even negative, when looking across occupations, those occupations that have longer hours worked on average have higher hourly wages (Denning et al., 2019). This means that women selecting into occupations with lower average hours explains a large and increasing share of the gender wage gap, and the authors estimate that the gender wage gap in the US would be 46% smaller today if the returns to occupation level hours remained at 1986 levels. This is related to descriptive evidence from the US that shows that in contrast to motherhood (or childbirth) being associated with a wage penalty, fatherhood is associated with a wage premium, and this fatherhood wage premium has increased with the motherhood wage penalty, as the returns to working "long hours" increased over time (Weeden et al., 2016). This is closely related to the analysis in this chapter, which considers the importance of occupation flexibility on men's and women's wage progression over the life cycle, where occupation flexibility is linked to the duration that workers are expected to be 'present' at the workplace, with occupations that have higher expectations in this regard being less flexible and higher paying. When part-time workers are excluded from analysis, results do not change substantially, suggesting that the definition of flexibility used here does not relate to individuals' specific working arrangements, but rather to their occupation as a whole.

The literature on flexibility shows that jobs that are more flexible are on average worse paid, so that women's higher demand for more flexibility would prevent their wages from fully converging to those of men. Evidence from a field experiment on a Chinese job board found that workers valued job flexibility and were willing to take lower pay for more flexible jobs (defined as both time flexibility and place flexibility), and that they especially valued place flexibility - they were more likely to apply for flexible jobs conditional on salary offered, and also reported lower reservation wages in exchange for more flexibility (He et al., 2019). They found that married men valued *both* place and time flexibility, whereas married women strongly valued having any type of flexibility and valued flexibility the most, whereas unmarried women did not value flexibility more than unmarried men did. Le Barbanchon et al. (2020) finds that unemployed women are much less willing to commute long distances for work, and this supply-side difference in lower willingness to pay for commute distances translated to lower willingness to pay contributes to them getting lower wages in their next job. Mas and Pallais (2017) also try to estimate the willingness to pay distribution for alternative work arrangements and find that on average workers are willing to give up 20% of wages to avoid jobs where employers set schedules at short notice, and 8% of wages to be have the option to work from home, as opposed to the number of hours they worked. They also found that though women did not value flexibility in schedules, they valued working from home and avoiding irregular work schedules more than men did, especially if they had young children. Chen et al. (2017) found that Uber drivers in the US required a 54% increase in wages to compensate them for the inability to adapt hourly to reservation wage shocks, and a 178% increase in wages if they were unable to adapt both daily and hourly, suggesting that Uber drivers would reduce their labour supply by about two thirds if they were required to supply labour inflexibly at prevailing wages. Wiswall and Zafar (2018) also find using a stated preferences approach that undergraduate students are willing to give up between 1.3% to 5.1% of annual earnings for additional flexibility (defined as lower hours and ability to work part-time) and women especially have a higher willingness to pay especially for being able to work part-time (7.3% compared 1.0% for men). Furthermore, research using German panel data shows that though the provision of flexible working arrangements and working time autonomy are associated with increases in hours worked for both men and women, only men see increases in income from these arrangements, pointing out that the wage penalty accruing from working flexibly may be gendered (Lott, 2015). Duchini and Van Effenterre (2018) use a French policy reform to provide causal evidence that removing constraints related to children's presence at home allows women to close 6% of the gender wage gap by enabling them to work longer and more regular hours. Longer hours in occupations and medical specialities reduced the likelihood of women working in them (Wasserman, 2019; Cortés and Pan, 2016; Cortes and Pan, 2017; Goldin and Katz, 2011). The descriptive trends reported earlier showed that though the flexibility wage penalty does not differ in magnitude by gender, men and women sort into flexible versus non-flexible occupations differently (and vary in their sorting behaviour over the life cycle) so that women end up bearing the brunt of working in more flexible occupations at more senior stages in their career, leading to a significant difference in pay. The analysis in this chapter does not try to disentangle the preferences for flexibility, instead taking occupational choices as given in decomposing the gender wage gap accrued to these choices, which enables consideration of whether it is the observed gender differences in occupational choice in terms of their flexibility that matters more than the gender differences in returns within these occupations.

Though part-time work and the ability to work lower hours are both related to flexibility, the research question of interest is related to flexibility as an occupation characteristic, and not directly related to the hours worked by the individual, which is a more contemporaneous choice on the individual's part. This measure of flexibility is defined as being related to the need to be present at the workplace and was introduced by Goldin (2014), who suggested that jobs are structured inflexibly so that there are disproportionate returns to working hours longer than average and working specific hours. The definition of workplace flexibility used, based on Goldin (2014), measures whether workers in an occupation have the ability to control their working schedule and structure. For instance, Lazear and Shaw (2007) reports for large US firms that the share of group work in all kinds of work has increased from 27% to 87%, which implies that workplaces increasingly require employees to be more present in the workplace, and have been paying an increasing premium for working long hours (Kuhn and Lozano, 2008; Cortés and Pan, 2019), reducing the amount of control employees have over their own working hours or location. Our contribution to this literature therefore arises in linking a measure of flexibility that defines flexibility as an characteristic of the occupation (across all workplaces and individuals) with the evolution of the gender wage gap.

This chapter investigated how gender differences in flexible work affect the changes in the gender wage gap over the life cycle and over time in the UK. Results show that women in the UK increasingly worked in flexible occupations over the life cycle and over time. Working in flexible occupations imposes a wage penalty, even after controlling for age, on both graduate men and women, but the wage penalty is larger for graduate women than men. This penalty has increased over time and increases over ages for both men and women, with the changes over time and ages slightly more pronounced for women than for men. For instance, a 40 year old graduate woman born in 1975-1979 faced a flexibility wage penalty close to 30% higher than a similarly aged graduate woman born in 1955-59, indicating changes to the flexibility wage penalty over time. On the other hand, compared to a 25 year old graduate woman, a 40 year old graduate woman from the 1975-79 cohort faced a flexibility wage penalty that was 40% larger, which indicates changes to the flexibility wage penalty over ages for the same cohort of individuals. Results from decomposition of the graduate wage gap suggest that more than a quarter of the average increase in the wage gap over the life cycle is explained by women sorting into flexible occupations as they grow older.

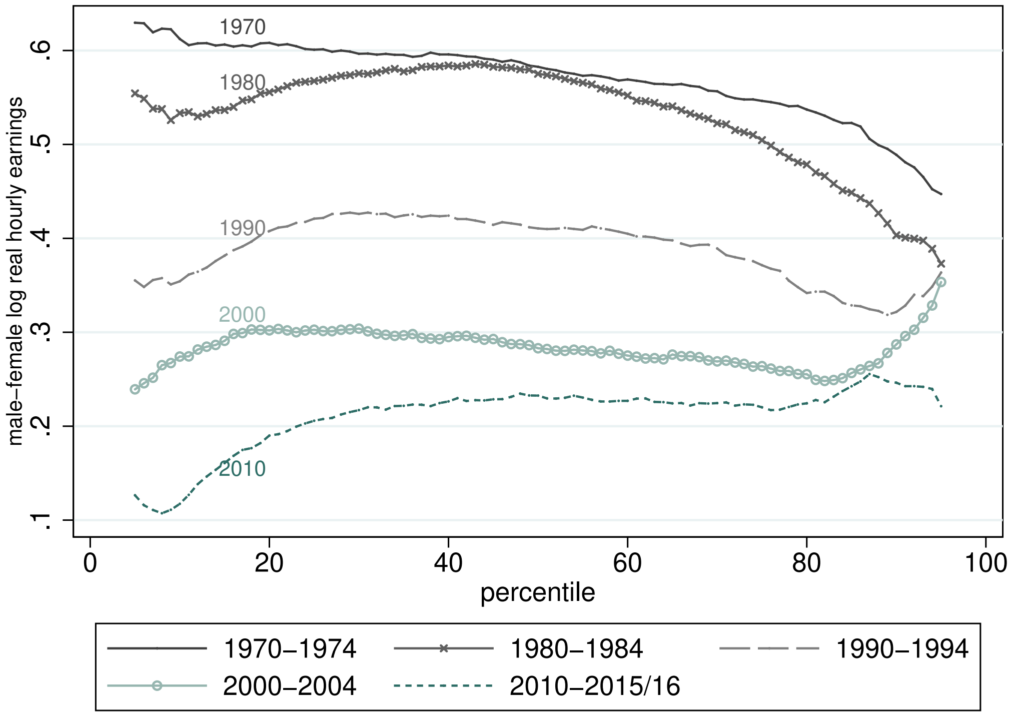
1.8 Conclusion

This chapter considers the role of occupation flexibility in explaining the evolution of the gender wage gap in the UK. Descriptive evidence suggests that though women have made strides in terms of gender pay equality, they remain massively under-represented in the upper part of the male earnings distribution, even when considering only graduates. Recent analysis of the evolution of the gender wage gap over the life cycle has paid attention to the importance of work flexibility in determining how male and female wages evolve over time for individuals. The existing literature on this subject has defined flexibility using part-time work, hours worked, job amenities, as well as commuting distance from home, which all tend to be reported at the individual level. They all broadly relate to the idea that as women become mothers, they face additional pressures on their time due to childcare responsibilities, and so workplace flexibility (in time or location) enables them to manage their careers along with their family lives more effectively. Occupations are defined as flexible using a flexibility score calculated based on externally reported occupation characteristics, and this measure of occupation flexibility is used to determine the importance of sorting into flexible occupations in how the gender wage gap evolves over the life cycle. The descriptive patterns related to flexibility cannot be explained by social and abstract skills, occupational traits that have also received attention in the literature.

Graduate women increased their participation in flexible occupations over the life cycle and across cohorts whereas men moved out of flexible occupations over the life cycle. The wage penalty associated with flexibility increases over cohorts and over the life cycle. Furthermore, the graduate gender wage gap increased over the life cycle for all cohorts. A quantile decomposition analysis of the gender wage gap over the life cycle is conducted in order to explain whether these results are driven by changes in workforce composition as men and women move between flexible and non-flexible occupations, or by changes in the flexibility wage penalty. Gender difference in changes to the shares of men versus women working in flexible occupations explains more than a third of the increase in the wage gap between age 25 and 52y at the 20th percentile and the median, compared to 12-15% of the increase at the 80th and the 90th percentiles. Furthermore, the gender wage gap fell across cohorts as the increase in later cohorts' women's wages outstripped the increase in men's wages despite women's wages being pushed down by their increasing participation in flexible occupations in more recent cohorts for all age groups, in contrast to men's wages. This suggests that the fall in the wage gap across cohorts would have been larger if not for women in more recent cohorts increasingly participating in more flexible occupations.

1.9 Tables and Figures

FIGURE 1.1: Log (male - female) hourly earnings across the distribution



Source: UK Family Expenditure Survey, 1968-2015/16.

Notes: The graph plots the difference between log male and female real hourly earnings across the distribution for each of the cohorts shown for individuals aged 25 to 55 in the Family Expenditure Survey between 1968 and 2015/16.

TABLE 1.1: 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

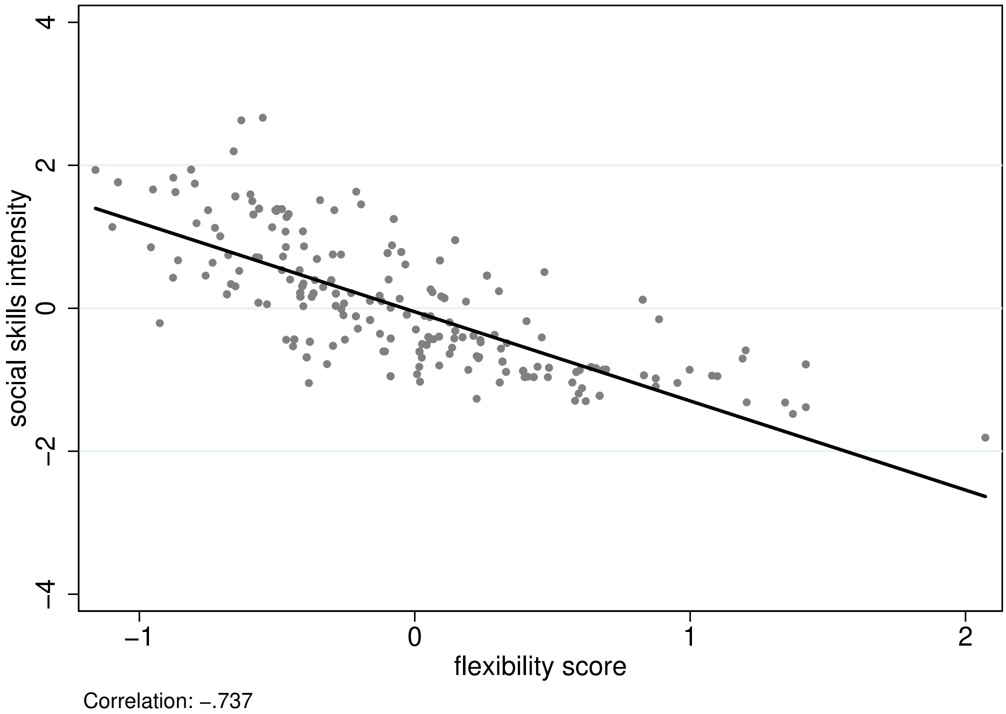
Notes: The table describes the nature of the ten most and least flexible SOC2000 minor occupation groups in the prime-aged sample of graduates in the QLFS between 2001 and 2010. For each minor occupation group, listed in order of their standardised flexibility score, the median flexibility score as well 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 1.2: Social skills intensity and occupation charcteristics in minor occupation groups for graduates between 2001 and 2010

Rank	SOC2000 3 digit	Occupation group title	Social skills intensity	Coordination	Negotiation	Persuasion	Social perceptiveness	Occupation share of graduates (%)	Male share of occupation graduates (%)	Share working part-time (%)
Highest social skills										
1	244	Public service professionals	1.94	1.62	1.38	1.71	2.82	1.58	38.9	13.9
2	113	Functional managers	1.51	1.65	1.58	1.53	1.00	9.18	67.3	5.0
3	354	Sales & related associate professionals	1.50	0.42	2.21	2.04	0.55	1.83	52.4	9.3
4	122	Managers & proprietors in hospitality & leisure services	1.48	1.57	1.83	1.38	1.14	0.88	57.6	8.1
5	241	Legal professionals	1.44	0.24	2.97	1.94	0.60	1.65	54.3	8.4
6	123	Managers & proprietors in other service industries	1.39	1.57	1.63	1.36	1.01	1.71	58.9	10.9
7	118	Health and social service managers	1.39	1.57	1.62	1.36	1.00	1.71	27.8	7.4
8	115	Financial institution and office managers	1.38	1.53	1.63	1.36	1.01	1.71	50.7	8.8
9	114	Quality and customer care managers	1.32	1.56	1.62	1.36	0.73	0.68	61.6	4.8
10	116	Managers in distribution, storage, and retailing	1.31	1.93	1.50	1.21	0.61	1.32	71.5	5.3
Lowest social skills (employing at least 0.4% of graduate sample between 2001 and 2010)										
73	922	Elementary personal services occupations (e.g. waitresses)	-0.88	-0.66	-0.92	-1.03	-0.89	0.42	40.6	52.9
64	522	Metal machining, fitting & instrument making trades	-0.73	-0.64	-0.91	-0.81	-0.77	0.47	98.0	1.4
62	421	Secretarial and related occupations	-0.69	-0.57	-0.77	-1.03	-0.38	1.47	6.0	38.7
59	531	Construction trades	-0.61	-0.10	-0.78	-0.67	-0.81	0.58	96.6	6.0
55	412	Administrative occupations: finance	-0.47	-0.52	-0.57	-0.51	-0.27	1.79	32.1	23.9
54	413	Administrative occupations: records	-0.44	-0.40	-0.55	-0.40	-0.42	1.16	41.9	24.2
53	524	Electrical trades	-0.44	-0.40	-0.46	-0.40	-0.50	0.83	97.0	1.9
52	821	Transport drivers and operatives	-0.42	-0.44	-0.33	-0.49	-0.42	0.50	89.7	16.8
49	356	Public service and other associate professionals	-0.28	-0.32	-0.33	-0.12	-0.44	2.64	40.9	14.7
46	311	Science and engineering technicians	-0.20	-0.36	-0.06	0.03	-0.44	1.10	71.4	7.9
Lowest social skills										
81	923	Elementary cleaning occupations	-1.04	-0.65	-1.15	-1.19	-1.18	0.21	37.0	61.5
80	532	Building trades	-0.96	-0.71	-1.09	-1.19	-0.94	0.09	89.6	10.9
79	921	Elementary administration occupations	-0.95	-0.93	-0.92	-1.06	-0.90	0.19	69.4	27.1
78	543	Food preparation trades	-0.93	-0.80	-0.79	-1.03	-0.84	0.23	60.8	22.3
77	521	Metal forming, welding, and related trades	-0.90	-0.48	-1.21	-1.20	-0.88	0.07	95.8	1.4
73	922	Elementary personal services occupations (e.g. waitresses)	-0.88	-0.66	-0.92	-1.03	-0.89	0.42	40.6	52.9
73	913	Elementary process plant occupations	-0.88	-0.66	-0.92	-1.03	-0.89	0.09	61.8	15.2
73	911	Elementary agricultural occupations	-0.88	-0.66	-0.92	-1.03	-0.89	0.09	72.0	13.5
73	914	Elementary goods storage occupations	-0.88	-0.66	-0.92	-1.03	-0.89	0.16	83.5	12.5
72	924	Elementary security occupations	-0.86	-0.96	-0.69	-1.03	-0.75	0.25	66.4	31.9

Notes: The table describes the nature of the ten SOC2000 minor occupation groups with the highest and lowest social skills intensity score 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 social skills intensity, the median social skills intensity as well as the median score in each of the four components of this score are shown. The occupation share of graduates is the percentage of the gradautes 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.

FIGURE 1.2: Correlation between flexibility score and social skills intensity in SOC2000 occupations



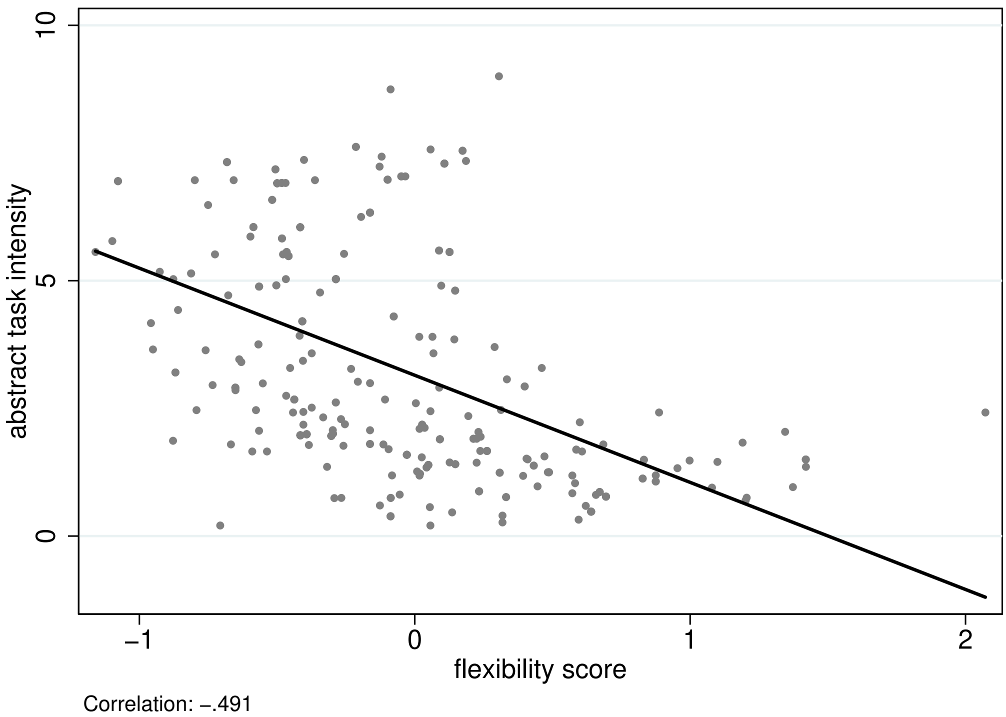
Notes: The graph plots the standardised flexibility score against the standardised social skills intensity score in SOC2000 occupations as well as the line of best fit correlating the two.

TABLE 1.3: Task intensity scores in minor occupation groups for graduates between 2001 and 2010

Rank	SOC2000 3 digit	Occupation group title	Median abstract score	Median routine score	Median manual score	Occupation share of graduates (%)	Male share of occupation graduates (%)	Share working part-time (%)
Most abstract occupations								
1	211	Science professionals	7.99	6.58	0.61	1.33	58.1	7.3
2	242	Business and statistical professionals	7.62	5.99	0.02	3.08	63.7	9.0
3	232	Research professionals	7.32	1.54	0.27	0.70	51.7	12.1
4	212	Engineering professionals	7.32	5.46	0.71	3.13	92.6	1.9
5	511	Agricultural trades	7.04	1.54	2.29	0.52	77.1	17.6
6	121	Managers in farming, horticulture, forestry, and fishing	6.98	1.71	1.88	0.16	74.4	6.0
7	113	Functional managers	6.97	1.89	0.24	9.19	67.3	5.0
8	123	Managers and proprietors in other service industries	6.91	1.88	0.49	1.71	58.9	10.9
8	118	Health and social services managers	6.91	1.89	0.47	1.71	27.8	7.4
10	112	Production managers	6.58	2.93	0.67	3.08	89.8	2.1
Least abstract occupations (employing at least 0.4% of graduate sample between 2001 and 2010)								
68	922	Elementary personal services occupations	0.86	1.71	1.61	0.42	40.6	52.9
61	531	Construction trades	1.35	7.14	3.56	0.58	96.6	6.0
55	331	Protective service occupations	1.53	1.44	2.87	1.00	74.4	2.7
54	611	Healthcare and related personal services	1.59	2.15	1.23	1.79	18.9	34.6
53	612	Childcare and related personal services	1.67	1.30	0.31	2.07	6.1	54.3
51	356	Public service and other associate professionals	1.73	1.40	2.11	2.64	40.9	14.7
50	413	Administrative occupations: records	1.78	5.12	0.10	1.16	41.9	24.2
48	522	Metal machining, fitting and instrument making trades	1.79	7.37	0.53	0.47	98.0	1.4
45	711	Sales assistants and retail cashiers	1.96	2.15	0.45	1.04	36.2	49.6
43	411	Administrative occupations: government and related organisations	1.97	6.44	0.07	1.70	36.4	17.3
Least abstract occupations								
75	822	Mobile machine drivers and operatives	0.21	5.72	3.97	0.04	98.5	2.8
74	921	Elementary administrative occupations	0.39	1.81	0.47	0.19	69.4	27.1
73	813	Assemblers and routine operatives	0.48	4.74	1.36	0.27	67.7	10.9
72	924	Elementary security occupations	0.77	1.71	0.85	0.25	66.4	31.9
71	623	Housekeeping occupations	0.80	2.69	2.13	0.08	47.3	34.3
70	812	Plant and machine operatives	0.81	5.23	1.51	0.12	94.6	1.7
68	913	Elementary process plant occupations	0.86	2.61	2.29	0.09	61.9	15.4
68	922	Elementary personal services occupations	0.86	1.71	1.61	0.42	40.6	52.9
66	814	Construction operatives	0.97	4.39	2.00	0.08	96.1	0.2
66	912	Elementary construction occupations	0.97	4.39	2.26	0.08	95.6	22.2

Notes: The table describes the nature of the ten SOC2000 minor occupation groups with the highest and lowest abstract task intensity score 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 abstract task intensity, the median intensity for abstract, routine, and manual tasks 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.

FIGURE 1.3: Correlation between flexibility score and abstract task intensity in SOC2000 occupations



Notes: The graph plots the standardised flexibility score against the standardised abstract intensity score in SOC2000 occupations as well as the line of best fit correlating the two.

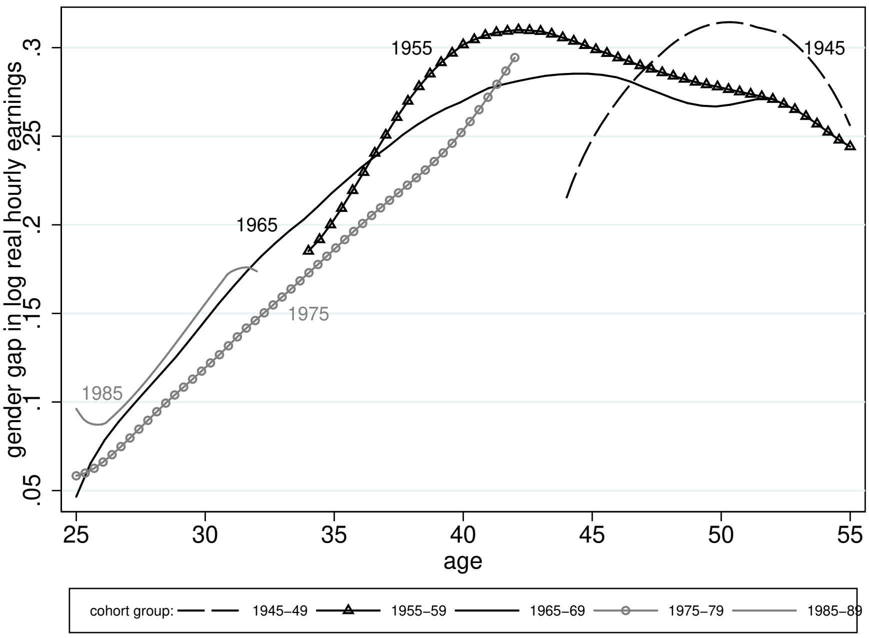
TABLE 1.4: Women's labour force participation and representation in the upper part of the male earnings distribution

	1995	2000	2005	2010	2015
PANEL A Sample: All women					
In workforce	0.622	0.649	0.675	0.694	0.713
Working full-time	0.560	0.607	0.639	0.633	0.664
Share of women with earnings higher than or equal to __ percentile of the earnings distribution of men working full-time					
50th percentile	0.270	0.298	0.324	0.347	0.367
80th percentile	0.081	0.089	0.101	0.102	0.112
90th percentile	0.034	0.035	0.042	0.040	0.045
Share of *full-time* women with earnings higher than or equal to __ percentile of the earnings distribution of men working full-time					
50th percentile	0.330	0.370	0.392	0.415	0.433
80th percentile	0.086	0.100	0.116	0.117	0.130
90th percentile	0.030	0.037	0.047	0.044	0.052
PANEL B Sample: Women with a graduate degree or higher level of education [compared to graduate men]					
In workforce	0.828	0.840	0.854	0.842	0.833
Working full-time	0.787	0.812	0.830	0.803	0.800
Share of women with earnings higher than or equal to __ percentile of the earnings distribution of men working full-time					
50th percentile	0.303	0.305	0.318	0.329	0.332
80th percentile	0.081	0.073	0.090	0.078	0.084
90th percentile	0.032	0.030	0.041	0.033	0.035
Share of *full-time* women with earnings higher than or equal to __ percentile of the earnings distribution of men working full-time					
50th percentile	0.281	0.303	0.324	0.341	0.348
80th percentile	0.062	0.066	0.089	0.076	0.088
90th percentile	0.025	0.027	0.043	0.032	0.036
Share of *full-time* women with earnings higher than or equal to __ percentile of the earnings distribution of men working full-time ***in the same occupation***					
50th percentile	0.280	0.349	0.449	0.458	0.422
80th percentile	0.073	0.103	0.168	0.167	0.151

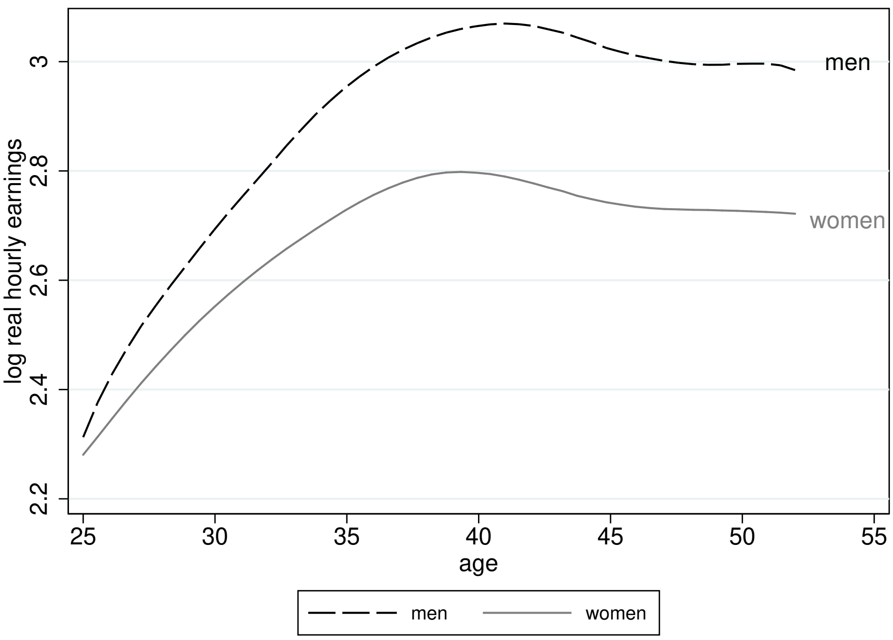
Notes: Data used in this table are from the prime-aged sample of the Quarterly Labour Force Survey and weighted to be representative of the population. In Panel A, the earnings of all women are compared to the earnings of full-time men. Panel B compares the earnings of graduate women to graduate men working full-time. The third set of shares in Panel B summarises the share of women whose earnings are in the upper portions of the earnings distribution of men in the same occupation. Occupations are defined according to UK Standard Occupation Classifications SOC90 in 1995 and 2000 and SOC2000 in 2005, 2010 and 2015. These shares represent the proportion of women whose log real hourly earnings are higher than or equal to the male occupation-specific earnings percentiles specified.

FIGURE 1.4: Gender wage gap for graduates by cohort over the life cycle

(a) Gender wage gap by cohort



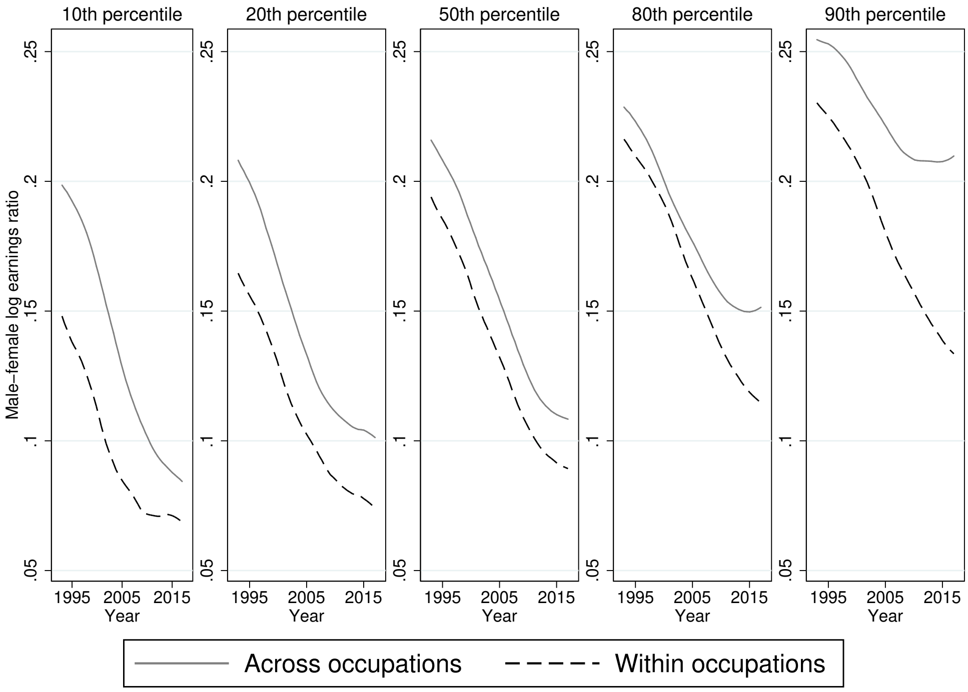
(b) Male and female wages over the life cycle for cohort born 1965-69



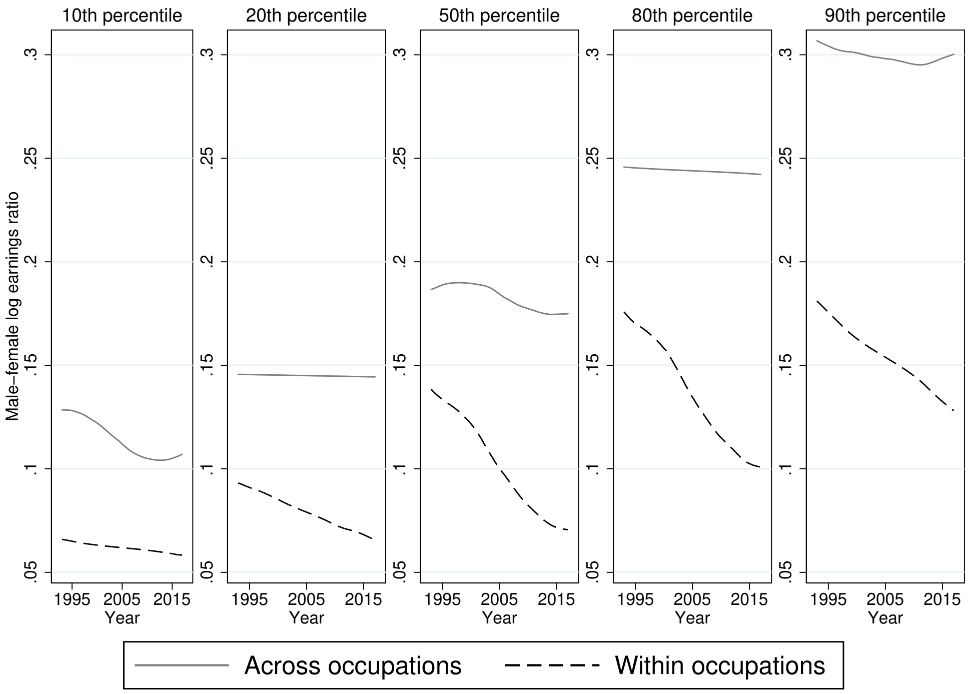
Notes: The graph in panel (a) plots the difference between log male and female real hourly earnings for different cohorts between ages 25 and 55. The graph in panel (b) plots the evolution of log real hourly earnings between ages 25 and 52 for men and women born between 1965 and 1969. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

FIGURE 1.5: The gender wage gap within and across occupations, across the distribution over time

(a) Overall gap in earnings for full-time employees



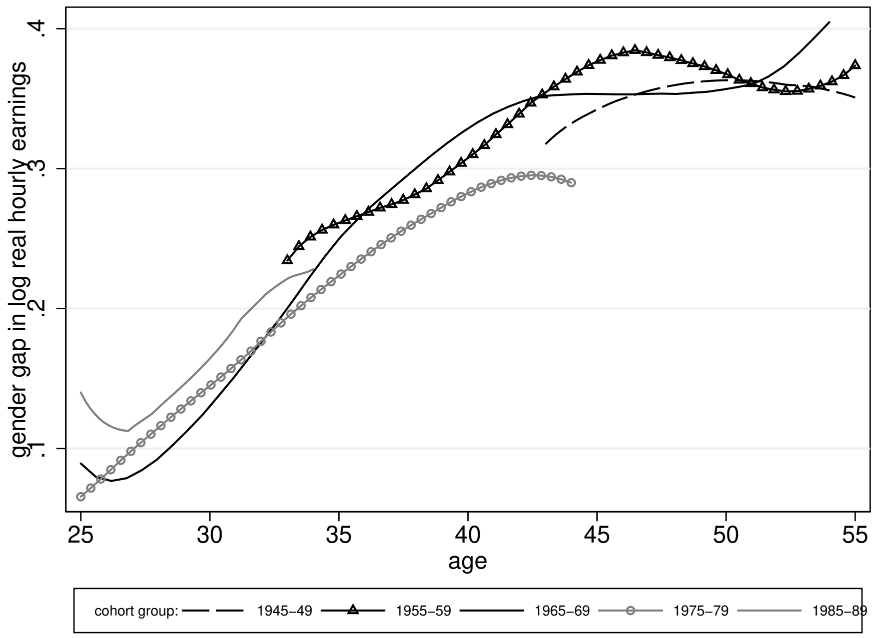
(b) Gap in earnings for graduate full-time employees



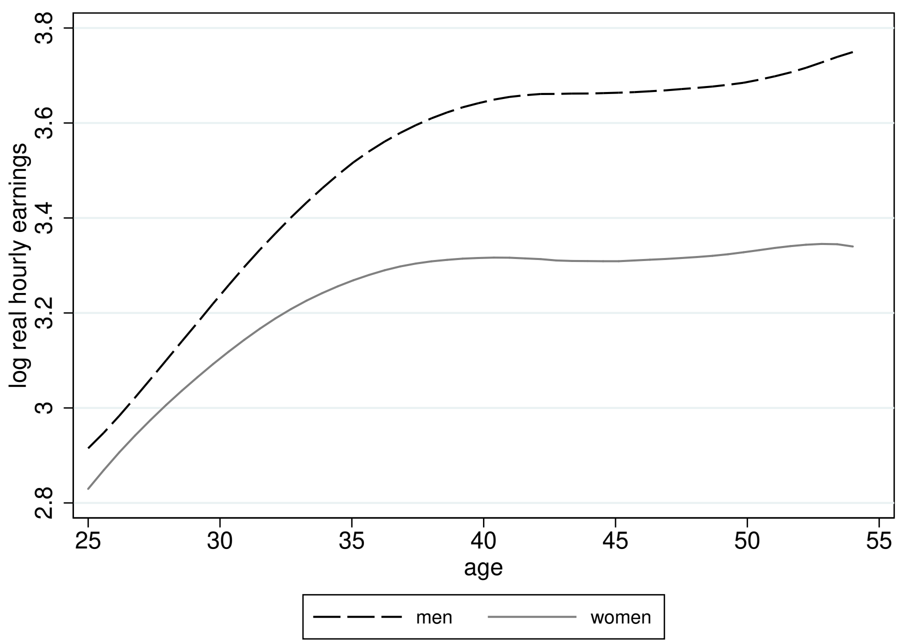
Notes: The graphs plot the difference between log male and female real hourly earnings at different percentiles of the earnings distribution, both within and across occupations - panel (a) for all full-time workers, and panel (b) for graduate full-time workers. The plotted lines are smoothed local polynomials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

FIGURE 1.6: Gender wage gap for US graduates, by cohort, over the life cycle

(a) Gender wage gap by cohort

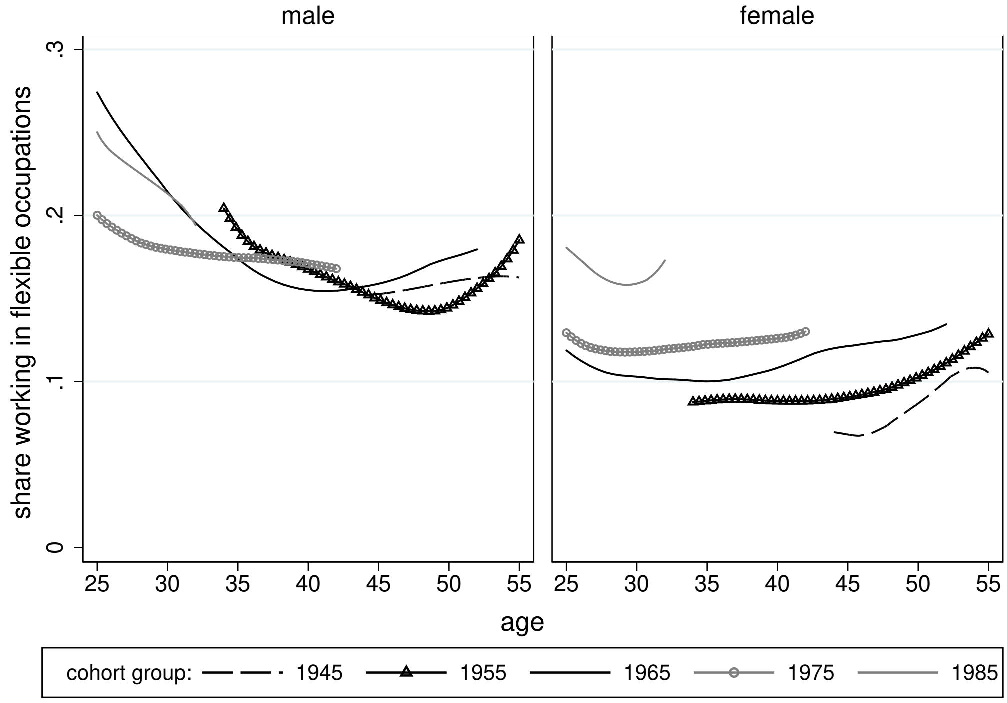


(b) Male and female wages over the life cycle for cohort born 1965-69



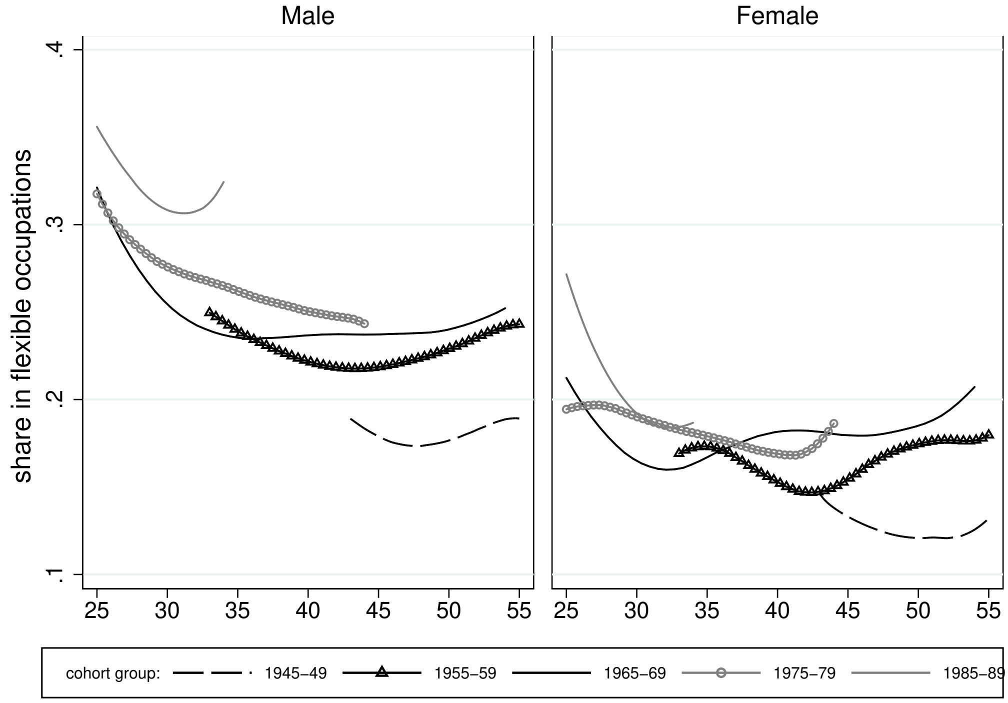
Notes: The data for this graph comes from IPUMS harmonised data for the US from 1992 to 2019. The graph in panel (a) plots the difference between log male and female real hourly earnings for different cohorts between ages 25 and 55. The graph in panel (b) plots the evolution of log real hourly earnings between ages 25 and 52 for men and women born between 1965 and 1969. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

FIGURE 1.7: Share of graduates working in flexible occupations by cohort, over the life cycle



Notes: The graphs plot the share of male and female graduates 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. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

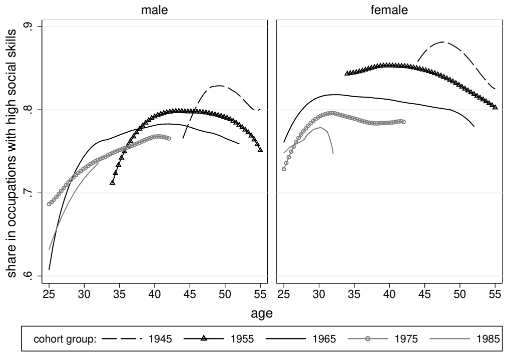
FIGURE 1.8: Share of US graduates working in flexible occupations by cohort, over the life cycle



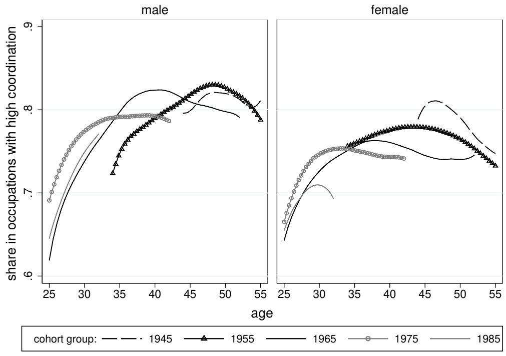
Notes: The data for this graph comes from IPUMS harmonised data for the US from 1992 to 2019. The graphs plot the share of male and female graduates working in flexible occupations, as defined by a binary indicator, across different cohorts between ages 25 and 55. The binary indicator defines flexible occupations as those that have a flexibility score above the median for all occupations. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

FIGURE 1.9: Share of graduates working in occupations with high social skills scores

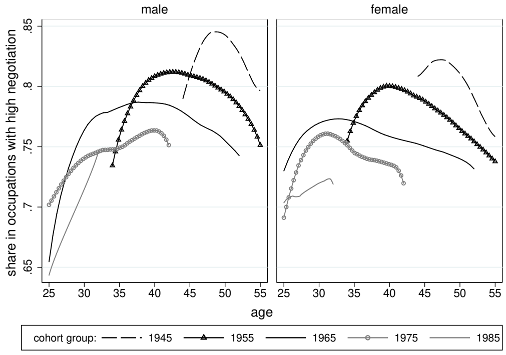
(a) Social skills intensity



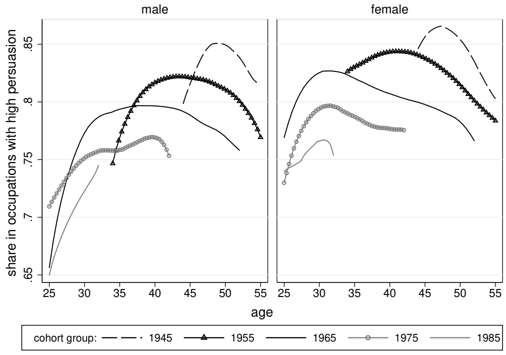
(b) Coordination



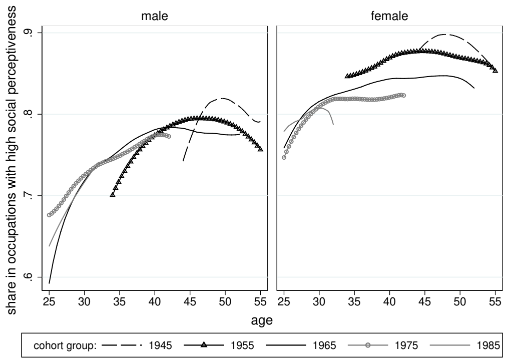
(c) Negotiation



(d) Persuasion



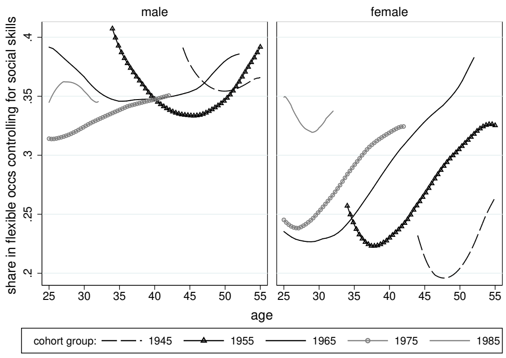
(e) Social perceptiveness



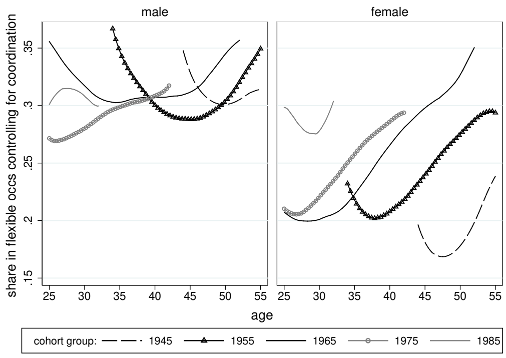
Notes: The graphs plot the share of individuals in each cohort between ages 25 and 55 who work in occupations that score higher than the median across all occupations on the social skills intensity score and each of its individual components. This is analogous to how the binary indicator for flexible occupations is defined to calculate the share working in flexible occupations.

FIGURE 1.10: Share of graduates working in flexible occupations controlling for social skills

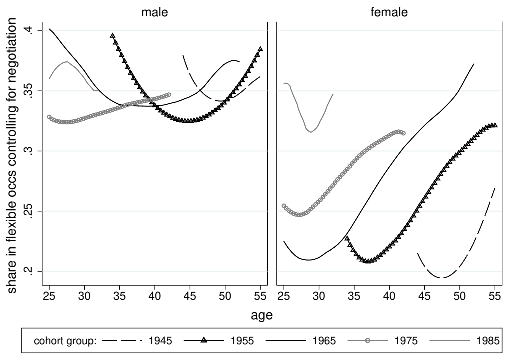
(a) Social skills intensity



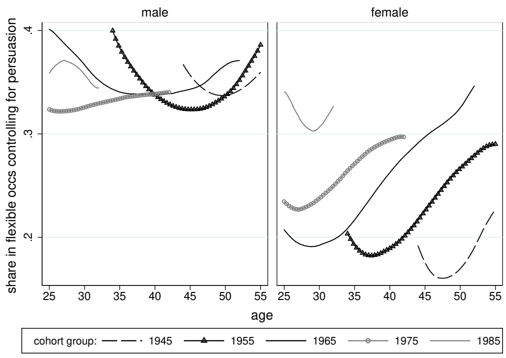
(b) Coordination



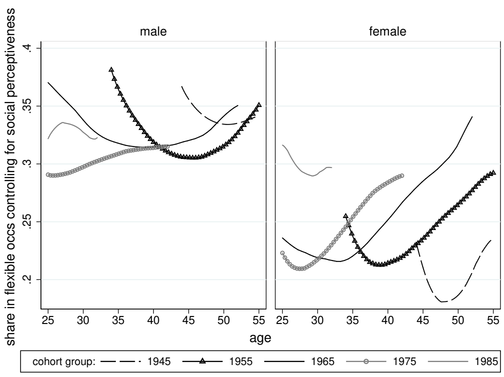
(c) Negotiation



(d) Persuasion



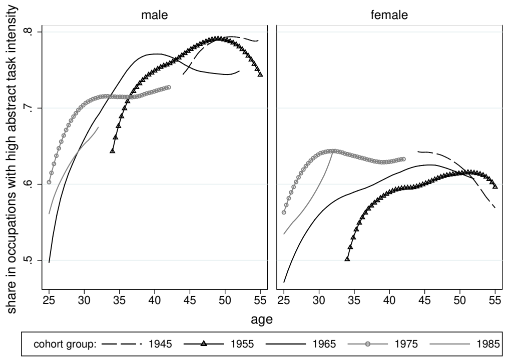
(e) Social perceptiveness



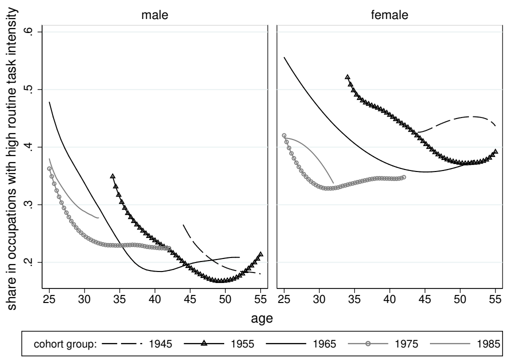
Notes: The graphs plot the share of individuals in each cohort between ages 25 and 55 who work in flexible occupations after having controlled for the social skills intensity score or its individual components in the occupation.

FIGURE 1.11: Share of graduates working in occupations with high abstract, routine, and manual task intensity

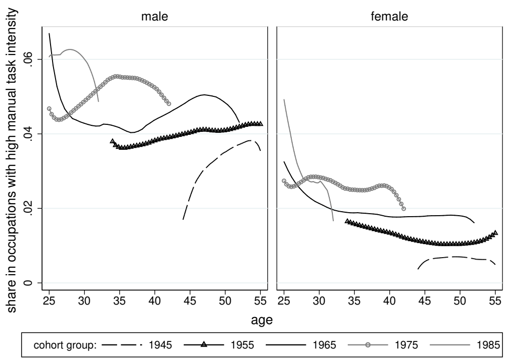
(a) Abstract task intensity



(b) Routine task intensity



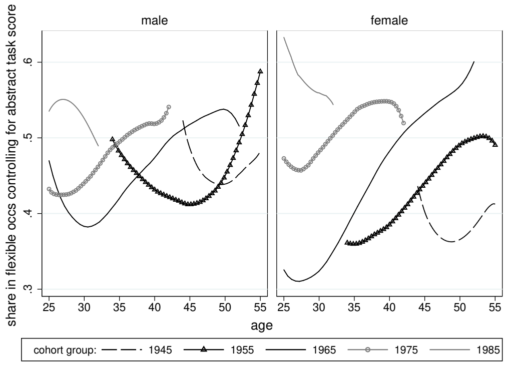
(c) Manual task intensity



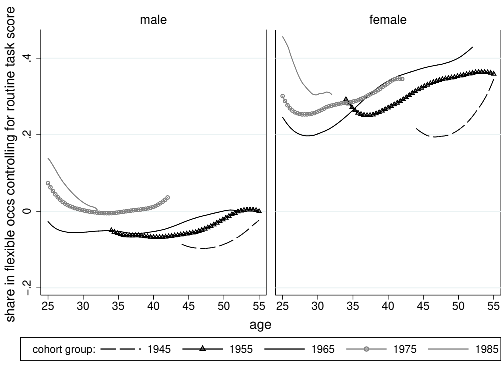
Notes: The graphs plot the share of individuals in each cohort between ages 25 and 55 who worked over the life cycle in occupations that score the highest in abstract task intensity, routine task intensity, and manual task intensity, respectively, when comparing between the three task measures.

FIGURE 1.12: Share of graduates working in flexible occupations controlling for task intensity measures

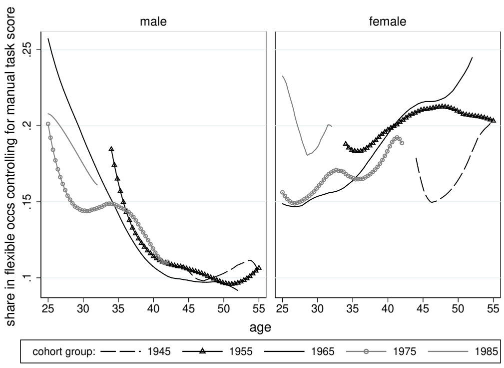
(a) Abstract task intensity



(b) Routine task intensity

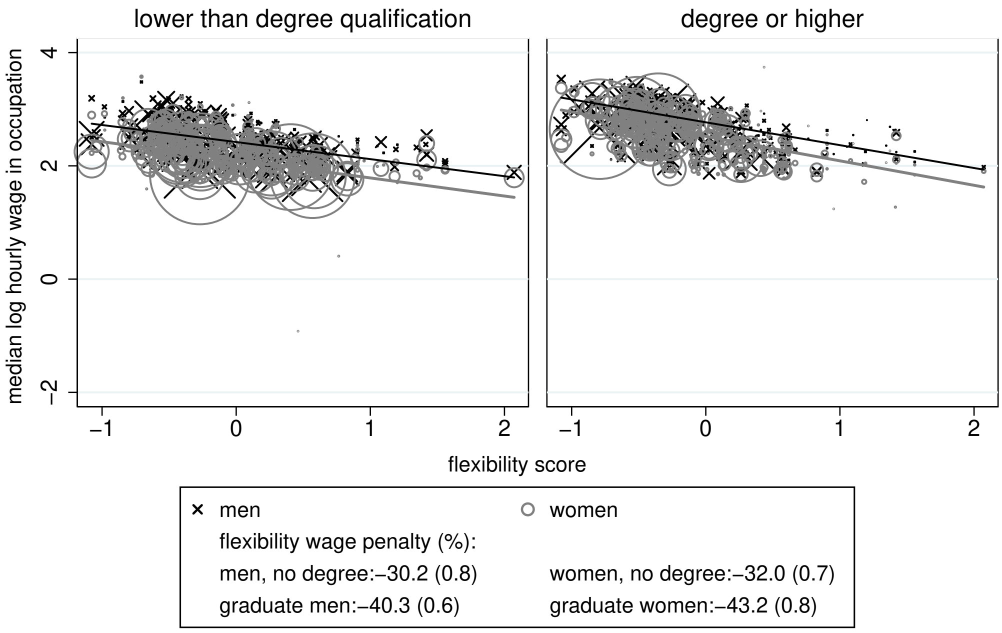


(c) Manual task intensity



Notes: The graphs plot the share of individuals in each cohort between ages 25 and 55 who work in flexible occupations after having controlled for each of the task intensity measures.

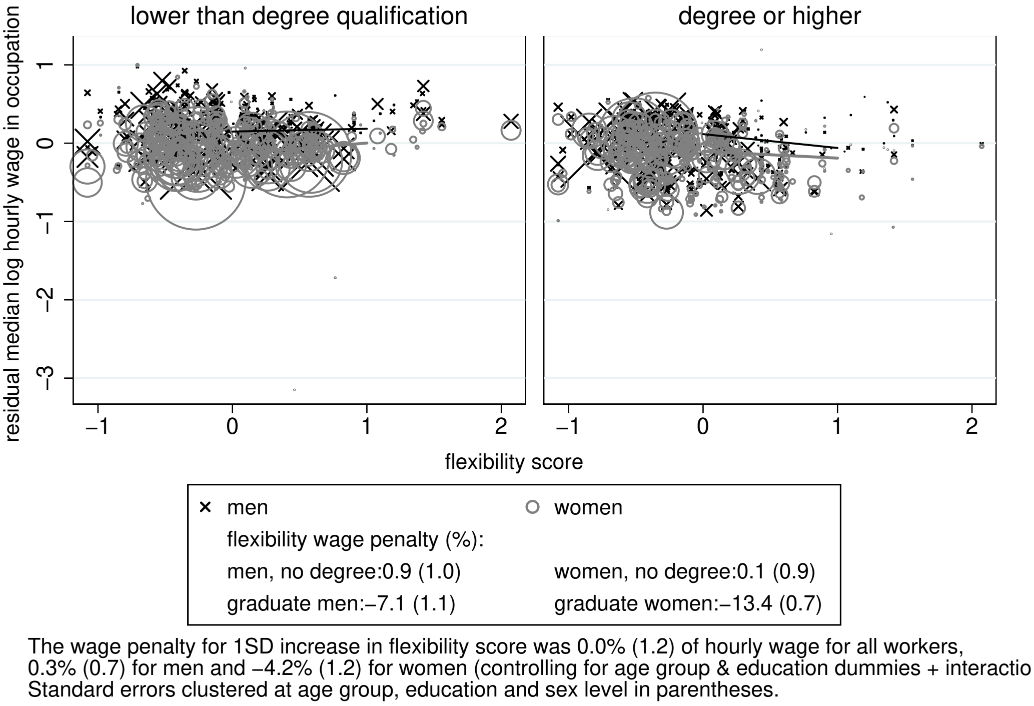
FIGURE 1.13: Unconditional wage penalty associated with flexibility in occupations



The wage penalty for 1SD increase in flexibility score was −45.1% (2.6) of hourly wage for all workers, −43.9% (3.0) for men and −50.8% (3.3) for women.
Standard errors clustered by age group, education and sex in parentheses.

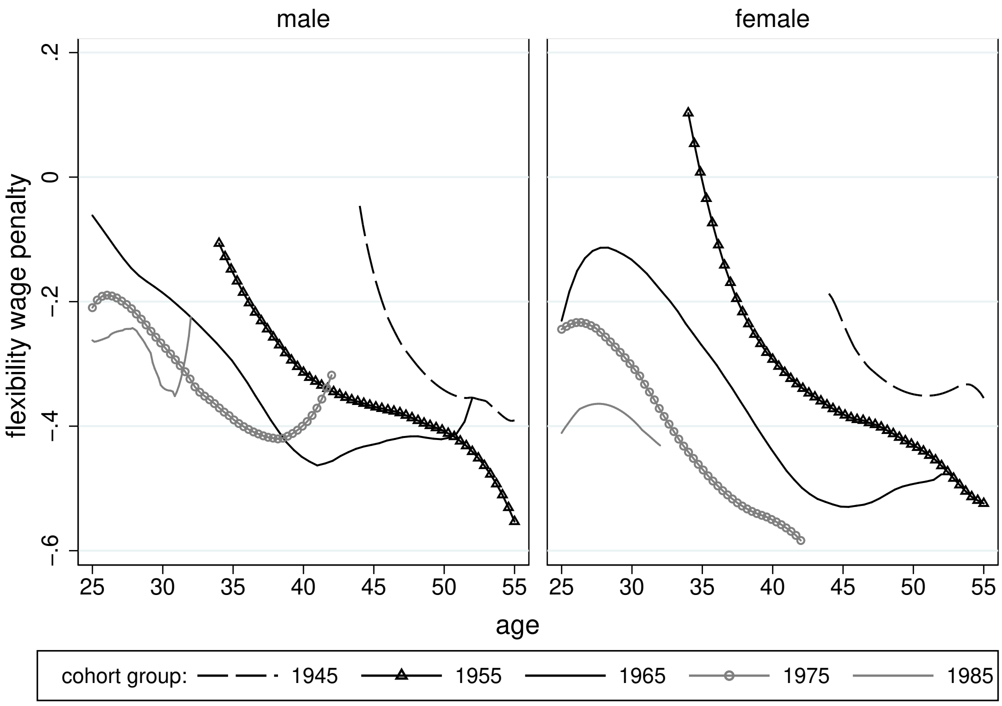
Notes: The graphs plot the median log hourly earnings in occupation against the occupation's standardised flexibility score, for non-graduates and graduates separately. The size of the markers indicate the employment share of women in the occupation. The slope of the regression lines indicate the unconditional wage penalty associated with a 1SD increase in the flexibility score. For the calculated unconditional wage penalties, standard errors clustered by age group, education level and sex are included in parentheses.

FIGURE 1.14: Wage penalty associated with flexibility in occupations, conditional on age group and education levels



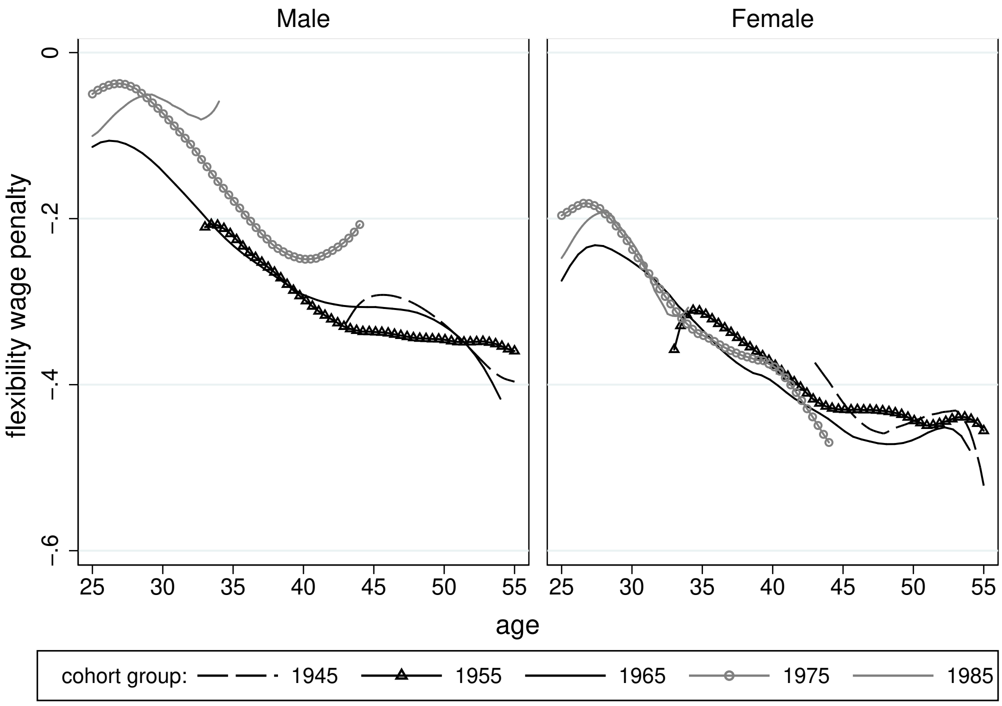
Notes: The graphs plot the median log hourly earnings in occupation against the occupation's standardised flexibility score, controlling for differences in age groups and education levels, for non-graduates and graduates separately. The size of the markers indicate the employment share of women in the occupation. The slope of the regression lines indicate the conditional wage penalty associated with a 1SD increase in the flexibility score. For the calculated conditional wage penalties, standard errors clustered by age group, education level and sex are included in parentheses.

FIGURE 1.15: Flexibility wage penalty for graduates by cohort, over the life cycle



Notes: The graph plots the evolution of the wage penalty associated with a 1SD increase in occupation flexibility score between ages 25 and 55, separately for male and female graduates in different cohorts. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

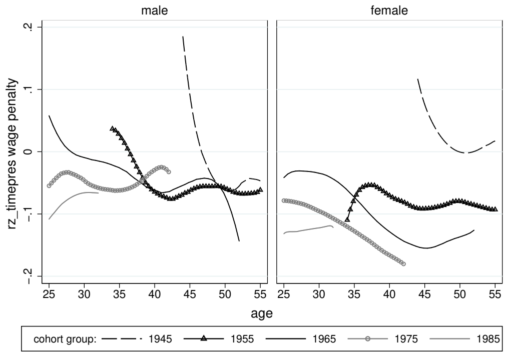
FIGURE 1.16: Flexibility wage penalty for US graduates by cohort, over the life cycle



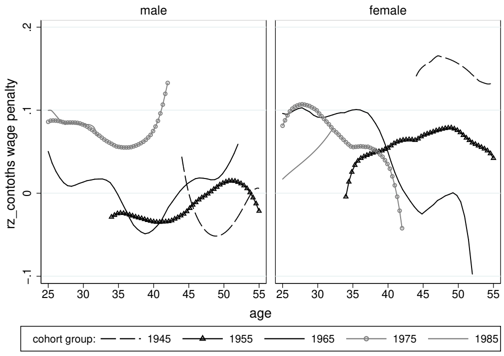
Notes: The data for this graph comes from IPUMS harmonised data for the US from 1992 to 2019. The graph plots the evolution of the wage penalty associated with a 1SD increase in occupation flexibility score between ages 25 and 55, separately for male and female graduates in different cohorts. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

FIGURE 1.17: Wage penalty associated with components of the flexibility measure

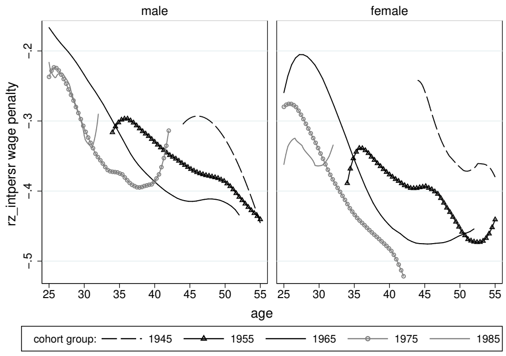
(a) Time pressure



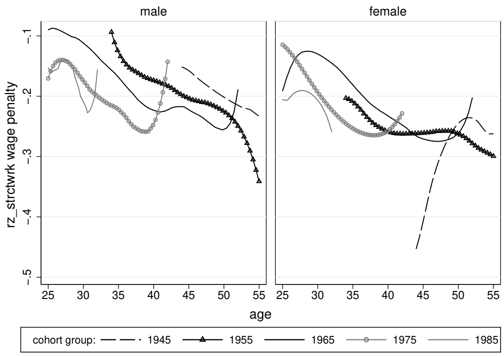
(b) Contact with others



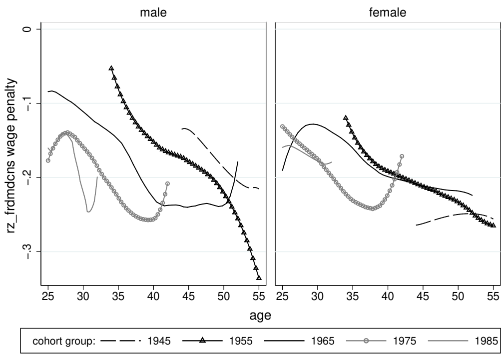
(c) Establishing and maintaining interpersonal relationships



(d) Structured work



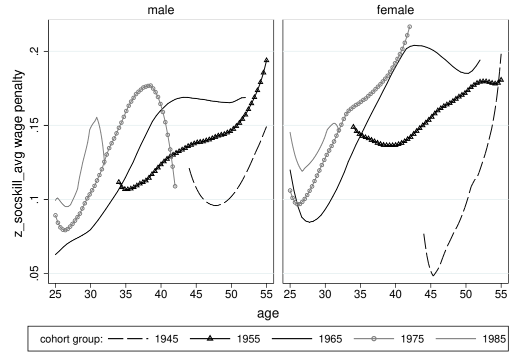
(e) Decision-making freedom



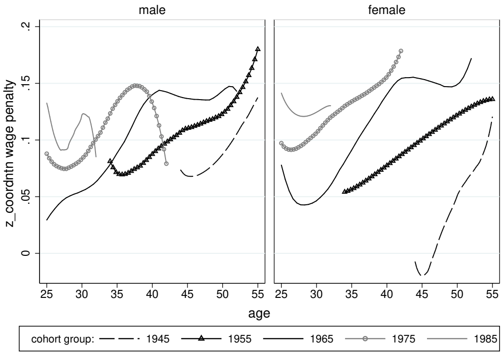
Notes: The graphs plot the evolution of the wage penalty associated with a 1SD increase in the individual components of the flexibility score between ages 25 and 55, separately for male and female graduates in different cohorts. This is analogous to how the flexibility wage penalty is calculated for occupations.

FIGURE 1.18: Wage premium associated with social skills in occupations

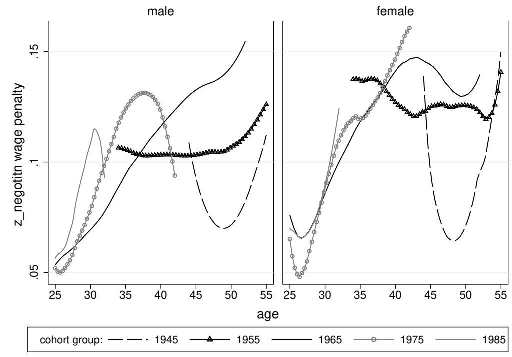
(a) Social skills intensity



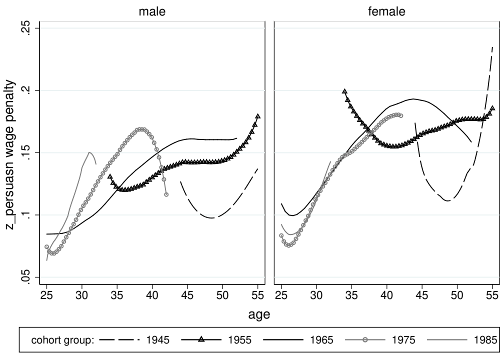
(b) Coordination



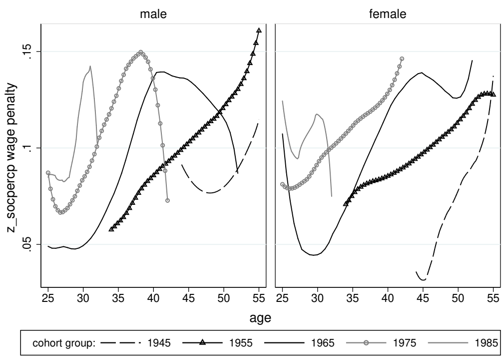
(c) Negotiation



(d) Persuasion



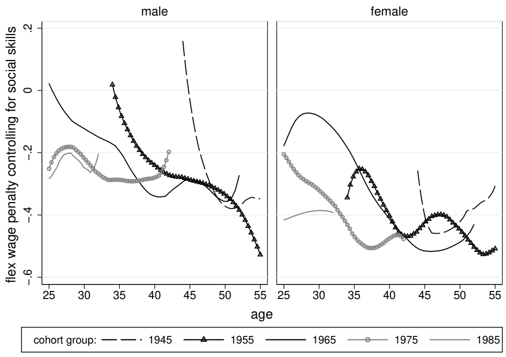
(e) Social perceptiveness



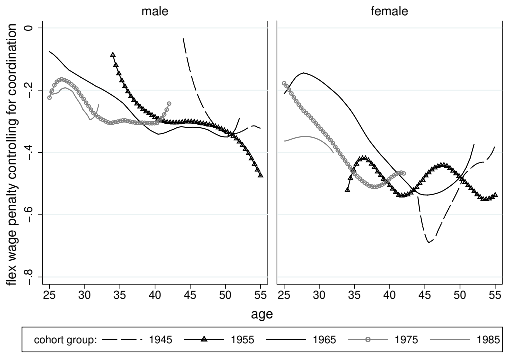
Notes: The graphs plot the evolution of the wage penalty associated with a 1SD increase in the individual components of the social skills score between ages 25 and 55, separately for male and female graduates in different cohorts. This is analogous to how the flexibility wage penalty is calculated for occupations.

FIGURE 1.19: Wage penalty associated with flexibility, controlling for social skills in occupations

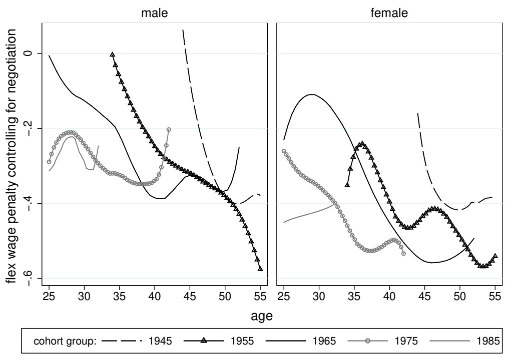
(a) Social skills intensity



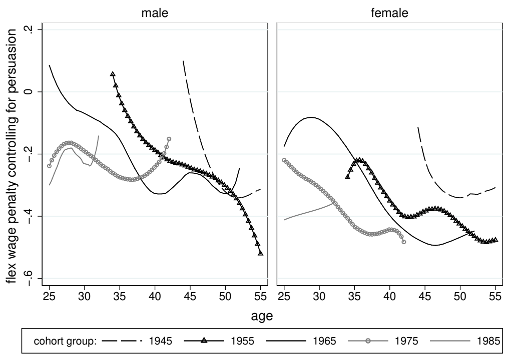
(b) Coordination



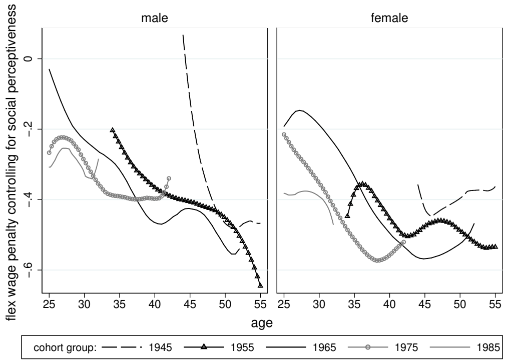
(c) Negotiation



(d) Persuasion



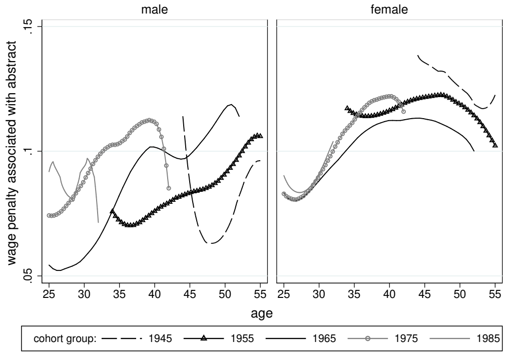
(e) Social perceptiveness



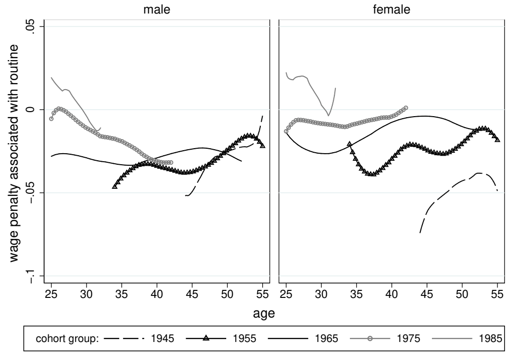
Notes: The graphs plot the evolution of the wage penalty associated with a 1SD increase in the flexibility score between ages 25 and 55, having controlled for individual components of the social skills score, separately for male and female graduates in different cohorts. This is analogous to how the flexibility wage penalty is calculated for occupations.

FIGURE 1.20: Wage premium (penalty) associated with occupation task intensity measures

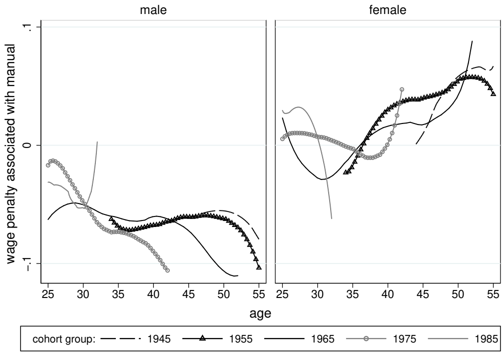
(a) Abstract task intensity



(b) Routine task intensity



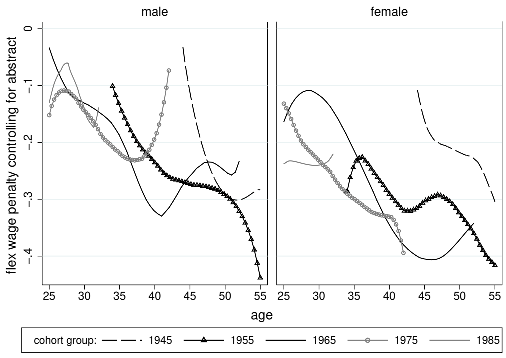
(c) Manual task intensity



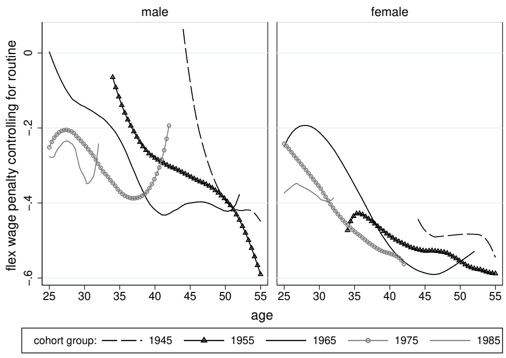
Notes: The graphs plot the evolution of the wage penalty associated with a 1SD increase in the abstract, routine, and manual task intensity scores between ages 25 and 55, separately for male and female graduates in different cohorts. This is analogous to how the flexibility wage penalty is calculated for occupations.

FIGURE 1.21: Wage penalty associated with flexibility, controlling for occupation task intensity measures

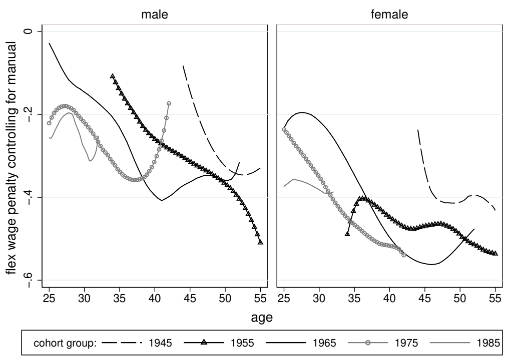
(a) Abstract task intensity



(b) Routine task intensity



(c) Negotiation



Notes: The graphs plot the evolution of the wage penalty associated with a 1SD increase in the flexibility score, between ages 25 and 55, controlling for the occupation abstract, routine, and manual task intensity scores, separately for male and female graduates in different cohorts.

TABLE 1.5: Decomposition of changes in log real hourly earnings over the life cycle for cohort of individuals born in 1965-69, at different percentiles of the earnings distribution

	Men	Women	Difference
10th percentile			
Difference in log real hourly wages (52y-25y)	0.437	0.242	0.195
	(0.087)	(0.079)	(0.116)
Changes in shares in flexible occupations (52y-25y)	0.027	-0.034	0.061
	(0.018)	(0.017)	(0.024)
Changes in returns to flexible occupations (52y-25y)	-0.075	0.041	-0.116
	(0.061)	(0.055)	(0.081)
Changes in residuals (52y-25y)	0.485	0.235	0.250
	(0.093)	(0.078)	(0.119)
20th percentile			
Difference in log real hourly wages (52y-25y)	0.465	0.205	0.260
	(0.070)	(0.052)	(0.089)
Changes in shares in flexible occupations (52y-25y)	0.034	-0.030	0.064
	(0.016)	(0.013)	(0.022)
Changes in returns to flexible occupations (52y-25y)	-0.054	-0.039	-0.015
	(0.045)	(0.031)	(0.053)
Changes in residuals (52y-25y)	0.485	0.274	0.211
	(0.075)	(0.053)	(0.091)
50th percentile			
Difference in log real hourly wages (52y-25y)	0.589	0.417	0.173
	(0.056)	(0.055)	(0.079)
Changes in shares in flexible occupations (52y-25y)	0.026	-0.046	0.072
	(0.011)	(0.018)	(0.023)
Changes in returns to flexible occupations (52y-25y)	-0.030	-0.099	0.068
	(0.032)	(0.025)	(0.040)
Changes in residuals (52y-25y)	0.593	0.561	0.032
	(0.063)	(0.062)	(0.089)
80th percentile			
Difference in log real hourly wages (52y-25y)	0.822	0.451	0.371
	(0.060)	(0.050)	(0.079)
Changes in shares in flexible occupations (52y-25y)	0.031	-0.026	0.057
	(0.011)	(0.010)	(0.015)
Changes in returns to flexible occupations (52y-25y)	-0.034	-0.021	-0.013
	(0.025)	(0.019)	(0.030)
Changes in residuals (52y-25y)	0.825	0.498	0.327
	(0.072)	(0.062)	(0.094)
90th percentile			
Difference in log real hourly wages (52y-25y)	0.868	0.544	0.325
	(0.066)	(0.055)	(0.083)
Changes in shares in flexible occupations (52y-25y)	0.022	-0.019	0.041
	(0.009)	(0.009)	(0.013)
Changes in returns to flexible occupations (52y-25y)	-0.046	-0.045	0.000
	(0.026)	(0.020)	(0.031)
Changes in residuals (52y-25y)	0.892	0.609	0.284
	(0.081)	(0.071)	(0.103)

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE 1.22: Decomposition of changes in the gender wage gap across the distribution over the life cycle

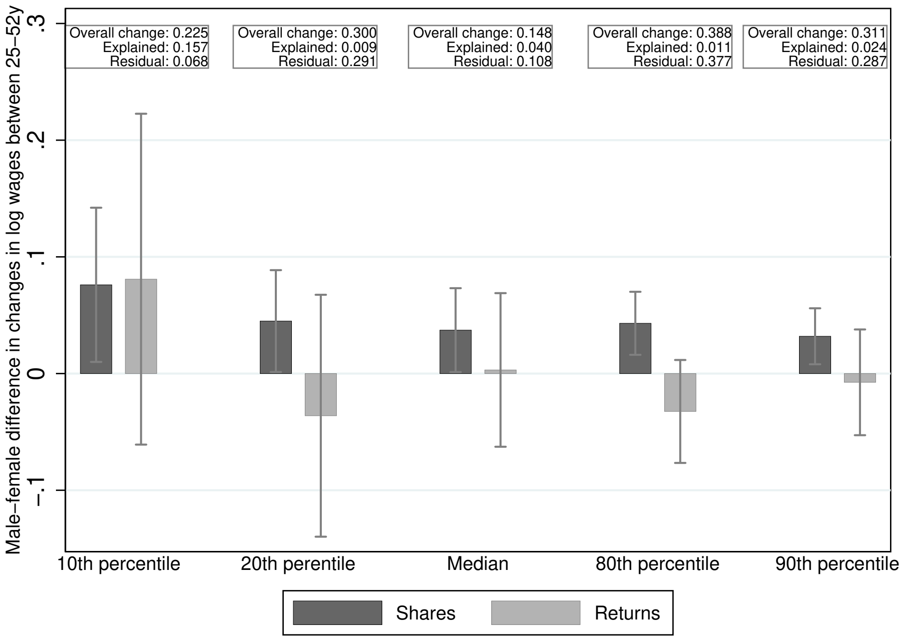


TABLE 1.6: Decomposition of changes in log real hourly earnings over the life cycle for cohort of individuals born in 1965-69, at different percentiles of the earnings distribution, controlling for other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (52y-25y)	0.357	0.228	0.129	0.466	0.187	0.279	0.606	0.379	0.227	0.828	0.425	0.403	0.875	0.559	0.316
	(0.103)	(0.085)	(0.132)	(0.079)	(0.054)	(0.097)	(0.050)	(0.055)	(0.077)	(0.056)	(0.048)	(0.077)	(0.084)	(0.064)	(0.102)
Changes in shares working in occupations (52y-25y)															
Flexible	0.019	-0.050	0.069	0.022	-0.039	0.060	0.015	-0.063	0.078	0.022	-0.035	0.057	0.015	-0.033	0.048
	(0.017)	(0.023)	(0.028)	(0.014)	(0.015)	(0.022)	(0.009)	(0.020)	(0.024)	(0.010)	(0.012)	(0.016)	(0.008)	(0.013)	(0.015)
Abstract	0.034	0.040	-0.005	0.052	0.024	0.029	0.037	0.028	0.009	0.028	0.022	0.006	0.021	0.024	-0.003
	(0.025)	(0.021)	(0.031)	(0.023)	(0.013)	(0.026)	(0.014)	(0.015)	(0.019)	(0.012)	(0.012)	(0.017)	(0.014)	(0.013)	(0.018)
Social	-0.012	-0.005	-0.007	0.003	-0.003	0.006	0.007	-0.005	0.012	-0.003	-0.003	0.001	0.013	-0.003	0.017
	(0.027)	(0.007)	(0.029)	(0.022)	(0.004)	(0.024)	(0.014)	(0.007)	(0.016)	(0.013)	(0.005)	(0.015)	(0.012)	(0.005)	(0.014)
Total	*0.041*	*-0.015*	*0.057*	*0.077*	*-0.018*	*0.095*	*0.059*	*-0.040*	*0.099*	*0.047*	*-0.017*	*0.063*	*0.049*	*-0.013*	*0.062*
	(0.030)	*(0.030)*	*(0.042)*	*(0.028)*	*(0.020)*	*(0.034)*	*(0.017)*	*(0.023)*	*(0.032)*	*(0.016)*	*(0.015)*	*(0.023)*	*(0.019)*	*(0.015)*	*(0.024)*
Changes in returns to occupations (52y-25y)															
Flexible	-0.082	0.032	-0.114	-0.053	-0.054	0.002	-0.023	-0.136	0.112	-0.015	-0.029	0.014	-0.040	-0.084	0.044
	(0.074)	(0.062)	(0.096)	(0.053)	(0.036)	(0.064)	(0.032)	(0.027)	(0.043)	(0.027)	(0.021)	(0.034)	(0.028)	(0.027)	(0.039)
Abstract	-0.057	-0.217	0.160	0.059	-0.058	0.117	0.223	0.119	0.104	0.152	0.016	0.136	0.033	0.216	-0.183
	(0.150)	(0.097)	(0.178)	(0.124)	(0.058)	(0.142)	(0.071)	(0.059)	(0.093)	(0.072)	(0.053)	(0.087)	(0.099)	(0.067)	(0.125)
Social	-0.091	0.068	-0.158	-0.002	-0.100	0.097	-0.117	-0.272	0.155	-0.053	-0.075	0.022	0.112	-0.156	0.268
	(0.199)	(0.186)	(0.283)	(0.159)	(0.118)	(0.209)	(0.107)	(0.110)	(0.152)	(0.103)	(0.090)	(0.138)	(0.087)	(0.112)	(0.148)
Residual	0.546	0.362	0.185	0.385	0.416	-0.032	0.464	0.708	-0.243	0.697	0.530	0.168	0.721	0.596	0.125
	(0.223)	(0.232)	(0.342)	(0.217)	(0.159)	(0.289)	(0.133)	(0.143)	(0.196)	(0.114)	(0.107)	(0.156)	(0.099)	(0.121)	(0.154)
Total	*0.316*	*0.244*	*0.072*	*0.389*	*0.204*	*0.185*	*0.547*	*0.419*	*0.128*	*0.781*	*0.441*	*0.340*	*0.826*	*0.572*	*0.254*
	(0.105)	*(0.083)*	*(0.129)*	*(0.081)*	*(0.051)*	*(0.095)*	*(0.050)*	*(0.053)*	*(0.074)*	*(0.053)*	*(0.048)*	*(0.074)*	*(0.078)*	*(0.064)*	*(0.098)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE 1.23: Decomposition of changes in the gender wage gap across the distribution over the life cycle, controlling for other occupational characteristics

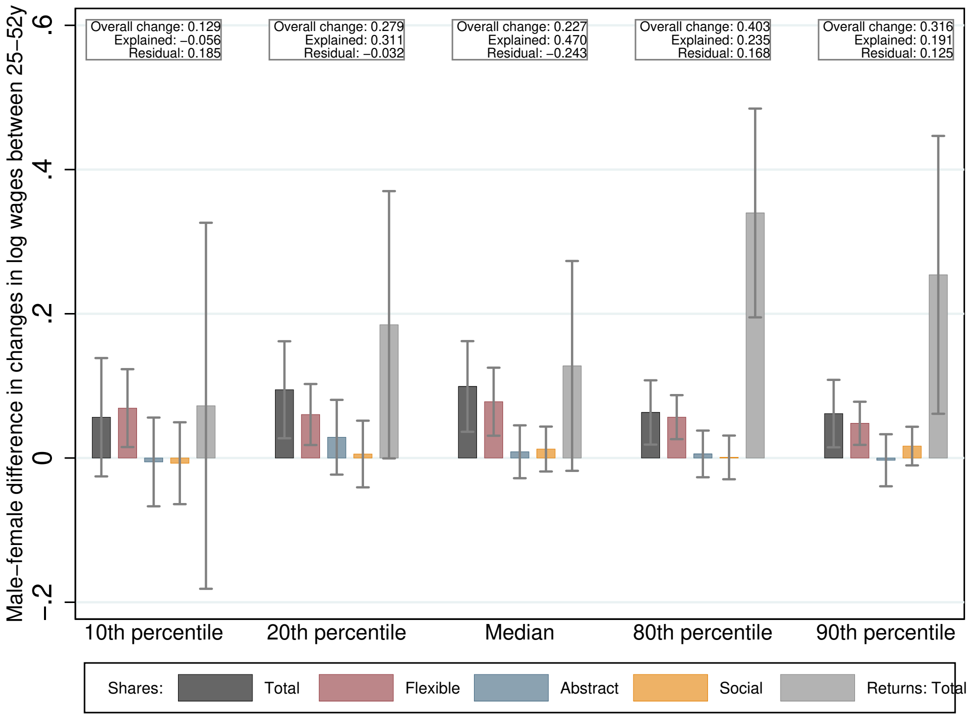


TABLE 1.7: Decomposition of changes in log real hourly earnings over the life cycle for cohort of individuals born in 1965-69, at different percentiles of the earnings distribution, controlling for and interacting with other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (52y-25y)	0.357	0.228	0.129	0.466	0.187	0.279	0.606	0.379	0.227	0.828	0.425	0.403	0.875	0.559	0.316
	(0.103)	(0.085)	(0.131)	(0.079)	(0.054)	(0.094)	(0.050)	(0.055)	(0.075)	(0.056)	(0.048)	(0.076)	(0.084)	(0.064)	(0.101)
Changes in shares working in occupations (52y-25y)															
Flexible	0.034	-0.031	0.065	0.035	0.005	0.030	0.009	-0.005	0.013	0.008	-0.001	0.010	-0.004	0.001	-0.005
	(0.027)	(0.038)	(0.045)	(0.025)	(0.020)	(0.031)	(0.012)	(0.016)	(0.020)	(0.009)	(0.013)	(0.015)	(0.009)	(0.010)	(0.014)
Abstract	0.022	0.041	-0.019	0.045	0.040	0.005	0.032	0.040	-0.008	0.046	0.033	0.013	0.020	0.035	-0.015
	(0.035)	(0.026)	(0.046)	(0.039)	(0.023)	(0.046)	(0.027)	(0.024)	(0.036)	(0.030)	(0.023)	(0.042)	(0.022)	(0.027)	(0.038)
Social	-0.015	0.000	-0.015	-0.009	0.004	-0.013	-0.003	0.003	-0.006	0.010	0.000	0.010	0.017	0.000	0.017
	(0.038)	(0.006)	(0.040)	(0.039)	(0.007)	(0.039)	(0.022)	(0.005)	(0.024)	(0.018)	(0.002)	(0.020)	(0.019)	(0.001)	(0.019)
Flexible*Abstract	0.000	0.022	-0.023	0.000	0.005	-0.005	0.001	0.014	-0.012	0.001	-0.037	0.038	0.001	-0.036	0.037
	(0.003)	(0.033)	(0.034)	(0.003)	(0.020)	(0.021)	(0.008)	(0.028)	(0.032)	(0.006)	(0.030)	(0.032)	(0.006)	(0.041)	(0.045)
Flexible*Social	-0.007	-0.057	0.050	-0.004	-0.023	0.019	-0.002	-0.044	0.041	-0.001	-0.013	0.012	-0.002	-0.008	0.006
	(0.027)	(0.058)	(0.078)	(0.014)	(0.025)	(0.035)	(0.008)	(0.019)	(0.023)	(0.004)	(0.011)	(0.012)	(0.005)	(0.009)	(0.012)
Abstract*Social	-0.014	-0.005	-0.009	-0.004	-0.011	0.007	0.022	-0.007	0.029	-0.018	-0.005	-0.013	0.023	-0.004	0.027
	(0.054)	(0.014)	(0.057)	(0.055)	(0.012)	(0.057)	(0.037)	(0.011)	(0.039)	(0.040)	(0.013)	(0.046)	(0.038)	(0.016)	(0.044)
Flexible*Abstract*Social	0.012	0.024	-0.011	0.009	-0.037	0.045	0.005	-0.039	0.044	0.001	0.002	-0.001	0.001	-0.007	0.008
	(0.035)	(0.055)	(0.077)	(0.023)	(0.028)	(0.042)	(0.013)	(0.026)	(0.031)	(0.004)	(0.022)	(0.024)	(0.003)	(0.031)	(0.035)
Total	*0.033*	*-0.006*	*0.039*	*0.071*	*-0.016*	*0.087*	*0.063*	*-0.037*	*0.101*	*0.048*	*-0.022*	*0.070*	*0.057*	*-0.019*	*0.076*
	(0.033)	*(0.030)*	*(0.050)*	*(0.029)*	*(0.023)*	*(0.039)*	*(0.019)*	*(0.027)*	*(0.038)*	*(0.018)*	*(0.017)*	*(0.025)*	*(0.022)*	*(0.018)*	*(0.029)*
Changes in returns to occupations (52y-25y)															
Flexible	-0.079	0.071	-0.150	0.021	0.026	-0.004	0.009	0.011	-0.003	0.007	0.026	-0.019	0.053	0.040	0.013
	(0.121)	(0.135)	(0.200)	(0.108)	(0.086)	(0.150)	(0.057)	(0.069)	(0.096)	(0.041)	(0.048)	(0.065)	(0.046)	(0.035)	(0.056)
Abstract	0.137	-0.030	0.168	0.422	0.175	0.247	-0.105	0.232	-0.337	0.025	0.191	-0.166	-0.084	0.395	-0.479
	(0.212)	(0.204)	(0.328)	(0.258)	(0.163)	(0.325)	(0.216)	(0.190)	(0.334)	(0.247)	(0.201)	(0.349)	(0.085)	(0.289)	(0.326)
Social	0.364	0.127	0.237	0.354	0.132	0.222	-0.233	0.178	-0.410	-0.081	0.100	-0.181	0.168	0.057	0.111
	(0.241)	(0.316)	(0.417)	(0.302)	(0.222)	(0.392)	(0.160)	(0.187)	(0.264)	(0.129)	(0.121)	(0.194)	(0.133)	(0.049)	(0.135)
Flexible*Abstract	0.071	-0.033	0.104	-0.032	-0.032	0.000	0.045	0.031	0.014	0.023	-0.021	0.045	-0.001	-0.072	0.070
	(0.066)	(0.073)	(0.116)	(0.074)	(0.050)	(0.097)	(0.047)	(0.057)	(0.086)	(0.050)	(0.054)	(0.079)	(0.024)	(0.077)	(0.093)
Flexible*Social	-0.322	0.239	-0.561	-0.120	0.122	-0.243	0.021	-0.054	0.075	0.007	-0.023	0.030	-0.031	-0.025	-0.006
	(0.075)	(0.122)	(0.207)	(0.068)	(0.056)	(0.117)	(0.022)	(0.040)	(0.058)	(0.017)	(0.027)	(0.040)	(0.023)	(0.020)	(0.031)
Abstract*Social	-0.491	-0.056	-0.435	-0.447	-0.142	-0.305	0.406	-0.093	0.500	0.159	-0.161	0.320	0.172	-0.106	0.279
	(0.226)	(0.207)	(0.327)	(0.266)	(0.157)	(0.328)	(0.205)	(0.181)	(0.318)	(0.231)	(0.188)	(0.333)	(0.145)	(0.267)	(0.310)
Flexible*Abstract*Social	0.258	-0.242	0.500	0.097	-0.134	0.231	-0.089	-0.059	-0.030	-0.041	0.018	-0.059	-0.024	0.010	-0.034
	(0.072)	(0.104)	(0.181)	(0.074)	(0.053)	(0.110)	(0.040)	(0.049)	(0.073)	(0.038)	(0.044)	(0.062)	(0.025)	(0.061)	(0.074)
Residual	0.386	0.157	0.229	0.101	0.056	0.045	0.488	0.171	0.317	0.681	0.317	0.364	0.565	0.279	0.286
	(0.286)	(0.360)	(0.500)	(0.358)	(0.264)	(0.475)	(0.197)	(0.216)	(0.315)	(0.146)	(0.137)	(0.223)	(0.059)	(0.030)	(0.063)
Total	*0.325*	*0.234*	*0.090*	*0.395*	*0.203*	*0.192*	*0.543*	*0.417*	*0.126*	*0.780*	*0.447*	*0.333*	*0.818*	*0.578*	*0.240*
	(0.099)	*(0.080)*	*(0.128)*	*(0.079)*	*(0.050)*	*(0.092)*	*(0.049)*	*(0.051)*	*(0.072)*	*(0.053)*	*(0.047)*	*(0.073)*	*(0.076)*	*(0.064)*	*(0.097)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE 1.24: Decomposition of changes in the gender wage gap across the distribution over the life cycle, controlling for and interacting with other occupational characteristics

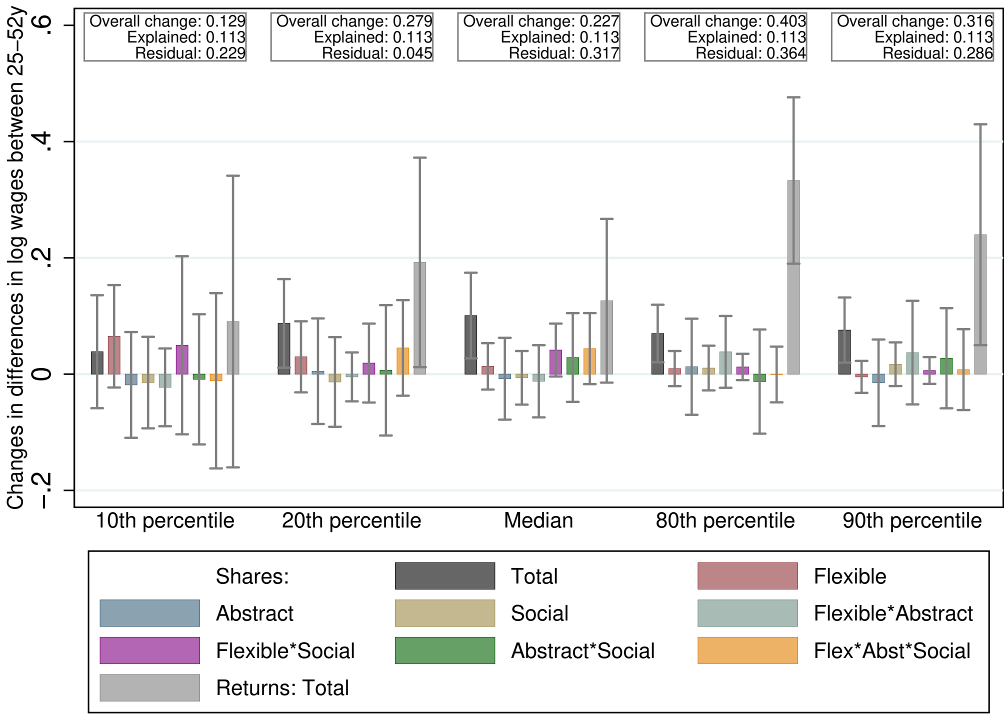


TABLE 1.8: Decomposition of changes in log real hourly earnings across the distribution between cohorts of individuals born in 1965-69 and 1985-89 in age group 25-34

	Men	Women	Difference
10th percentile			
Difference in log real hourly wages (1985-1965)	-0.132	-0.075	-0.058
	(0.014)	(0.014)	(0.020)
Changes in shares in flexible occupations (1985-1965)	-0.001	-0.038	0.037
	(0.002)	(0.003)	(0.004)
Changes in returns to flexible occupations (1985-1965)	-0.015	0.036	-0.051
	(0.009)	(0.009)	(0.013)
Changes in residuals (1985-1965)	-0.117	-0.073	-0.044
	(0.014)	(0.014)	(0.020)
20th percentile			
Difference in log real hourly wages (1985-1965)	-0.146	-0.128	-0.018
	(0.011)	(0.010)	(0.015)
Changes in shares in flexible occupations (1985-1965)	0.000	-0.034	0.034
	(0.002)	(0.003)	(0.003)
Changes in returns to flexible occupations (1985-1965)	-0.004	-0.015	0.011
	(0.007)	(0.005)	(0.008)
Changes in residuals (1985-1965)	-0.141	-0.079	-0.062
	(0.011)	(0.010)	(0.016)
50th percentile			
Difference in log real hourly wages (1985-1965)	-0.100	-0.082	-0.018
	(0.011)	(0.008)	(0.013)
Changes in shares in flexible occupations (1985-1965)	-0.001	-0.029	0.028
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1985-1965)	-0.010	-0.021	0.011
	(0.006)	(0.003)	(0.007)
Changes in residuals (1985-1965)	-0.090	-0.033	-0.057
	(0.013)	(0.009)	(0.015)
80th percentile			
Difference in log real hourly wages (1985-1965)	-0.120	-0.096	-0.024
	(0.012)	(0.010)	(0.015)
Changes in shares in flexible occupations (1985-1965)	-0.001	-0.022	0.021
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1985-1965)	0.033	-0.008	0.041
	(0.005)	(0.003)	(0.006)
Changes in residuals (1985-1965)	-0.153	-0.067	-0.086
	(0.015)	(0.011)	(0.017)
90th percentile			
Difference in log real hourly wages (1985-1965)	-0.145	-0.121	-0.024
	(0.018)	(0.012)	(0.022)
Changes in shares in flexible occupations (1985-1965)	-0.001	-0.019	0.019
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1985-1965)	0.007	-0.002	0.009
	(0.008)	(0.004)	(0.008)
Changes in residuals (1985-1965)	-0.152	-0.100	-0.052
	(0.023)	(0.015)	(0.027)

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE 1.9: Decomposition of changes in log real hourly earnings across the distribution between cohorts of individuals born in 1955-59 and 1975-79 in age group 35-44

	Men	Women	Difference
10th percentile			
Difference in log real hourly wages (1975-1955)	-0.091	0.062	-0.153
	(0.018)	(0.016)	(0.024)
Changes in shares in flexible occupations (1975-1955)	-0.002	-0.034	0.033
	(0.003)	(0.004)	(0.005)
Changes in returns to flexible occupations (1975-1955)	-0.021	0.026	-0.047
	(0.012)	(0.009)	(0.015)
Changes in residuals (1975-1955)	-0.069	0.070	-0.139
	(0.018)	(0.015)	(0.023)
20th percentile			
Difference in log real hourly wages (1975-1955)	-0.053	0.023	-0.076
	(0.013)	(0.013)	(0.018)
Changes in shares in flexible occupations (1975-1955)	-0.002	-0.035	0.033
	(0.003)	(0.004)	(0.005)
Changes in returns to flexible occupations (1975-1955)	-0.032	-0.008	-0.024
	(0.008)	(0.006)	(0.010)
Changes in residuals (1975-1955)	-0.019	0.066	-0.085
	(0.013)	(0.012)	(0.018)
50th percentile			
Difference in log real hourly wages (1975-1955)	0.017	0.079	-0.062
	(0.009)	(0.009)	(0.012)
Changes in shares in flexible occupations (1975-1955)	-0.001	-0.022	0.021
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1975-1955)	-0.009	-0.016	0.007
	(0.004)	(0.003)	(0.005)
Changes in residuals (1975-1955)	0.027	0.117	-0.090
	(0.010)	(0.010)	(0.013)
80th percentile			
Difference in log real hourly wages (1975-1955)	0.059	0.099	-0.040
	(0.013)	(0.010)	(0.016)
Changes in shares in flexible occupations (1975-1955)	-0.001	-0.014	0.012
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1975-1955)	-0.027	-0.009	-0.018
	(0.005)	(0.003)	(0.005)
Changes in residuals (1975-1955)	0.087	0.122	-0.034
	(0.016)	(0.012)	(0.019)
90th percentile			
Difference in log real hourly wages (1975-1955)	0.095	0.146	-0.051
	(0.018)	(0.016)	(0.024)
Changes in shares in flexible occupations (1975-1955)	-0.001	-0.016	0.015
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1975-1955)	-0.016	-0.014	-0.002
	(0.005)	(0.005)	(0.007)
Changes in residuals (1975-1955)	0.113	0.176	-0.063
	(0.022)	(0.019)	(0.029)

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

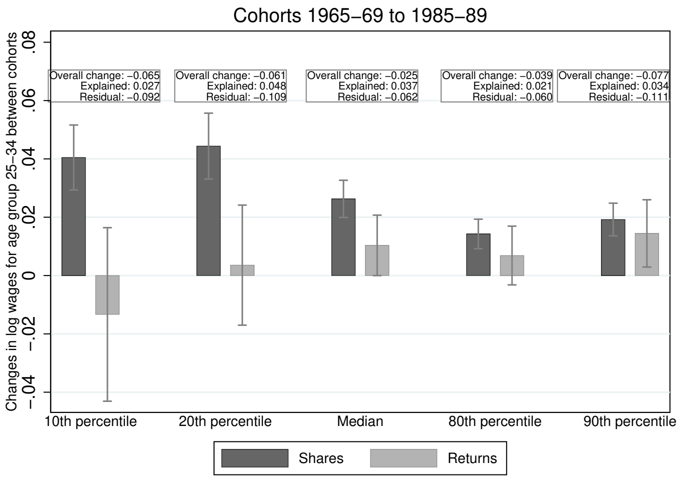
TABLE 1.10: Decomposition of changes in log real hourly earnings across the distribution between cohorts of individuals born in 1945-49 and 1965-69 in age group 45-55

	Men	Women	Difference
10th percentile			
Difference in log real hourly wages (1965-1945)	-0.041	0.014	-0.055
	(0.020)	(0.014)	(0.024)
Changes in shares in flexible occupations (1965-1945)	-0.005	-0.050	0.046
	(0.004)	(0.004)	(0.006)
Changes in returns to flexible occupations (1965-1945)	-0.017	0.021	-0.039
	(0.013)	(0.008)	(0.015)
Changes in residuals (1965-1945)	-0.019	0.043	-0.062
	(0.019)	(0.013)	(0.023)
20th percentile			
Difference in log real hourly wages (1965-1945)	-0.024	0.003	-0.027
	(0.015)	(0.014)	(0.020)
Changes in shares in flexible occupations (1965-1945)	-0.004	-0.062	0.058
	(0.004)	(0.005)	(0.006)
Changes in returns to flexible occupations (1965-1945)	-0.041	-0.019	-0.022
	(0.009)	(0.007)	(0.011)
Changes in residuals (1965-1945)	0.022	0.084	-0.062
	(0.015)	(0.013)	(0.020)
50th percentile			
Difference in log real hourly wages (1965-1945)	0.050	0.054	-0.005
	(0.009)	(0.009)	(0.013)
Changes in shares in flexible occupations (1965-1945)	-0.002	-0.038	0.036
	(0.002)	(0.003)	(0.003)
Changes in returns to flexible occupations (1965-1945)	-0.013	-0.019	0.006
	(0.004)	(0.003)	(0.005)
Changes in residuals (1965-1945)	0.065	0.112	-0.047
	(0.010)	(0.010)	(0.014)
80th percentile			
Difference in log real hourly wages (1965-1945)	0.106	0.108	-0.002
	(0.013)	(0.009)	(0.016)
Changes in shares in flexible occupations (1965-1945)	-0.002	-0.021	0.018
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1965-1945)	-0.003	-0.012	0.009
	(0.005)	(0.003)	(0.005)
Changes in residuals (1965-1945)	0.112	0.141	-0.029
	(0.015)	(0.010)	(0.018)
90th percentile			
Difference in log real hourly wages (1965-1945)	0.145	0.168	-0.023
	(0.013)	(0.014)	(0.021)
Changes in shares in flexible occupations (1965-1945)	-0.002	-0.025	0.023
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1965-1945)	-0.011	-0.025	0.014
	(0.004)	(0.004)	(0.006)
Changes in residuals (1965-1945)	0.158	0.217	-0.059
	(0.016)	(0.017)	(0.025)

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE 1.25: Decomposition of changes in the gender wage gap across the distribution, across cohorts

(a) Age 25-34



(b) Age 35-44

(c) Age 45-55

TABLE 1.11: Decomposition of changes in log real hourly earnings across the distribution between cohorts of individuals born in 1965-69 and 1985-89 in age group 25-34, controlling for other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1985-65)	-0.144	-0.080	-0.065	-0.147	-0.136	-0.011	-0.102	-0.087	-0.015	-0.120	-0.095	-0.025	-0.140	-0.114	-0.026
	(0.015)	(0.014)	(0.022)	(0.012)	(0.010)	(0.016)	(0.013)	(0.009)	(0.016)	(0.013)	(0.010)	(0.017)	(0.022)	(0.014)	(0.027)
Changes in shares working in occupations (52y-25y)															
Flexible	-0.004	-0.038	0.035	-0.003	-0.033	0.030	-0.004	-0.031	0.027	-0.006	-0.024	0.018	-0.007	-0.023	0.016
	(0.001)	(0.004)	(0.004)	(0.001)	(0.003)	(0.003)	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Abstract	-0.007	0.006	-0.013	-0.006	0.006	-0.012	-0.008	0.006	-0.014	-0.006	0.007	-0.013	-0.007	0.007	-0.014
	(0.004)	(0.002)	(0.004)	(0.003)	(0.002)	(0.004)	(0.004)	(0.002)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)
Social	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.003	-0.001	0.002	0.003	-0.002
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Total	*-0.010*	*-0.032*	*0.023*	*-0.009*	*-0.026*	*0.018*	*-0.011*	*-0.023*	*0.013*	*-0.011*	*-0.014*	*0.003*	*-0.012*	*-0.012*	*0.000*
	(0.004)	*(0.004)*	*(0.006)*	*(0.004)*	*(0.004)*	*(0.005)*	*(0.004)*	*(0.004)*	*(0.005)*	*(0.004)*	*(0.003)*	*(0.005)*	*(0.004)*	*(0.003)*	*(0.005)*
Changes in returns to occupations (52y-25y)															
Flexible	0.004	0.030	-0.026	0.013	-0.023	0.035	0.016	-0.029	0.045	0.040	-0.013	0.053	0.013	-0.001	0.015
	(0.010)	(0.010)	(0.014)	(0.007)	(0.006)	(0.009)	(0.008)	(0.004)	(0.009)	(0.007)	(0.004)	(0.008)	(0.011)	(0.005)	(0.012)
Abstract	0.030	-0.060	0.090	0.090	-0.012	0.103	0.151	-0.048	0.199	-0.013	-0.021	0.007	0.107	-0.060	0.168
	(0.027)	(0.017)	(0.032)	(0.019)	(0.012)	(0.022)	(0.018)	(0.010)	(0.020)	(0.017)	(0.011)	(0.019)	(0.026)	(0.015)	(0.030)
Social	-0.057	-0.138	0.081	-0.054	-0.166	0.112	-0.032	-0.052	0.020	-0.004	0.007	-0.011	-0.037	0.033	-0.070
	(0.029)	(0.036)	(0.045)	(0.021)	(0.023)	(0.031)	(0.022)	(0.018)	(0.028)	(0.024)	(0.021)	(0.031)	(0.039)	(0.030)	(0.049)
Residual	-0.111	0.121	-0.232	-0.187	0.092	-0.279	-0.227	0.065	-0.291	-0.131	-0.054	-0.077	-0.211	-0.073	-0.138
	(0.043)	(0.045)	(0.063)	(0.031)	(0.030)	(0.043)	(0.030)	(0.023)	(0.037)	(0.027)	(0.024)	(0.036)	(0.043)	(0.032)	(0.054)
Total	*-0.135*	*-0.048*	*-0.087*	*-0.138*	*-0.109*	*-0.029*	*-0.092*	*-0.064*	*-0.028*	*-0.109*	*-0.081*	*-0.028*	*-0.127*	*-0.102*	*-0.025*
	(0.015)	*(0.014)*	*(0.021)*	*(0.011)*	*(0.010)*	*(0.014)*	*(0.012)*	*(0.009)*	*(0.015)*	*(0.013)*	*(0.010)*	*(0.017)*	*(0.022)*	*(0.014)*	*(0.027)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE 1.12: Decomposition of changes in log real hourly earnings across the distribution between cohorts of individuals born in 1955-59 and 1975-79 in age group 35-44, controlling for other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1975-55)	-0.089	0.061	-0.150	-0.046	0.022	-0.067	0.023	0.072	-0.049	0.072	0.109	-0.037	0.126	0.162	-0.036
	(0.020)	(0.017)	(0.027)	(0.014)	(0.013)	(0.019)	(0.010)	(0.010)	(0.013)	(0.015)	(0.011)	(0.018)	(0.017)	(0.018)	(0.024)
Changes in shares working in occupations (52y-25y)															
Flexible	-0.007	-0.041	0.035	-0.005	-0.042	0.037	-0.004	-0.028	0.025	-0.006	-0.019	0.013	-0.006	-0.024	0.018
	(0.002)	(0.004)	(0.005)	(0.002)	(0.004)	(0.004)	(0.001)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Abstract	-0.010	0.009	-0.018	-0.009	0.012	-0.021	-0.006	0.015	-0.021	-0.006	0.015	-0.021	-0.005	0.017	-0.023
	(0.005)	(0.002)	(0.005)	(0.004)	(0.002)	(0.005)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.002)	(0.004)	(0.004)
Social	0.000	-0.001	0.001	0.000	-0.001	0.001	0.000	0.003	-0.003	0.000	0.006	-0.006	0.000	0.009	-0.009
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Total	*-0.016*	*-0.033*	*0.017*	*-0.014*	*-0.031*	*0.017*	*-0.010*	*-0.011*	*0.001*	*-0.012*	*0.002*	*-0.014*	*-0.010*	*0.003*	*-0.013*
	(0.006)	*(0.005)*	*(0.008)*	*(0.005)*	*(0.005)*	*(0.007)*	*(0.003)*	*(0.004)*	*(0.005)*	*(0.004)*	*(0.003)*	*(0.005)*	*(0.003)*	*(0.004)*	*(0.005)*
Changes in returns to occupations (52y-25y)															
Flexible	0.001	0.026	-0.025	-0.007	-0.005	-0.002	0.003	-0.019	0.022	-0.020	-0.006	-0.014	-0.008	-0.018	0.010
	(0.013)	(0.011)	(0.017)	(0.008)	(0.008)	(0.012)	(0.005)	(0.004)	(0.006)	(0.006)	(0.004)	(0.007)	(0.007)	(0.005)	(0.008)
Abstract	0.034	-0.030	0.064	0.107	-0.043	0.150	0.091	-0.006	0.097	0.145	0.018	0.127	0.067	0.095	-0.028
	(0.045)	(0.021)	(0.051)	(0.029)	(0.016)	(0.035)	(0.017)	(0.012)	(0.020)	(0.021)	(0.012)	(0.024)	(0.024)	(0.019)	(0.030)
Social	0.038	-0.113	0.151	0.041	-0.164	0.205	0.014	-0.076	0.090	-0.004	-0.030	0.026	-0.045	-0.075	0.031
	(0.054)	(0.050)	(0.068)	(0.035)	(0.038)	(0.047)	(0.022)	(0.023)	(0.030)	(0.032)	(0.023)	(0.038)	(0.039)	(0.038)	(0.055)
Residual	-0.146	0.210	-0.356	-0.172	0.264	-0.436	-0.075	0.184	-0.260	-0.038	0.124	-0.162	0.122	0.158	-0.036
	(0.071)	(0.060)	(0.089)	(0.046)	(0.045)	(0.064)	(0.026)	(0.026)	(0.036)	(0.033)	(0.024)	(0.040)	(0.037)	(0.040)	(0.055)
Total	*-0.073*	*0.094*	*-0.166*	*-0.031*	*0.053*	*-0.084*	*0.032*	*0.083*	*-0.050*	*0.084*	*0.106*	*-0.023*	*0.136*	*0.159*	*-0.023*
	(0.019)	*(0.016)*	*(0.026)*	*(0.013)*	*(0.012)*	*(0.018)*	*(0.009)*	*(0.009)*	*(0.012)*	*(0.015)*	*(0.010)*	*(0.017)*	*(0.017)*	*(0.017)*	*(0.024)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

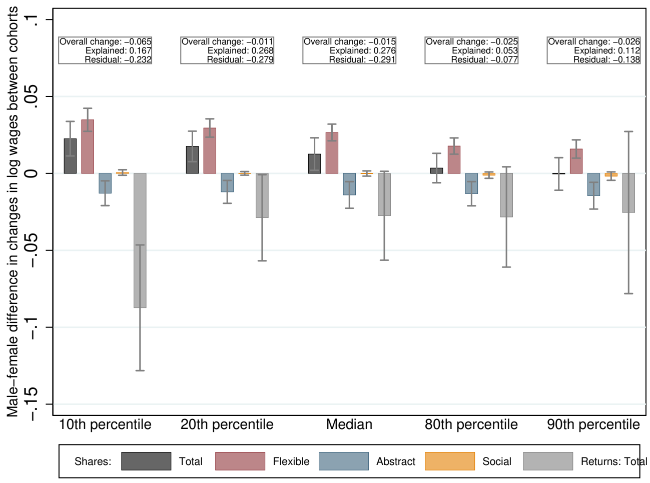
TABLE 1.13: Decomposition of changes in log real hourly earnings across the distribution between cohorts of individuals born in 1945-49 and 1965-69 in age group 45-55, controlling for other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1965-45)	-0.042	0.016	-0.058	-0.015	-0.003	-0.012	0.054	0.051	0.003	0.122	0.119	0.003	0.163	0.188	-0.025
	(0.021)	(0.015)	(0.026)	(0.016)	(0.014)	(0.022)	(0.010)	(0.010)	(0.014)	(0.013)	(0.010)	(0.016)	(0.016)	(0.015)	(0.021)
Changes in shares working in occupations (52y-25y)															
Flexible	-0.005	-0.054	0.049	-0.005	-0.065	0.060	-0.003	-0.044	0.041	-0.004	-0.028	0.024	-0.003	-0.034	0.031
	(0.002)	(0.004)	(0.005)	(0.002)	(0.005)	(0.005)	(0.001)	(0.003)	(0.003)	(0.001)	(0.002)	(0.003)	(0.001)	(0.003)	(0.003)
Abstract	-0.014	0.001	-0.015	-0.015	0.001	-0.016	-0.010	0.001	-0.011	-0.009	0.001	-0.011	-0.006	0.001	-0.008
	(0.004)	(0.002)	(0.004)	(0.004)	(0.002)	(0.004)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)	(0.004)
Social	-0.002	-0.002	0.000	-0.001	-0.002	0.001	0.000	0.002	-0.002	0.001	0.004	-0.003	0.000	0.005	-0.005
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Total	*-0.022*	*-0.055*	*0.033*	*-0.022*	*-0.066*	*0.045*	*-0.012*	*-0.041*	*0.029*	*-0.012*	*-0.023*	*0.011*	*-0.009*	*-0.027*	*0.018*
	(0.005)	*(0.005)*	*(0.007)*	*(0.005)*	*(0.005)*	*(0.008)*	*(0.003)*	*(0.004)*	*(0.005)*	*(0.003)*	*(0.003)*	*(0.005)*	*(0.002)*	*(0.004)*	*(0.005)*
Changes in returns to occupations (52y-25y)															
Flexible	-0.022	0.007	-0.029	-0.025	-0.043	0.018	0.000	-0.033	0.033	-0.003	-0.027	0.024	-0.006	-0.039	0.033
	(0.014)	(0.010)	(0.017)	(0.011)	(0.008)	(0.014)	(0.006)	(0.004)	(0.007)	(0.006)	(0.003)	(0.007)	(0.006)	(0.005)	(0.008)
Abstract	-0.227	-0.104	-0.123	0.046	-0.098	0.144	0.109	-0.070	0.179	0.097	0.016	0.081	0.094	0.111	-0.018
	(0.052)	(0.019)	(0.054)	(0.039)	(0.018)	(0.043)	(0.020)	(0.012)	(0.024)	(0.023)	(0.011)	(0.026)	(0.024)	(0.017)	(0.029)
Social	0.057	-0.193	0.250	0.059	-0.266	0.325	-0.010	-0.100	0.090	-0.045	-0.052	0.007	0.014	-0.077	0.092
	(0.066)	(0.052)	(0.086)	(0.049)	(0.045)	(0.067)	(0.026)	(0.024)	(0.037)	(0.033)	(0.021)	(0.040)	(0.034)	(0.032)	(0.046)
Residual	0.172	0.361	-0.189	-0.073	0.470	-0.543	-0.033	0.295	-0.328	0.085	0.205	-0.120	0.071	0.221	-0.150
	(0.079)	(0.059)	(0.098)	(0.059)	(0.051)	(0.077)	(0.029)	(0.026)	(0.040)	(0.032)	(0.022)	(0.040)	(0.033)	(0.034)	(0.048)
Total	*-0.020*	*0.071*	*-0.091*	*0.007*	*0.064*	*-0.057*	*0.066*	*0.092*	*-0.026*	*0.134*	*0.141*	*-0.008*	*0.172*	*0.215*	*-0.043*
	(0.020)	*(0.014)*	*(0.025)*	*(0.015)*	*(0.013)*	*(0.021)*	*(0.009)*	*(0.009)*	*(0.013)*	*(0.013)*	*(0.009)*	*(0.016)*	*(0.016)*	*(0.016)*	*(0.022)*

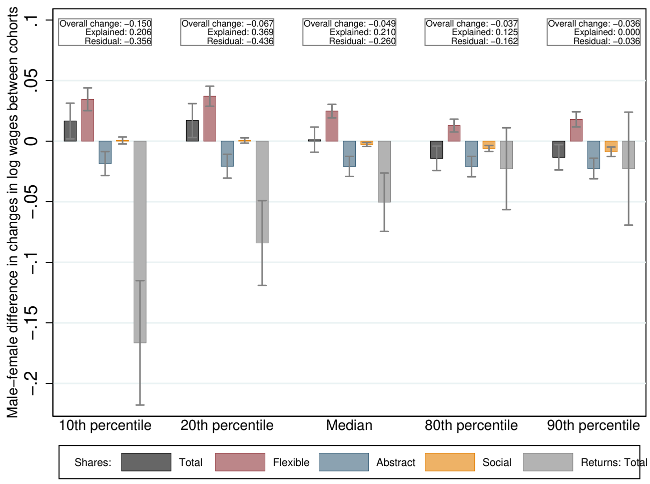
Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE 1.26: Decomposition of changes in the gender wage gap across the distribution across cohorts, controlling for other occupational characteristics

(a) Age 25-34



(b) Age 35-44



(c) Age 45-55

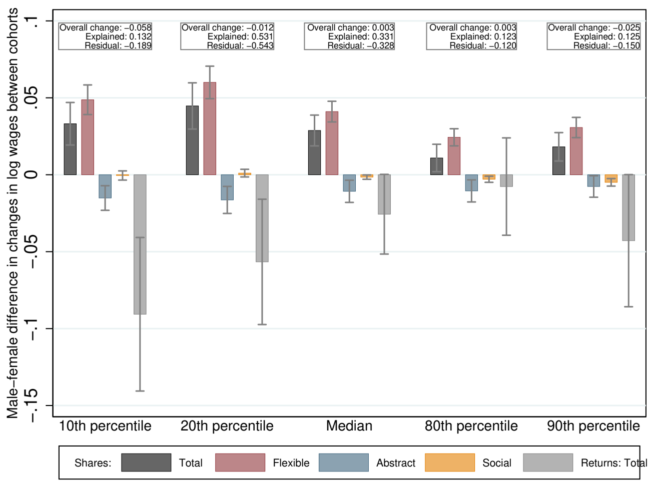


TABLE 1.14: Decomposition of changes in log real hourly earnings across the distribution between cohorts of individuals born in 1965-69 and 1985-89 in age group 25-34, controlling for and interacting with other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1985-65)	-0.144	-0.080	-0.065	-0.147	-0.136	-0.011	-0.102	-0.087	-0.015	-0.120	-0.095	-0.025	-0.140	-0.114	-0.026
	(0.015)	(0.014)	(0.022)	(0.012)	(0.010)	(0.016)	(0.013)	(0.009)	(0.016)	(0.013)	(0.010)	(0.017)	(0.022)	(0.014)	(0.027)
Changes in shares working in occupations (52y-25y)															
Flexible	-0.003	-0.010	0.007	-0.002	0.000	-0.002	-0.003	-0.004	0.001	0.000	-0.006	0.005	0.000	0.001	-0.002
	(0.002)	(0.006)	(0.007)	(0.001)	(0.004)	(0.004)	(0.001)	(0.003)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.003)	(0.003)
Abstract	-0.008	0.010	-0.018	-0.008	0.010	-0.018	-0.009	0.010	-0.019	-0.009	0.009	-0.019	-0.009	0.012	-0.022
	(0.004)	(0.004)	(0.006)	(0.004)	(0.004)	(0.006)	(0.005)	(0.004)	(0.006)	(0.005)	(0.004)	(0.006)	(0.005)	(0.005)	(0.007)
Social	-0.001	-0.006	0.005	-0.001	-0.005	0.004	0.000	-0.003	0.003	-0.001	0.000	-0.001	-0.001	0.000	0.000
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Flexible*Abstract	0.000	0.000	0.000	0.000	-0.012	0.012	0.000	-0.014	0.014	0.000	-0.012	0.012	0.000	-0.023	0.023
	(0.000)	(0.004)	(0.004)	(0.000)	(0.004)	(0.004)	(0.001)	(0.003)	(0.004)	(0.001)	(0.004)	(0.004)	(0.001)	(0.005)	(0.005)
Flexible*Social	-0.011	-0.033	0.023	-0.007	-0.027	0.020	-0.003	-0.014	0.010	-0.002	-0.001	-0.001	-0.002	-0.002	-0.001
	(0.004)	(0.006)	(0.007)	(0.003)	(0.004)	(0.005)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Abstract*Social	0.008	0.004	0.003	0.007	0.004	0.003	0.007	0.003	0.004	0.009	0.001	0.008	0.006	0.004	0.002
	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)	(0.001)	(0.003)	(0.004)	(0.002)	(0.004)
Flexible*Abstract*Social	0.003	0.010	-0.007	0.002	0.011	-0.009	0.001	0.004	-0.003	0.000	-0.003	0.003	0.000	0.003	-0.003
	(0.003)	(0.005)	(0.006)	(0.002)	(0.004)	(0.004)	(0.002)	(0.003)	(0.003)	(0.000)	(0.003)	(0.003)	(0.001)	(0.004)	(0.004)
Total	*-0.012*	*-0.025*	*0.013*	*-0.008*	*-0.019*	*0.011*	*-0.007*	*-0.018*	*0.011*	*-0.003*	*-0.011*	*0.007*	*-0.007*	*-0.004*	*-0.003*
	(0.005)	*(0.005)*	*(0.007)*	*(0.004)*	*(0.004)*	*(0.006)*	*(0.005)*	*(0.004)*	*(0.006)*	*(0.004)*	*(0.004)*	*(0.005)*	*(0.005)*	*(0.004)*	*(0.007)*
Changes in returns to occupations (52y-25y)															
Flexible	0.078	0.004	0.075	0.065	-0.035	0.100	0.008	-0.044	0.052	0.005	-0.017	0.021	-0.004	-0.006	0.001
	(0.031)	(0.022)	(0.039)	(0.022)	(0.014)	(0.028)	(0.018)	(0.011)	(0.021)	(0.010)	(0.009)	(0.014)	(0.014)	(0.009)	(0.017)
Abstract	0.129	-0.175	0.304	0.153	-0.096	0.248	0.068	-0.096	0.164	-0.088	-0.056	-0.032	0.052	-0.122	0.173
	(0.070)	(0.048)	(0.086)	(0.051)	(0.036)	(0.065)	(0.048)	(0.032)	(0.059)	(0.049)	(0.040)	(0.062)	(0.075)	(0.058)	(0.092)
Social	0.081	-0.205	0.287	0.065	-0.179	0.244	-0.056	-0.064	0.008	-0.051	0.000	-0.051	-0.069	0.032	-0.101
	(0.083)	(0.065)	(0.104)	(0.059)	(0.048)	(0.077)	(0.048)	(0.037)	(0.061)	(0.030)	(0.032)	(0.044)	(0.040)	(0.029)	(0.051)
Flexible*Abstract	-0.036	-0.005	-0.031	-0.014	0.020	-0.033	0.014	0.018	-0.004	0.033	0.012	0.021	0.028	0.017	0.011
	(0.017)	(0.011)	(0.021)	(0.012)	(0.010)	(0.017)	(0.014)	(0.008)	(0.016)	(0.014)	(0.009)	(0.017)	(0.025)	(0.012)	(0.028)
Flexible*Social	-0.016	0.050	-0.066	-0.031	0.028	-0.059	-0.013	0.019	-0.032	0.010	0.006	0.004	0.006	0.000	0.007
	(0.026)	(0.018)	(0.032)	(0.016)	(0.010)	(0.019)	(0.011)	(0.007)	(0.013)	(0.006)	(0.006)	(0.009)	(0.008)	(0.007)	(0.010)
Abstract*Social	-0.073	0.133	-0.205	-0.058	0.101	-0.159	0.074	0.062	0.012	0.060	0.054	0.006	0.063	0.076	-0.012
	(0.067)	(0.046)	(0.079)	(0.049)	(0.034)	(0.060)	(0.046)	(0.031)	(0.056)	(0.047)	(0.037)	(0.058)	(0.072)	(0.055)	(0.088)
Flexible*Abstract*Social	0.009	-0.023	0.032	0.016	-0.033	0.050	0.006	-0.021	0.027	-0.015	-0.012	-0.003	-0.020	-0.008	-0.011
	(0.024)	(0.015)	(0.029)	(0.015)	(0.011)	(0.019)	(0.014)	(0.008)	(0.016)	(0.013)	(0.008)	(0.015)	(0.022)	(0.011)	(0.025)
Residual	-0.306	0.167	-0.473	-0.334	0.079	-0.413	-0.198	0.056	-0.254	-0.070	-0.072	0.001	-0.188	-0.098	-0.090
	(0.102)	(0.076)	(0.130)	(0.072)	(0.056)	(0.096)	(0.059)	(0.043)	(0.073)	(0.035)	(0.038)	(0.053)	(0.048)	(0.033)	(0.061)
Total	*-0.133*	*-0.055*	*-0.078*	*-0.139*	*-0.117*	*-0.022*	*-0.096*	*-0.070*	*-0.026*	*-0.117*	*-0.085*	*-0.032*	*-0.132*	*-0.110*	*-0.022*
	(0.015)	*(0.014)*	*(0.021)*	*(0.011)*	*(0.010)*	*(0.014)*	*(0.012)*	*(0.009)*	*(0.015)*	*(0.013)*	*(0.010)*	*(0.017)*	*(0.023)*	*(0.014)*	*(0.027)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE 1.15: Decomposition of changes in log real hourly earnings across the distribution between cohorts of individuals born in 1955-59 and 1975-79 in age group 35-44, controlling for and interacting with other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1975-55)	-0.089	0.061	-0.150	-0.046	0.022	-0.067	0.023	0.072	-0.049	0.072	0.109	-0.037	0.126	0.162	-0.036
	(0.020)	(0.017)	(0.027)	(0.014)	(0.013)	(0.019)	(0.010)	(0.010)	(0.013)	(0.015)	(0.011)	(0.018)	(0.017)	(0.018)	(0.024)
Changes in shares working in occupations (1975-55)															
Flexible	-0.012	-0.023	0.011	-0.008	-0.012	0.004	-0.002	-0.004	0.002	-0.002	-0.002	0.000	-0.001	-0.002	0.001
	(0.004)	(0.006)	(0.007)	(0.003)	(0.004)	(0.005)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Abstract	-0.008	0.017	-0.026	-0.009	0.024	-0.033	-0.007	0.019	-0.026	-0.008	0.019	-0.027	-0.008	0.024	-0.032
	(0.004)	(0.004)	(0.006)	(0.004)	(0.005)	(0.007)	(0.003)	(0.004)	(0.005)	(0.004)	(0.004)	(0.006)	(0.004)	(0.006)	(0.007)
Social	0.000	-0.011	0.011	0.000	-0.016	0.016	0.000	-0.006	0.006	0.000	0.001	-0.001	0.000	0.002	-0.002
	(0.000)	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Flexible*Abstract	0.004	0.005	-0.001	0.002	0.002	0.000	-0.001	-0.004	0.003	-0.002	-0.006	0.004	-0.003	-0.010	0.007
	(0.003)	(0.004)	(0.005)	(0.001)	(0.003)	(0.003)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.005)	(0.005)
Flexible*Social	-0.016	-0.003	-0.013	-0.011	-0.010	-0.001	-0.003	-0.006	0.003	-0.001	-0.001	0.000	0.000	0.000	0.000
	(0.006)	(0.003)	(0.007)	(0.003)	(0.003)	(0.005)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Abstract*Social	0.004	0.003	0.001	0.005	0.004	0.001	0.002	0.001	0.001	0.002	0.001	0.002	0.006	0.002	0.004
	(0.003)	(0.002)	(0.004)	(0.002)	(0.003)	(0.004)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.002)	(0.003)
Flexible*Abstract*Social	0.006	-0.012	0.018	0.005	-0.009	0.014	0.002	-0.006	0.007	0.001	-0.006	0.006	0.001	-0.005	0.007
	(0.004)	(0.004)	(0.006)	(0.003)	(0.003)	(0.004)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.003)	(0.004)
Total	*-0.021*	*-0.022*	*0.001*	*-0.016*	*-0.017*	*0.001*	*-0.009*	*-0.005*	*-0.004*	*-0.010*	*0.006*	*-0.016*	*-0.006*	*0.009*	*-0.015*
	(0.007)	*(0.005)*	*(0.009)*	*(0.006)*	*(0.005)*	*(0.008)*	*(0.003)*	*(0.004)*	*(0.006)*	*(0.004)*	*(0.004)*	*(0.006)*	*(0.004)*	*(0.006)*	*(0.007)*
Changes in returns to occupations (1975-55)															
Flexible	0.059	0.029	0.030	0.017	-0.023	0.039	0.005	-0.018	0.024	0.017	0.004	0.013	0.013	0.012	0.001
	(0.037)	(0.025)	(0.045)	(0.024)	(0.018)	(0.030)	(0.010)	(0.010)	(0.014)	(0.008)	(0.008)	(0.011)	(0.008)	(0.011)	(0.014)
Abstract	0.123	-0.106	0.229	0.076	-0.199	0.275	-0.032	-0.078	0.045	0.107	-0.027	0.134	0.093	0.045	0.048
	(0.120)	(0.071)	(0.137)	(0.082)	(0.054)	(0.095)	(0.047)	(0.045)	(0.067)	(0.068)	(0.057)	(0.086)	(0.088)	(0.093)	(0.129)
Social	0.226	-0.065	0.291	0.128	-0.133	0.261	-0.044	-0.050	0.005	0.029	0.004	0.025	0.015	0.015	-0.001
	(0.133)	(0.084)	(0.155)	(0.090)	(0.064)	(0.107)	(0.041)	(0.039)	(0.058)	(0.033)	(0.029)	(0.043)	(0.035)	(0.041)	(0.053)
Flexible*Abstract	-0.027	-0.024	-0.004	0.005	0.014	-0.008	0.005	0.013	-0.008	-0.008	0.004	-0.011	-0.006	0.010	-0.016
	(0.020)	(0.017)	(0.027)	(0.014)	(0.012)	(0.019)	(0.009)	(0.010)	(0.013)	(0.012)	(0.011)	(0.016)	(0.014)	(0.018)	(0.022)
Flexible*Social	-0.077	-0.015	-0.063	-0.046	0.007	-0.052	-0.004	-0.001	-0.004	-0.009	-0.002	-0.007	-0.008	-0.006	-0.003
	(0.033)	(0.021)	(0.042)	(0.017)	(0.015)	(0.023)	(0.007)	(0.007)	(0.011)	(0.006)	(0.006)	(0.009)	(0.008)	(0.008)	(0.012)
Abstract*Social	-0.132	0.073	-0.205	-0.002	0.152	-0.154	0.151	0.089	0.062	0.095	0.066	0.029	-0.006	0.083	-0.089
	(0.121)	(0.068)	(0.138)	(0.082)	(0.053)	(0.095)	(0.047)	(0.044)	(0.067)	(0.066)	(0.055)	(0.085)	(0.085)	(0.090)	(0.128)
Flexible*Abstract*Social	0.072	0.037	0.035	0.030	-0.003	0.033	-0.002	-0.011	0.009	-0.009	-0.007	-0.002	0.001	-0.025	0.026
	(0.031)	(0.020)	(0.039)	(0.017)	(0.014)	(0.022)	(0.009)	(0.010)	(0.013)	(0.011)	(0.011)	(0.015)	(0.013)	(0.016)	(0.021)
Residual	-0.311	0.153	-0.465	-0.238	0.224	-0.462	-0.046	0.133	-0.179	-0.140	0.062	-0.202	0.030	0.018	0.012
	(0.150)	(0.096)	(0.176)	(0.101)	(0.073)	(0.122)	(0.044)	(0.043)	(0.062)	(0.033)	(0.032)	(0.046)	(0.035)	(0.046)	(0.058)
Total	*-0.068*	*0.083*	*-0.151*	*-0.030*	*0.038*	*-0.068*	*0.032*	*0.077*	*-0.046*	*0.082*	*0.102*	*-0.021*	*0.132*	*0.153*	*-0.021*
	(0.019)	*(0.016)*	*(0.026)*	*(0.013)*	*(0.012)*	*(0.017)*	*(0.009)*	*(0.009)*	*(0.012)*	*(0.015)*	*(0.010)*	*(0.018)*	*(0.017)*	*(0.017)*	*(0.024)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

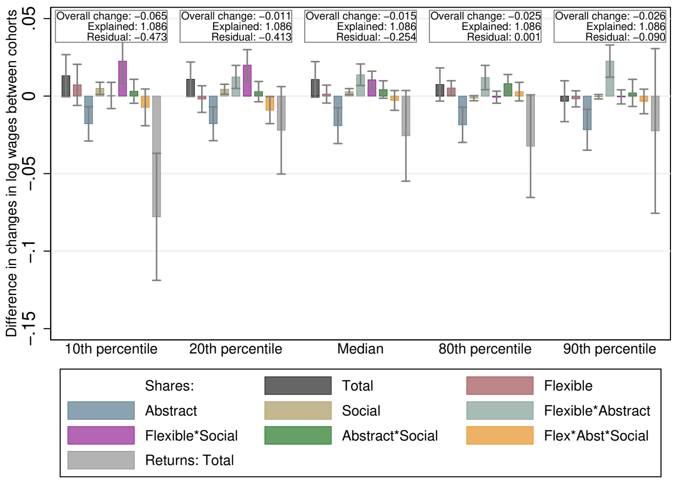
TABLE 1.16: Decomposition of changes in log real hourly earnings across the distribution between cohorts of individuals born in 1945-49 and 1965-69 in age group 45-55, controlling for and interacting with other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1965-45)	-0.042	0.016	-0.058	-0.015	-0.003	-0.012	0.054	0.051	0.003	0.122	0.119	0.003	0.163	0.188	-0.025
	(0.021)	(0.015)	(0.026)	(0.016)	(0.014)	(0.022)	(0.010)	(0.010)	(0.014)	(0.013)	(0.010)	(0.016)	(0.016)	(0.015)	(0.021)
Changes in shares working in occupations (1965-45)															
Flexible	-0.010	-0.047	0.038	-0.006	-0.021	0.015	-0.002	-0.007	0.005	-0.001	0.000	-0.001	0.000	-0.004	0.004
	(0.004)	(0.007)	(0.008)	(0.003)	(0.006)	(0.007)	(0.001)	(0.003)	(0.003)	(0.001)	(0.002)	(0.002)	(0.000)	(0.003)	(0.003)
Abstract	-0.013	0.001	-0.014	-0.015	0.002	-0.017	-0.011	0.002	-0.012	-0.011	0.001	-0.012	-0.006	0.001	-0.008
	(0.004)	(0.002)	(0.005)	(0.004)	(0.005)	(0.006)	(0.003)	(0.004)	(0.005)	(0.003)	(0.003)	(0.004)	(0.002)	(0.003)	(0.004)
Social	-0.002	-0.006	0.004	-0.003	-0.014	0.011	-0.001	-0.005	0.004	-0.001	0.000	-0.001	-0.001	0.002	-0.003
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Flexible*Abstract	0.002	0.041	-0.040	0.001	0.013	-0.012	0.000	-0.003	0.004	0.000	-0.006	0.006	0.000	-0.019	0.018
	(0.002)	(0.007)	(0.008)	(0.002)	(0.007)	(0.007)	(0.000)	(0.005)	(0.005)	(0.000)	(0.006)	(0.006)	(0.001)	(0.009)	(0.009)
Flexible*Social	-0.001	0.011	-0.012	-0.003	-0.010	0.007	-0.001	-0.010	0.009	-0.001	-0.004	0.003	-0.001	0.003	-0.004
	(0.002)	(0.007)	(0.007)	(0.002)	(0.006)	(0.007)	(0.001)	(0.003)	(0.003)	(0.000)	(0.002)	(0.002)	(0.001)	(0.003)	(0.003)
Abstract*Social	0.005	0.002	0.002	0.004	0.011	-0.006	0.003	0.003	0.000	0.002	0.000	0.002	-0.003	-0.002	-0.001
	(0.006)	(0.002)	(0.006)	(0.005)	(0.003)	(0.006)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)	(0.005)
Flexible*Abstract*Social	0.000	-0.059	0.059	0.000	-0.049	0.049	0.000	-0.026	0.026	0.000	-0.021	0.021	0.000	-0.019	0.019
	(0.001)	(0.009)	(0.009)	(0.001)	(0.008)	(0.008)	(0.000)	(0.005)	(0.005)	(0.000)	(0.005)	(0.005)	(0.000)	(0.008)	(0.008)
Total	*-0.019*	*-0.056*	*0.037*	*-0.021*	*-0.067*	*0.046*	*-0.011*	*-0.047*	*0.036*	*-0.011*	*-0.030*	*0.019*	*-0.012*	*-0.038*	*0.027*
	(0.006)	*(0.005)*	*(0.008)*	*(0.006)*	*(0.006)*	*(0.009)*	*(0.003)*	*(0.005)*	*(0.005)*	*(0.003)*	*(0.004)*	*(0.005)*	*(0.003)*	*(0.005)*	*(0.006)*
Changes in returns to occupations (1965-45)															
Flexible	0.084	0.004	0.080	0.045	-0.045	0.090	0.003	-0.012	0.015	0.009	0.006	0.003	0.017	0.012	0.005
	(0.040)	(0.021)	(0.046)	(0.029)	(0.018)	(0.036)	(0.012)	(0.009)	(0.015)	(0.010)	(0.006)	(0.012)	(0.007)	(0.009)	(0.012)
Abstract	0.212	-0.247	0.459	0.310	-0.104	0.414	0.092	0.094	-0.002	0.103	0.119	-0.016	0.096	0.248	-0.152
	(0.148)	(0.083)	(0.168)	(0.116)	(0.109)	(0.159)	(0.059)	(0.069)	(0.095)	(0.075)	(0.067)	(0.104)	(0.072)	(0.086)	(0.115)
Social	0.467	-0.203	0.670	0.381	-0.175	0.556	-0.011	0.026	-0.036	-0.025	0.050	-0.075	0.034	0.029	0.005
	(0.149)	(0.067)	(0.166)	(0.114)	(0.069)	(0.137)	(0.050)	(0.038)	(0.062)	(0.046)	(0.024)	(0.052)	(0.033)	(0.036)	(0.051)
Flexible*Abstract	-0.065	-0.007	-0.058	-0.021	0.003	-0.023	0.003	-0.014	0.017	0.001	-0.018	0.019	-0.010	-0.030	0.020
	(0.024)	(0.014)	(0.028)	(0.018)	(0.015)	(0.024)	(0.010)	(0.010)	(0.014)	(0.013)	(0.010)	(0.016)	(0.011)	(0.013)	(0.018)
Flexible*Social	-0.054	0.012	-0.065	-0.062	0.021	-0.082	0.010	-0.011	0.021	0.007	-0.011	0.018	-0.004	-0.008	0.004
	(0.044)	(0.018)	(0.045)	(0.026)	(0.015)	(0.030)	(0.009)	(0.007)	(0.012)	(0.005)	(0.005)	(0.007)	(0.004)	(0.007)	(0.008)
Abstract*Social	-0.459	0.154	-0.613	-0.309	0.021	-0.330	0.028	-0.147	0.174	0.013	-0.073	0.087	0.039	-0.079	0.118
	(0.150)	(0.082)	(0.169)	(0.117)	(0.107)	(0.156)	(0.060)	(0.068)	(0.093)	(0.075)	(0.066)	(0.103)	(0.073)	(0.086)	(0.120)
Flexible*Abstract*Social	0.056	0.002	0.055	0.044	-0.008	0.053	-0.014	0.017	-0.031	-0.015	0.009	-0.023	-0.002	0.001	-0.003
	(0.044)	(0.016)	(0.044)	(0.026)	(0.016)	(0.030)	(0.011)	(0.009)	(0.014)	(0.011)	(0.009)	(0.014)	(0.010)	(0.011)	(0.016)
Residual	-0.264	0.357	-0.621	-0.384	0.352	-0.736	-0.045	0.146	-0.191	0.040	0.067	-0.027	0.005	0.052	-0.047
	(0.165)	(0.073)	(0.183)	(0.127)	(0.077)	(0.153)	(0.054)	(0.040)	(0.067)	(0.047)	(0.025)	(0.054)	(0.025)	(0.040)	(0.047)
Total	*-0.022*	*0.072*	*-0.094*	*0.006*	*0.064*	*-0.058*	*0.065*	*0.098*	*-0.033*	*0.133*	*0.149*	*-0.015*	*0.175*	*0.226*	*-0.051*
	(0.020)	*(0.014)*	*(0.025)*	*(0.015)*	*(0.013)*	*(0.020)*	*(0.009)*	*(0.009)*	*(0.013)*	*(0.013)*	*(0.010)*	*(0.016)*	*(0.016)*	*(0.016)*	*(0.022)*

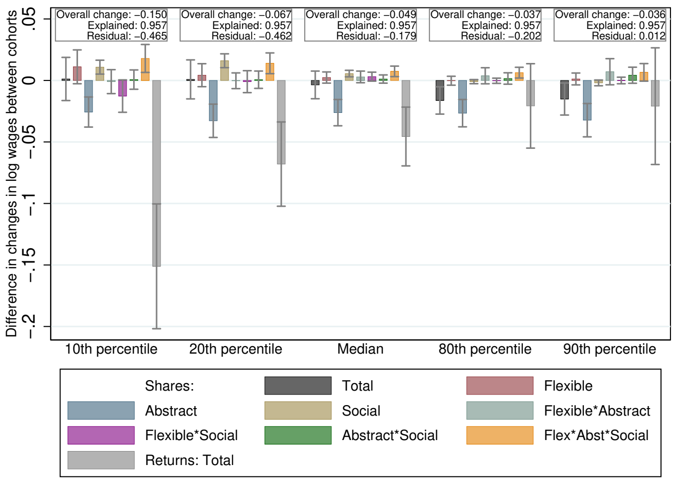
Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE 1.27: Decomposition of changes in the gender wage gap across the distribution across cohorts, controlling for and interacting with other occupational characteristics

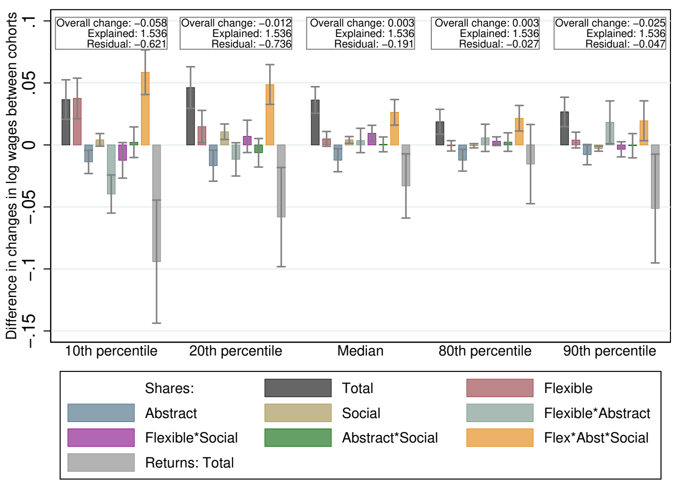
(a) Age 25-34



(b) Age 35-44



(c) Age 45-55



Chapter 2

Occupation Flexibility and the Graduate Gender Wage Gap: Evidence From an Equilibrium Model for the UK

(co-authored with Sonia Bhalotra and Manuel Fernández)

Abstract

This chapter 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 for graduates in the UK. We document that the gender wage gap increases over the life cycle, especially between ages 25 and 40. The share of women working in flexible occupations has grown over the life cycle, and especially substantially over time for successive cohorts, whereas men have been less likely to work in flexible occupations at older ages. The wage penalty from working in flexible occupations has increased both over the life cycle and over time. We estimate a model of labour supply and demand to quantify the importance of changes to preferences and relative demand for flexibility on the gender wage gap. We find that there is higher demand for male labour at older ages, in particular in inflexible occupations, which contributes to the increase in the gender wage gap over the life cycle. On the supply side, women's preferences for job flexibility have increased across cohorts, which has contributed to widening the wage gap and the flexibility wage penalty over time. Fertility and marriage are associated with reductions in labour supply for women, whereas men are likely to increase working in inflexible occupations after marriage, conforming to their life cycle patterns of moving out of lower paid flexible occupations. Childcare costs reduce women's likelihood of working, though child-related benefits and tax credits do not significantly affect labour market participation of graduate women.

2.1 Introduction

The graduate gender wage gap is small close to labour market entry in the UK, but it increases over the life cycle as women's earnings growth stagnates in comparison to that of men on average. Despite reductions in the average gender wage gap over time, the life cycle pattern has remained consistent over successive cohorts of workers, suggesting that the life cycle increase in gender wage disparity underlies the stalling in convergence of the gender wage gap over time. The 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 links 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). There is little research that explicitly ties occupation flexibility to the changes in the gender wage gap over time and over the life cycle. This chapter uses a model of labour demand and supply in flexible occupations to examine how changes in these forces explained the changes in the gender wage gap and the share working in flexible occupations in the UK over time and over the life cycle.

This chapter first summarises three key descriptive patterns related to the gender wage gap and occupation flexibility in the UK: first, how the gender wage gap changes over the life cycle and over time for graduates; second, how graduate male and female participation in flexible occupations changes over the life cycle and over time; and third, that graduates suffer a wage penalty from working in flexible occupations which changes over time and over the life cycle. We follow Goldin (2014) in defining flexibility as an occupation characteristic, such that workers are not easily able to choose their hours or location of work in flexible occupations. This definition implies that occupations where employees are imperfect substitutes in performing their tasks (so that there are transaction costs to substituting work across workers) this would result in premiums of earnings with respect to the number of timing of hours worked. Goldin illustrates this definition using a measure defined from the O*Net Survey of job characteristics in the USA, identifying five particular characteristics that are most relevant - including time pressure, workers needing to be around at particular times, scheduling flexibility in the occupation, workers needing to be in contact with colleagues and clients, and the degree to which workers can be substituted for each other in the occupation.

The first descriptive pattern shows that the gender wage gap increased over the life cycle for cohorts of graduates born between 1945 and 1985 in the UK, with the graduate gender wage gap at labour market entry close to zero but increasing to about 20% of real hourly male earnings by age 50-55, remaining similar in magnitude across cohorts over all ages. This increasing wage gap over the life cycle was driven by slower wage growth among women compared to men, which supports the hypothesis in the literature that women's changing work patterns over the life cycle contribute to substantial and sustained reductions in their earnings (Adda et al., 2017; Kleven et al., 2019b; Angelov et al., 2016; Bertrand et al., 2010; Gicheva, 2013). We next illustrate that the share of women working in flexible occupations increased both over the life cycle as well as across cohorts, with an increase of about 2 percentage points over the life cycle compared to about 8 percentage points across successive cohorts. This ties into existing evidence on the motherhood penalty and women's increased demand for flexibility over the life cycle (Cortés and Pan, 2019; Costa Dias et al., 2018; Le Barbanchon et al., 2020; Cortés and Pan, 2020), with it being less established that women have also increased their demands for flexibility over time. On the other hand, men increasingly moved into inflexible occupations at older ages, with little change across cohorts over time. This is indicative of men increasingly over time working in higher paid ('greedy') occupations which pay premiums for working inflexibly or 'overworking', with such occupations have seen especially high increases in their returns over time (Coser, 1974; Denning et al., 2019; Kuhn and Lozano, 2008). This supports our next stylised fact that the wage penalty associated with working in flexible occupations increases with age and over time for successive cohorts of both graduate men and women.

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 formulating a model in which individuals are differentiated by sex, age, and cohort over time, with each type having different labour market preferences and outcomes. On the supply side, workers of different type 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 which 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 to understand how outcomes would be different in response to changes in the parameters.

The analysis in this chapter focuses on prime-aged graduates, as the gender wage gap has not converged as much at the top of the distribution. Furthermore, flexibility might be an especially binding constraint for graduate women who despite working longer hours than non-graduate women, also have 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 graduate workers.

Our model and parameters of interest illustrate the importance of flexibility in explaining the gender wage gap. We find that increases to women's preferences for flexibility over successive cohorts drove the large increase in women working in flexible occupations over successive cohorts, and contributed to more than 80% of the increase 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 has become more common in workplaces, so that cultural norms around flexible working may be more widespread, encouraged by legislation that enables employees to request flexible working arrangements. This shift towards working in flexible occupations by more recent cohorts of women 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).

The findings related to flexibility align with previous evidence in this area - for instance, the finding that the increased likelihood of women working in flexible occupations was driven by increases in women's preferences for working in flexible occupations over successive cohorts align with research suggesting that the overrepresentation of women in low-paid occupational (and educational) fields could be attributed to gender differences in preferences (Zafar, 2013). Liu (2016) found for the US that preferences for part-time work increased with marriage and the number of children only for women, explaining a substantial portion of the gender employment gap but only about 6% of the gender wage gap. Research from Germany also shows that the provision of flexible working arrangements and working time autonomy were associated with increased hours worked for both men and women, but increased income from these arrangements only accrued to men (Lott, 2015). An element of the preferences for flexibility operates through children's presence at home as shown by Duchini and Van Effenterre (2018) using a French policy reform that removing constraints related to children's presence at home allowed women to work longer and more regular hours, closing the gender wage gap by about 6%. The flexibility penalty may operate through various mechanisms, as for instance, existing research has shown gender wage penalties arising due to reduced levels of labour supply in comparison to an ideal full-time, uninterrupted career progression – that is, through part-time work, career interruptions leading to lost investments in skills and skill deprecation, leading to lost accumulated human capital that therefore hinders their career progression (Manning and Petrongolo, 2008; Adda et al., 2017; Costa Dias et al., 2018; Costa Dias et al., 2021). Flexible occupations are more likely to have higher proportions working part-time (as seen in Table 1.1), and have lower levels of skill depreciation as a characteristic of the flexibility definition used here is that employees are less likely to be substitutes in inflexible occupations so that they have highly personalised skill development which are therefore more likely to atrophy with career interruptions).

We also find that the relative demand for male labour increased over age, so that men were increasingly in higher demand in both flexible and inflexible occupations at older ages, compared to women, therefore 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 (especially in inflexible occupations) at older ages relative to women has been referred to as an 'age twist', as 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). Women of all age groups, but particularly in the 35-44 age group, were more likely to have a child under five in their household in 2017 than in 1993, which will have contributed to their increased preferences for flexibility. However, we 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 existing research that older men were increasingly more likely to work long hours in recent years (Kuhn and Lozano, 2008). Though the likelihood of being married fell sharply for both men and women between 1993 and 2017, increasing women's likelihood of working overall and in both flexible and inflexible occupations, this effect was less pronounced, suggesting that marriage did not have strong deterrent effects on women's labour force participation, after having taken fertility and childcare into consideration.

This chapter is structured as follows: the following section describes the data and definitions used, Section 2.3 summarises the key descriptive patterns of interest, Section 2.4 sets out the model and estimation strategy, Section 2.5 presents a discussion of the results for the parameter estimates and counterfactual simulations, and Section 2.6 concludes.

2.2 Data

The main data used in analysis is from the UK Quarterly Labour Force Survey waves from summer 1993 to winter 2017, restricting the analysis sample to graduates aged 25 to 55 years (prime-aged population). The data include measures of labour force participation, gross weekly wages, and usual hours worked per week in 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.

The measure of occupation flexibility that we use follows Goldin's 2014 definition, which averages five standardised job characteristics in the O*NET survey in the US to characterise occupation flexibility as a continuous measure:

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 around to finish tasks for 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 that 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 listing 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 the US Standard Occupational Classification 2000 and were matched to UK

SOC2000 4 digit occupations using multiple crosswalks.[1] 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 is fixed for an occupation over time, as the measure corresponds to O*NET characteristics for a fixed 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.

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. Data from the Family Resources Survey was used to calculate the average childcare costs per child and weekly child-related benefits for women.

2.3 Descriptive patterns in the UK Labour Force Survey

This section describes three key stylised facts related to labour market outcomes for the prime-aged graduate population in the UK from 1993 to 2017: first, how has the gender wage gap changed over the life cycle and over time for cohorts of graduates in the UK? Second, how has the share of graduates working in flexible occupations changed over the life cycle and over time, and how do these changes vary for men

[1]Refer to Data Appendix A for detailed information on the construction of these measures.
[2]0.1% of observations were trimmed from the sample.

and women? Finally, does working in flexible occupations impose a wage penalty on graduates, and if so, does this penalty vary over the life cycle and over time?

Illustrating the first stylised fact, Figure 2.1a plots the difference in log male and female real hourly earnings from ages 25 to 55 for graduates born in cohorts from 1945-49 to 1985-89 (where available in LFS data from 1993-2017). The graduate gender wage gap at labour market entry was close to zero for all cohorts that we have data around age 25. However, this gap increased steadily at older ages for individuals from these cohorts, peaking at about 30% of real hourly earnings around age 40, and declining a little after that. Although there is a significant increase in the gender wage gap over age, it has remained of similar magnitude when comparing individuals of the same age across cohorts, indicating that changes in the gender wage gap over time mostly reflected changes in the wages paid to male and female graduates of different ages (and differences in age composition across cohorts), rather than changes in the remuneration to graduates of the same age across different cohorts.

Whether this increase in the gender wage gap over age results from male or female wages can be examined in more detail in Figure 2.1b, which plots the log average real hourly earnings of graduate men and women born in 1965-69 between the ages of 25 to 52. Though graduate men and women in this cohort group had very similar hourly earnings around labour market entry at age 25, their wage growth through even their early career was much slower than that of men, and levelled off earlier by their late thirties. This corresponds to the timing when women would potentially start to require more flexibility at work due to increased childcare responsibilities, and is supported by evidence in the literature related to the 'motherhood penalty' or 'child penalty', where women suffer slower wage growth due to career interruptions and changes to their working patterns after motherhood (Adda et al., 2017; Bertrand et al., 2010; Costa Dias et al., 2018; Kleven et al., 2019b). Men's wages, in contrast, continued growing and only stabilised later into their careers at about age forty-five.

There is a growing literature detailing how the child penalty operates to increase the gender wage gap over the life cycle, with key explanations centred around changes to women's labour supply post motherhood in favour of working options that allow them time and/or place flexibility. For instance, career interruptions, reductions in hours worked, and subsequent loss of human capital due to skill deterioration or lost potential experience, as well as selection into lower-paying or more 'child-friendly' occupations or workplaces closer to home are channels through which having children imposes costs on women and causes the gender wage gap to increase post-motherhood (Angelov et al., 2016; Adda et al., 2017; Bertrand et al., 2010; Costa Dias et al., 2018; Gicheva, 2013; Kleven et al., 2019b).

It has been documented in the literature is that women are more willing than men to accept lower wages in specific occupations that are more geared towards flexibility and therefore would enable them to manage a career alongside their family (He et al., 2019; Le Barbanchon et al., 2020; Wiswall and Zafar, 2018). This brings us to the next stylised fact on whether the share of graduates working in flexible occupations has changed over time and over the life cycle in the UK. Figure 2.2 shows the share of graduate men and women of cohorts from 1945-49 to 1985-89 working in flexible occupations (as categorised by a binary measure of flexibility, and as opposed to working in inflexible occupations) over ages 25 to 55. The average share of women working in flexible occupations increased over the life cycle (although by a small magnitude) for each cohort as higher proportions of women selected into these occupations at older ages for all cohorts, as would be expected by existing research on flexibility and the child penalty. On the other hand, there were large increases in the likelihood of working in flexible occupations over the cohorts, as women in later cohorts were much more likely to work in flexible occupations compared to women of the same age in preceding cohorts. Graduate women's participation in flexible occupations increased substantially over time, conditional on age. Unlike the evidence on the motherhood penalty showing women's increasing demand for flexibility over the life cycle, this increase in women's demand for flexibility over time has not been explored much in the literature, though suggestive evidence exists that this may be due to the costs of motherhood having increased as childcare-associated time pressures have risen for recent cohorts of women (Altintas, 2016; Chiappori et al., 2017; Dotti Sani and Treas, 2016; Kuziemko et al., 2018).

In contrast to their female counterparts, graduate men increasingly worked in non-flexible occupations at older ages (moving out of working in flexible occupations over the life cycle on average). This suggests that movements along the career ladder to higher paying occupations coincided with increased working in non-flexible occupations, as more of these higher paying occupations rewarded being able to work inflexibly, which is a channel through which women are unable to experience faster rates of wage growth enjoyed by men in their career progression(Cha, 2010; Cha and Weeden, 2014; Denning et al., 2019). Comparing men of the same age across different cohorts, however, men did not change their participation in flexible occupations over cohorts much, suggesting that the patterns of career progression and movement across occupations remained similar for men of different cohorts. Cha (2013) finds that in comparison to men and childless women, mothers were more likely to exit male-dominated occupations when they worked more than fifty hours per week, whereas other research looking at high-skilled employees (lawyers and MBA graduates) found large earnings penalties for women but not men after the arrival of their first child (Azmat and Ferrer, 2017; Noonan et al., 2005; Bertrand et al., 2010).

Women in particular were willing to accept lower wages in return for being able to work flexibly, as flexible occupations tend to be lower paid on average, indicating a wage penalty from working in flexible occupations. For our final stylised fact, we document this flexibility wage penalty and how it varies over the life cycle and over time. Figure 2.3 graphically represents the wage penalty associated with working in occupations that score 1SD higher on the continuous flexibility measure, for cohorts of graduate men and women over ages 25 to 55, born from 1945-49 to 1985-89. The flexibility wage penalty is defined as the slope of the regression line associating the median log hourly wage in the occupation with the occupation's flexibility score. The more negative the slope, the larger the wage penalty associated with flexibility. There are no marked gender differences in the evolution of the wage penalty across cohorts and over the life cycle, as for both graduate men and women in every cohort, the flexibility wage penalty increased on average over the life cycle (becoming more negative at older ages), consistent with evidence that higher-paying and more senior occupations on the career ladder are less flexible on average.

The flexibility wage penalty also was higher for graduates in later cohorts compared to those of the same age in earlier cohorts, suggesting that the cost associated with working in flexible occupations increased over time. As the measure of flexibility used in this chapter is fixed over time, it does not capture changes in occupations' levels of flexibility over time due to changing regulations or working environments. This evidence, however, is consistent with the findings that the premium for working long hours (or overworking), especially in certain 'greedy occupations' has increased over time (Cha, 2010; Cha and Weeden, 2014; Cortés and Pan, 2019; Coser, 1974; Kuhn and Lozano, 2008), and that the nature of work has changed making it more costly to work flexibly (for example, due to the increased prevalence of group work) (Lazear and Shaw, 2007). The wage penalty associated with flexibility is slightly higher at all ages for graduate women than for graduate men, which is likely due to women being more likely to work in more flexible occupations than men (Cortés and Pan, 2019), as they tend to have a higher willingness to pay for flexibility. For instance, Mas and Pallais (2017) and Bustelo et al. (2020) found using discrete choice experiments that women were likely to be willing to pay more (between 8-20%) for flexible schedules and being able to work from home, with higher estimates of willingness to pay if they had young children.

Finally, we also describe other descriptive patterns related to variables used in modelling. Figure 2.4 plots the change over time in the average hourly childcare costs per child incurred by women who have children under five in the household. The data on childcare costs and child benefits was taken from the Family Resources Survey – average hourly childcare costs per child and average benefits were calculated for each labour type (graduate men and women with children of a given age group in a year) for the model which is estimated as aggregated for each labour type. [3] Women in the different age groups incurred similar levels off childcare costs over time, where these childcare costs could be up to a third of hourly wages.

Figure 2.5 plots the change in child-related benefits over time. Figure 2.5a plots the share of graduates receiving child-related benefits over time, and shows that a 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 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 is the most relevant new benefit that was introduced in the period of analysis. Figure 2.5b shows that the average weekly

[3] 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. This results in a dip in the average childcare costs around 2004 as plotted in Figure 2.4.

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 group, suggesting that this is the age group most likely to have children that they are responsible for, and to also receive benefits conditional on having these children.

The patterns described above in the stylised facts suggest that while there may be labour supply forces inducing gender differences in the share of graduates working in flexible versus inflexible occupations over the life cycle and cohorts, interactions with labour demand forces could also additionally result in graduate men and women of different ages and cohorts being remunerated differently.

2.4 Model

We propose a model consisting of successive cohorts of workers across the life cycle as in 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 graduates over ages 25 to 55 across cohorts.

Individuals in the model are differentiated into types based on their sex (indexed $s \in \{mal, fem\}$), age (indexed $a \in \{25, 26, ..., 55\}$), and cohorts (indexed $c \in \{1945, 1955, ..., 1985\}$) in each year (calendar years indexed as $t \in \{1993, 1994, ..., 2017\}$). Labour market preferences and subsequently outcomes differ for individuals of different types.

2.4.1 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:

$$Y_t = Z_t \left[\alpha_{1,t} L_{fle,t}^{\rho_1} + (1 - \alpha_{1,t}) L_{inf,t}^{\rho_1} \right]^{1/\rho_1} \tag{2.1}$$

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 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 allow the model to flexibly capture movements in overall productivity as well as in the relative demand for labour in flexible occupations over time.

In the second nest of the production technology, firms aggregate labour of six types (three age groups and two sexes) within each occupation category:

$$L_{o,t} = \left[{}_{a,s} \alpha_{2,a,o,s} L_{a,o,s,t}^{\rho_2} \right]^{1/\rho_2} \quad \text{for} \quad o = fle, inf \tag{2.2}$$

$L_{a,o,s,t}$ is the total labour input of age group $a \in \{25-34, 35-44, 45-55\}$ and sex $s \in \{m, f\}$ used in occupation o in year t, and $\alpha_{2,a,o,s}$ is the share parameter that captures the intensity with which this labour input is used relative to labour inputs of the other sex and age groups, which is fixed over time. [4] ρ_2 is the substitution parameter (defined in relation to the elasticity of substitution as above) governing how labour inputs across different ages are substituted between. The demand side of the model has 22 parameters that need to be estimated.[5]

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

$$Y_t = \left[\alpha_t L^{\rho}_{\tau_1,t} + (1-\alpha_t) L^{\rho}_{\tau_2,t}\right]^{1/\rho} \tag{2.3}$$

α_t is the time-varying share of each type of labour used in production and ρ is the the substitution parameter such that the elasticity of substitution between the two types of labour is $\sigma = \frac{1}{1-\rho}$. As wages equal marginal products of labour in equilibrium, the gender wage gap (expressed as the log ratio of male to female wages) would be a function of the ratios of the relative labour shares for male and female labour as well as the equilibrium quantities of male and female supplied:

$$\log\left(\frac{W_M}{W_F}\right) = \log\left(\frac{\alpha_M}{\alpha_F}\right) - \frac{1}{\sigma}\log\left(\frac{L_M}{L_F}\right) \tag{2.4}$$

On the demand side, therefore, the relative demands for male and female labour in flexible and inflexible occupations over time and at different ages determine how the gender wage gap evolves over time. On the supply side, however, the ratio

[4]The share parameters are fixed over time within each occupation type implying that the structure of firms' relative demand for labour inputs across different ages does not vary over time, given occupation type.

[5]The demand-side parameters include two elasticities of substitution (one for each nest of the production function), four parameters related to the time-varying changes in technology or total factor productivity, and sixteen parameters related to the share parameters (four in the first nest, and twelve in the second nest of the production function).

of male to female labour supply in each occupation is determined by male and female preferences for working in each occupation as determined in a random utility framework.

2.4.2 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:

$$\begin{aligned} U(j \mid s,c,a,t) &= \psi_{0,s,a,j} + \psi_{0,s,c,j} + \psi_1 W_{a,s,o,t} \cdot \mathbf{1}[j=o] + ... \\ &+ \pi_{2,s,j} Pr(\text{child} < 5 = 1 \mid s,a,t) + ... \\ &+ \pi_{3,s,j} Pr(\text{marr} = 1 \mid s,a,t) + ... \\ &+ \gamma_{1,o}\text{CHC}_{a,t} \cdot \mathbf{1}[j=o] \cdot \mathbf{1}[\text{child} < 5 = 1] \cdot \mathbf{1}[\text{s = f}] + ... \\ &+ \gamma_{2,o}\text{CBEN}_{a,t} \cdot \mathbf{1}[\text{child} < 5 = 1] \cdot \mathbf{1}[\text{s = f}] + ... \\ &+ \epsilon_{j,s,a,c,t} \quad \text{for} \quad j = fle, inf, hom; o = fle, inf \end{aligned} \tag{2.5}$$

$U(j \mid s,c,a,t)$ is the utility from labour supply alternative j obtained by an individual of sex s, cohort c, and age a at time t. $\psi_{0,s,a,j}$ captures age- and sex- specific preferences over the alternatives j that are fixed over time. $\psi_{0,s,c,j}$ captures cohort- and sex- specific preferences over the alternatives j that are fixed over ages. This allows the female share working in flexible occupations for a given cohort to be higher or lower than that of a previous cohort across all ages, for example. ψ_1 is a parameter describing the sensitivity to age-occupation-specific wages in a given year $W_{a,o,t}$, 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 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. The age- and sex-specific likelihoods of being married and having children in a given year are therefore included to account for these differences in preferences, as $Pr(\text{marr} = 1 \mid s, a, t)$ and $Pr(\text{child} < 5 = 1 \mid s, a, t)$ respectively. These likelihoods vary over time and age to capture generational and life-cycle differences in the likelihood of marriage and children for men and women. $\pi_{2,s,j}$ captures sex-specific preferences for home production or the two market occupations, given their type's likelihood of having children, whereas $\pi_{3,s,j}$ captures sex-specific preferences for home production or the two market occupations, given their type's likelihood of being married. These preferences only vary by sex, as it is likely that women have different labour supply responses to these life events than men do.

Average childcare costs CHC are included for women of different age groups in each year if they have children under five in the household, and only if they are working in a market occupation. The childcare costs are calculated as the average hourly childcare costs per child. The disutility from childcare costs differs by occupation through the coefficient $\gamma_{1,o}$. The average child-related benefits $CBEN$ received by graduate women in each year are also included. As these child-related benefits are received by children's primary caregivers, which in most cases are women, so that these terms only enter the labour supply utilities of women. The utility of receiving benefits ($\gamma_{2,o}$) only varies by occupation.

Finally, following a multinomial logit specification, $\epsilon_{j,s,a,c,t}$ is assumed to be distributed independently and identically extreme value, which allows the utilities to be expresed as multinomial choice probabilities. Given 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:

$$Pr(j = 1 \mid s, c, a, t) = \frac{exp\left[U(j \mid s, c, a, t)\right]}{{}_j\, exp\left[U(j \mid s, c, a, t)\right]} \quad \text{for} \quad j = fle, inf, hom \tag{2.6}$$

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.

$$L^{supply}_{s,c,a,t} = Pr(j = 1 \mid s, c, a, t) \times \text{LabourForce}_{s,c,a,t} \tag{2.7}$$

The supply side of the model has 37 parameters that need to be estimated, of which 24 are gender- and age-/cohort-specific preferences for occupations.

2.4.3 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 $s = \{m, f\}$, occupation $o = fle, inf$, age group $a \in \{25-34, 35-44, 45-55\}$ at time t as below:

$$W_{a,o,s,t} = \frac{\partial Y_t}{\partial L_{a,o,s,t}} \tag{2.8}$$

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

$$\frac{W_{a,o,m,t}}{W_{a,o,f,t}} = \frac{\alpha_{2,a,o,m} L_{a,o,m,t}^{\rho_2 - 1}}{\alpha_{2,a,o,f} L_{a,o,f,t}^{\rho_2 - 1}} \tag{2.9}$$

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

$$\log\left(\frac{W_{a,o,m,t}}{W_{a,o,f,t}}\right) = \log\left(\frac{\alpha_{2,a,o,m}}{\alpha_{2,a,o,f}}\right) - \frac{1}{\sigma_2}\log\left(\frac{L_{a,o,m,t}}{L_{a,o,f,t}}\right) \tag{2.10}$$

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

$$L_{a,o,s,t}^{demand} = L_{a,o,s,t}^{supply} \tag{2.11}$$

The model parameters are identified off the variation in employment and wages for individuals in each type and occupation in the data. The model has 59 parameters in total to to be estimated, 22 from the demand side of the model and 37 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. Using this approach, a solution is obtained by iteration over a fixed point algorithm, which proceeds as follows: (i) for a given set of parameter values, an arbitrary wage vector W^0 is plugged into the occupational choice model to get the estimated occupational choice probabilities for each labour type, from which labour supplies can be estimated using the cohort sizes for each labour type (Equations 2.6 and 2.7); (ii) these estimated labour supplies can be plugged into the marginal productivity function (Equation 2.8) to get predicted wages W^1; (iii) if the predicted wages W^1 equal W^0, there is a solution for these given parameters, and if not, the iterative process is repeated till there is a solution.

The model generates predictions of wages and labour supplies for (31 ages $\times$ 2 sexes =) 62 types of labour in each of 25 years from 1993 to 2017. There are three labour supply predictions for each type (one for each occupational choice alternative), so that there are 186 labour supply predictions for each year (4650 in total).There are two wage predictions (one for each market occupation) for each type, so that there are 124 wage predictions for each year (3100 in total). These 7750 predictions are optimised with respect to the 59 parameters to minimise the differences between the predictions and observed data.

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

2.5 Results

2.5.1 Model Fit

Figures 2.6 and 2.7 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 2.3, but averaged over the age groups and cohorts as specified in the model in Section 2.4. 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 fit the data relatively well, in general capturing the nature of any trends in the data. Figure 2.6a 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 2.3 showed that the gender wage gap increased substantially over the life cycle, with the levels remaining similar 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 2.6b, 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 age 35-44 after which the rate of increase fell.

Figure 2.7 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 over cohorts and did not change much over age, whereas the share of men working in flexible occupations fell over the life cycle, with levels not changing much over successive cohorts. Figures 2.7a and 2.7b 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 fell substantially between ages 25 and 45 for all cohorts, with no further falls or slight increases after that, and this is captured well by the estimates. On the other hand, while the share of women working in flexible occupations did not increase much over ages (conditional on cohorts), later cohorts of women were much more likely to work in flexible occupations than earlier cohorts. Figure 2.7b shows that these patterns are mirrored closely in the predicted data. These graphs show that the model captures the overall trends with respect to the outcomes of interest fairly well, and therefore, we next explore how the parameters estimated in the model can explain these observed patterns.

2.5.2 Parameter Estimates

Demand side

Elasticities of substitution

Table 2.1 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 much higher at about 38.4, suggesting that these labour types are close substitutes in production, conditional on occupation.

From Table 2.2, there was a 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 2.10). 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, that 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 2.8 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 2.8a and 2.8b 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 2.8c. Finally, Figure 2.8d plots the estimated evolution of total factor productivity, which also follows a quadratic time trend.

Figure 2.8a 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, though 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 2.10). 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 2.1b 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 2.8b 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 a downward pressure on relative wages in flexible occupations compared to inflexible occupations, so that the wage penalty for working in flexible occupations would increase 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 2.3 and more clearly in Figure 2.6b.

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).[6] These differences in firm demand (and therefore to 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 differenes 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 gound 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 lack of mentors

[6]Refer Chapter 1 for a summary for the UK.

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 even sometimes benefited from) fatherhood. Participants in lab experiments judged fathers to be more committed and recommended higher starting salaries, in contrast to mothers being 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 call-back penalty of 43% compared to 24% for men, from applying to gender mis-matched jobs.

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 that have 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 levels of management. Figure 2.9 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.[7] 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 2.10 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 2.8c 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 an increase in the wage penalty from working in flexible occupations over time. This pattern can be seen in Figure 2.3, which also shows that the increase in the flexibility wage penalty over time slowed for the most recent cohorts, which corresponds to the relative demand for labour in flexible occupations increasing in the most recent years. This slowdown in demand for inflexible jobs aligns with the reversal in the growth of demand for cognitive tasks starting in 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 2.8d shows that there was an overall increase in productivity over time

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

(modelled as a cubic time trend) between 1993 and 2017, with a downturn around 2009, coinciding with the Great Recession in this period.

Supply side

Earnings

Table 2.3 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[8]. The wage elasticity of labour supply is the increase in the probability of choosing to work in market occupations as a result of the increase in the average hourly wage.[9] 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 that the estimated wage elasticity of labour supply among graduates is quite low on average.

[8]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.

[9]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 2.6.

As a robustness check, Table 2.4 reports results from estimating the supply side of the model using OLS and multinomial logit regressions.[10] 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 is in line with the above discussion, though the OLS estimates are significant only for men.

Marriage and Fertility

The estimated coefficients for marriage and fertility show that both life events were associated negatively with women's labour supply, whereas fertility in particular was positively associated with men choosing to work in both 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 under five in the household, averaged across all age groups and years. These reported effects show that having a child had a greater effect on reducing women's labour supply than did marriage, with the reduction in labour supply larger for flexible occupations in the case of both life events. 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 2.5) was associated with 8.5 and 18.1 percentage point reductions in the probability of a woman

[10]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 differs between men and women.

of this age group working in inflexible and flexible occupations respectively. This is in contrast with Cha (2013) who finds that that in comparison 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 much less likely to drop out of the labour market around the time of first childbirth in recent decades, suggesting that women's labour market attachment has grown overall (Roantree and Vira, 2018). The OLS and multinomial logit estimates in Table 2.4 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%. 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 2.5. 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). The robustness check in Table 2.4 using OLS estimates finds that marriage makes men and women both significantly less likely to be in home production or work in flexible occupations and more likely to work in inflexible occupations. For women, this is different from the results in the model, but the reduced form estimation uses an indicator of marriage at the individual level, rather than the probability of being married in the age group, which may explain the differences in results.

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 were not associated with large increases in women's labour force participation. The reported average marginal effects are the changes in the probability of choosing the specified occupation associated with a 0.001 increase in the childcare costs accrued and the benefits received conditional on having children, averaged across women of all age groups and years.

The reported average marginal effects show that increased childcare costs had the effect of reducing 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 in order to take care of children themselves. A £0.01 increase in weekly childcare costs was associated with 0.6 and 1.0 percentage point reductions 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. Lack of childcare especially limits the labour supply of high-skilled women, for whom the outsourcing of domestic production forms a tighter constraint on their time allocation as 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. Adda et al. (2017) estimates a positive costs of childcare that is higher for children aged six years and younger, at €31 per day, compared to €12 daily for children older than six, which suggests that parents engage in consumption smoothing in anticipation of children being born. Other studies that look at the responsiveness of female labour supply to childcare costs find a negative elasticity of labour supply with respect to childcare costs, both in terms of participation and hours worked, as summarised in Gong et al. (2010).

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 an important factor in determining the labour force participation of the graduate women in our sample. Other research looking at female labour supply in the UK has found that while the receipt of tax credits have 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).

The OLS and multinomial estimates in Table 2.4 report 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 in line with the parameter estimates reported by the model though they are not statistically significant.

Age- and Cohort-Specific Preferences for Occupations

The model estimates preference parameters that show how gender-specific preferences for working in flexible and inflexible occupations vary over the life cycle and across cohorts, shown in Table 2.6. Figure 2.11 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.[11]

Figure 2.11a 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 2.11b. Figure 2.2 showed earlier that the share of women working in flexible occupations

[11]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 2.11a 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 2.6 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 2.11a.

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 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 so that 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 insitutional 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 to women's preferences for working in flexible occupations over time may arise due to changes in the costs of motherhood over time, as policies related to and availability of formal and informal childcare change 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, though 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 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; **?**).

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, and this has reinforced patterns of assortative mating (amnog 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 2.12 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 skills admissions than previously, causing greater wage dispersion among graduates, and a weakening of graduate status as a signal for 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 may be that the composition of the graduate labour force changed so that preferences for flexibility became more important, rather than a general overall increase in preferences for flexibility among highly skilled graduates (comparable to the earliest cohorts). Figure 2.12 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 to more highly motivated individuals who were able to capture high-paying jobs that may have been inflexible in nature. However, as graduate degrees became more common, women who went to university may not only have been those who were career-oriented and therefore, the preferences for flexibility among graduates themselves may have increased naturally as a result of this.

Figure 2.11a 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 2.11b 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 2.2), 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. Table 2.4 confirms using OLS and MNL estimation that 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 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 be working in inflexible occupations, which does not vary by gender.

2.5.3 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 2.7 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), on average the gender age gap increased by 24.3 log points over the life cycle (across all years of the sample), with a smaller increase over time of 0.7 log points 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 fell over time (across all cohorts) by about 4.6 percentage points on average, while the share of women working in flexible occupations increased over time at 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.[12]

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 2.8a 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 2.7 show that without these increases in relative demand for male

[12]The estimates of the change in the gender wage gap and 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 – averaging the changes across all years and over all ages, respectively. This makes some of the patterns in the estimates different to what has been discussed earlier.

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 from working in flexible occupations would also have reduced 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 2.7, 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 2.11 showed that the changes in men's and women's preferences for working in flexible and inflexible occupations over time was 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 2.7 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 have also meant that there would have been smaller increases in the wage penalty from working in flexible occupations both over time and over 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 2.7 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 over ages.

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 2.5, 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) show that in the absence of the reduction in marriage rates, both the reduction 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 the reduction in marriage rates would have therefore 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) as 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.

2.6 Conclusion

This chapter estimates a model of labour supply and demand in order to evaluate the importance of occupation flexibility for changes to 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.

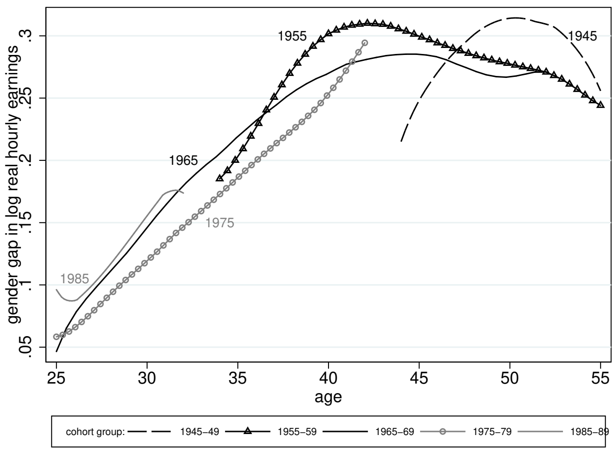
Our estimates show that increases in relative demand for male labour (versus female labour), and in inflexible occupations, mainly contributed to the increase in the gender wage gap over the life cycle, with the increase in this relative demand (and the gender wage gap) especially pronounced till about 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, and this increase in women's preferences for flexibility over cohorts, has been concurrent with an increase in the wage premium to 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 with women, men were likely to reduce their participation in flexible occupations and increase it in inflexible occupations after marriage, also 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 (though the childcare data used in the data was aggregated and measured inconsistently over time, and so should be interpreted with caution). 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).

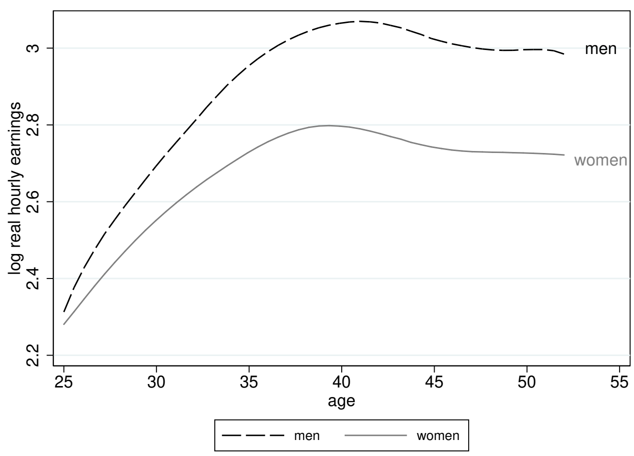
2.7 Tables and Figures

FIGURE 2.1: Gender wage gap for graduates, by cohort, over the life cycle

(a) Gender wage gap by cohort

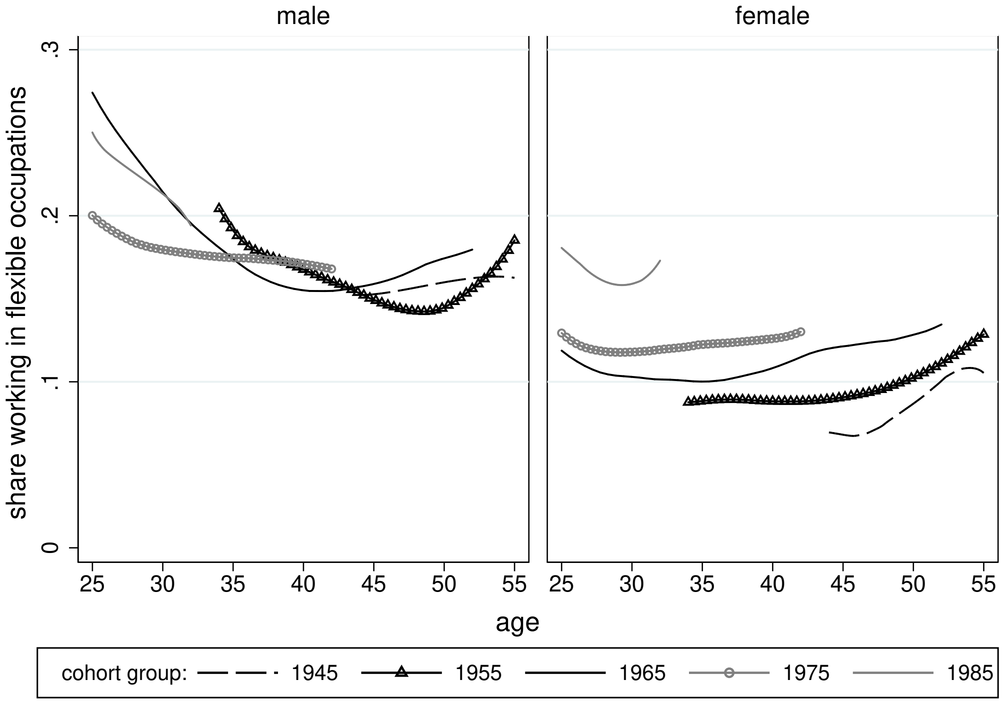


(b) Male and female wages over the life cycle for cohort born 1965-69



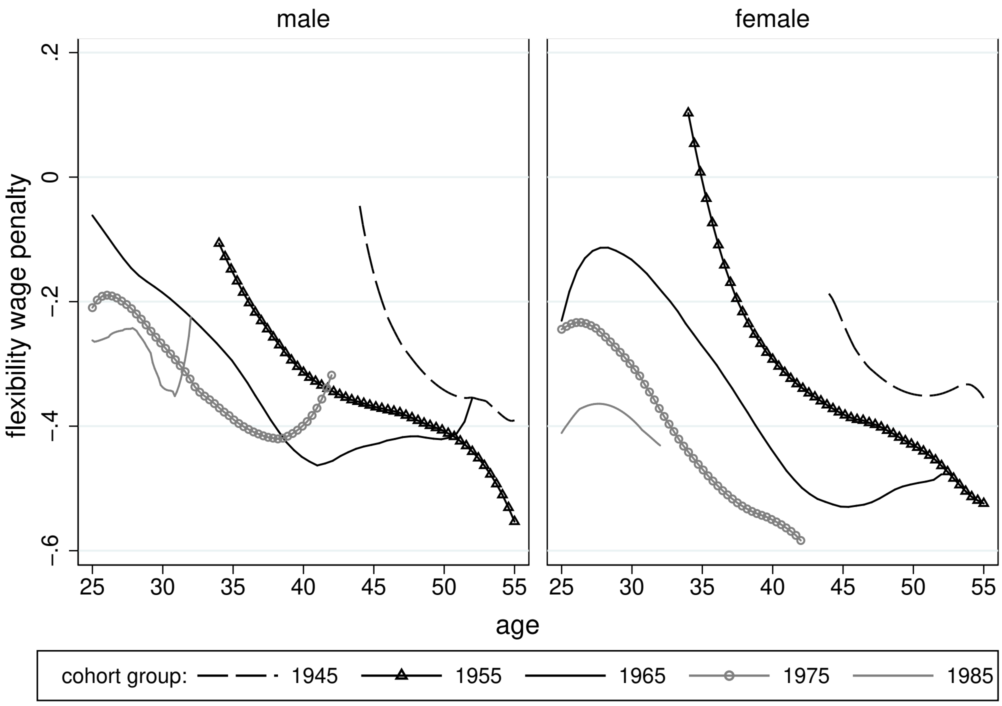
Notes: The graph in panel (a) plots the difference between log male and female real hourly earnings for different cohorts between ages 25 and 55. The graph in panel (b) plots the evolution of log real hourly earnings between ages 25 and 52 for men and women born between 1965 and 1969. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

FIGURE 2.2: Share of graduates working in flexible occupations by cohort, over the life cycle



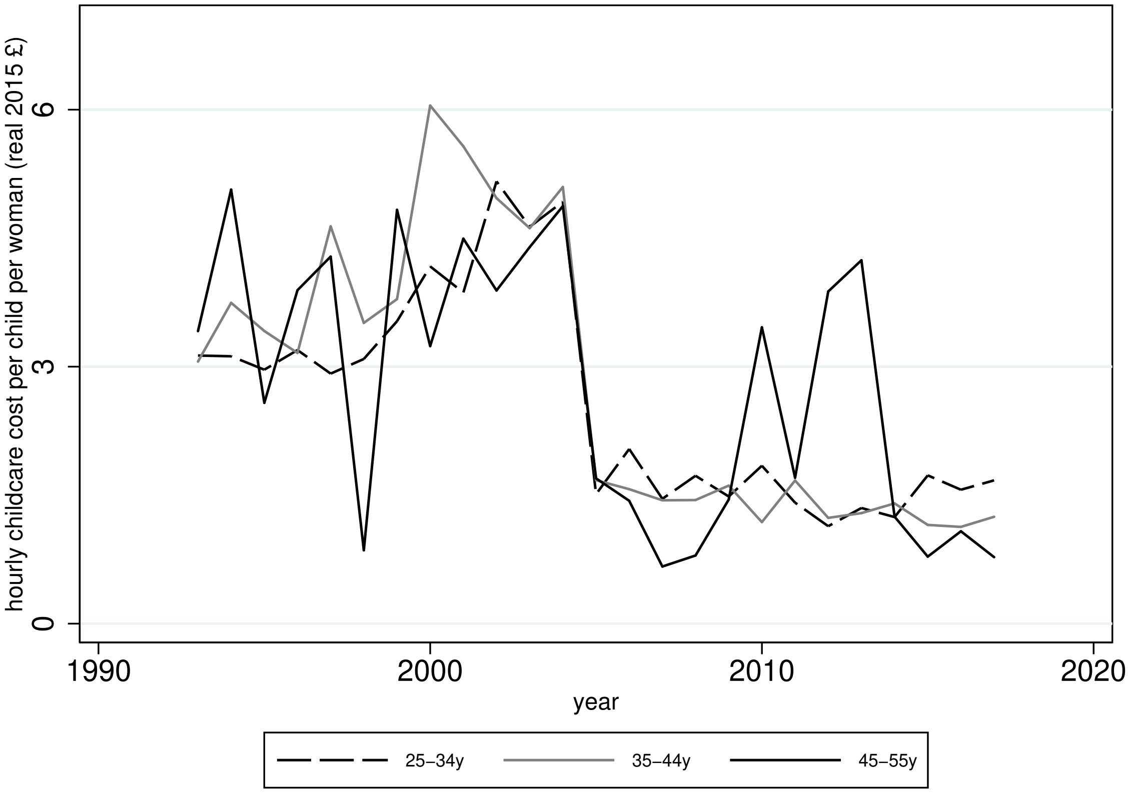
Notes: The graphs plot the share of male and female graduates working in flexible occupations, as defined by a binary indicator, across different cohorts between ages 25 and 55. The binary indicator defines flexible occupations as those that have a flexibility score above the median for all occupations. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

FIGURE 2.3: Flexibility wage penalty for graduates by cohort, over the life cycle



Notes: The graph plots the evolution of the wage penalty associated with a 1SD increase in occupation flexibility score between ages 25 and 55, separately for male and female graduates in different cohorts. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

FIGURE 2.4: Childcare Costs over Time

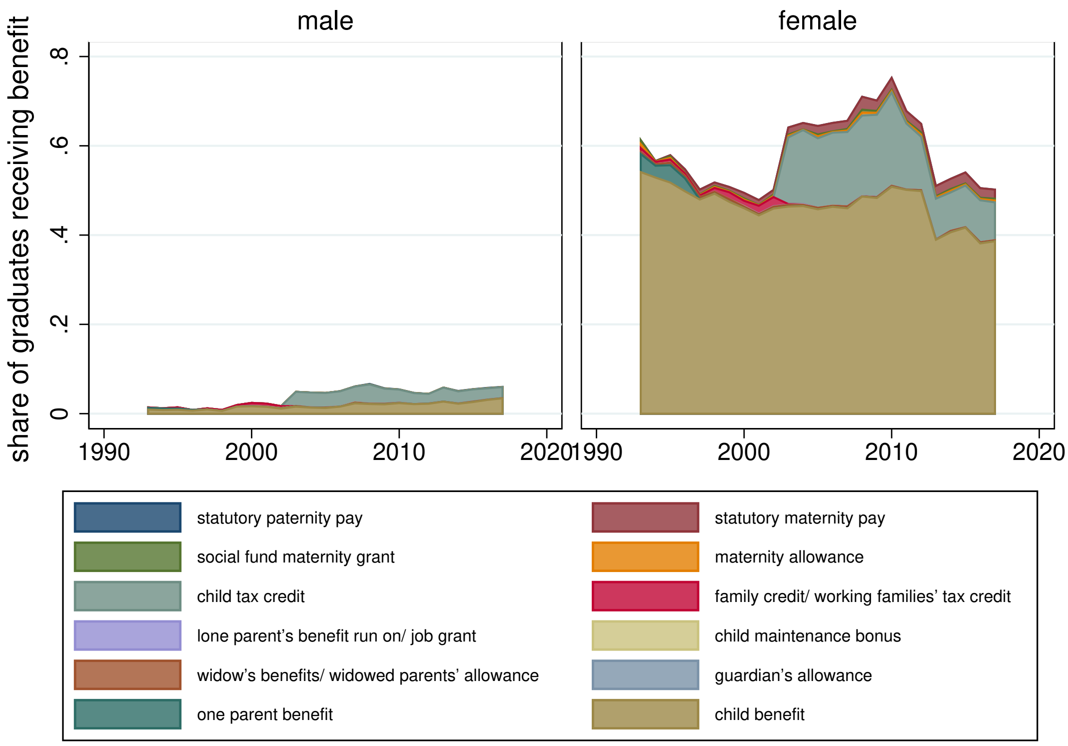


Source: Family Resources Survey.

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 2.5: Child-Related Benefits Over Time

(a) Share of Graduates Receiving Child-Related Benefits



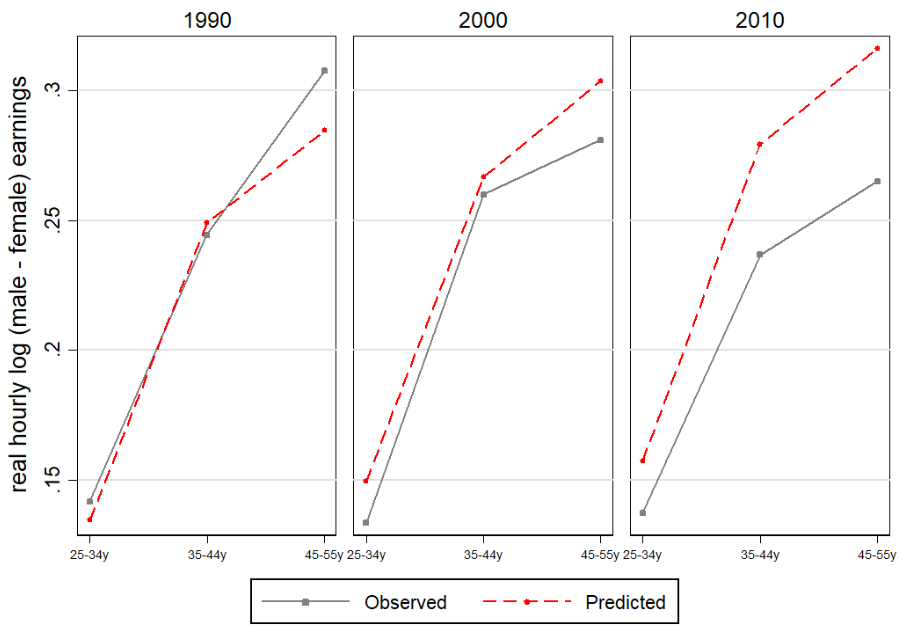
(b) Weekly Child-Related Benefit

Source: Family Resources Survey.

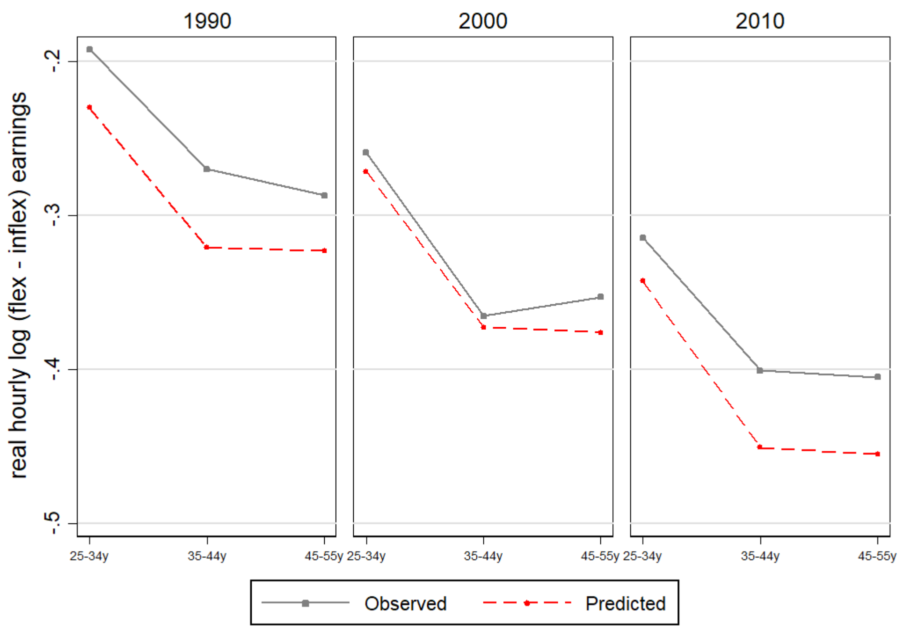
Notes: The graph in panel (a) plots the share of graduate men and women receiving child-related benefits over time. The graph in panel (b) plots the average child-related benefits received by women over time, in real 2015 £.

FIGURE 2.6: 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



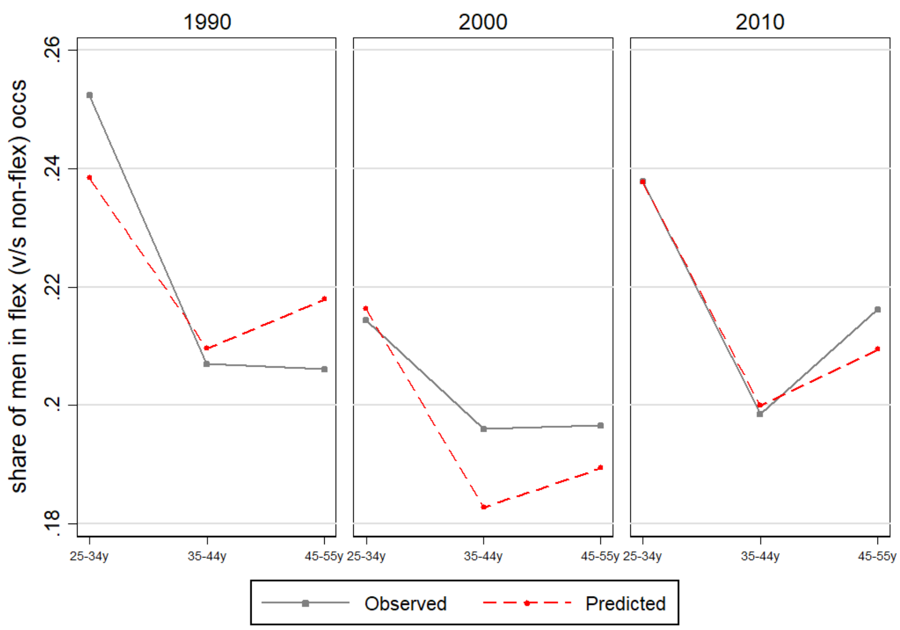
(b) Log (flexible-inflexible) wage penalty



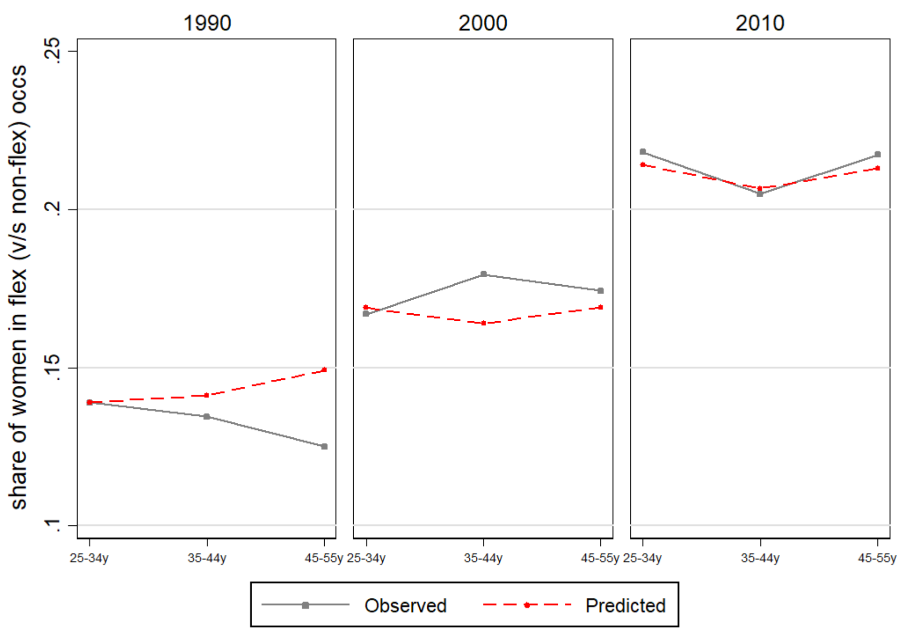
Notes: These graphs plot the trends in the outcomes of interest related to earnings (the male-female gender wage gap and the wage penalty from working in flexible occupations (relative to inflexible occupations), for the age groups and cohorts used in the model, both as observed in the data and predicted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

FIGURE 2.7: 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.

TABLE 2.1: 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 2.2: Changes in Relative Wages and Labour Supplies between 1993 and 2017

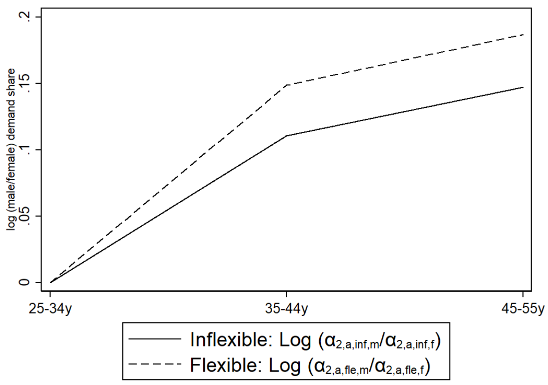
	1993		2017		Dif-in-dif Earnings	Dif-in-dif Labour Supply
	Δ Earnings	Δ Labour Supply	Δ Earnings	Δ Labour Supply		
Occupation						
Inflexible – flexible	0.3489	1.3162	0.3764	1.2823	-0.0275	0.0339
Gender						
Male – female	0.2851	0.3525	0.2386	-0.0302	0.0465	0.3827
Gender, occupation						
Male – female, 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.

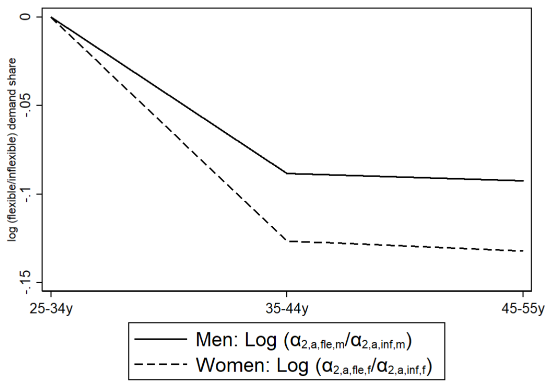
FIGURE 2.8: Estimates of Relative Demand Shares and Total Factor Productivity

Production Technology: Nest II

(a) Male vs. Female

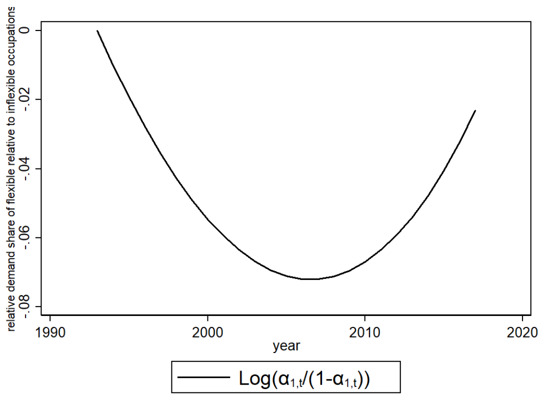


(b) Flexible vs. Inflexible



Production Technology: Nest I

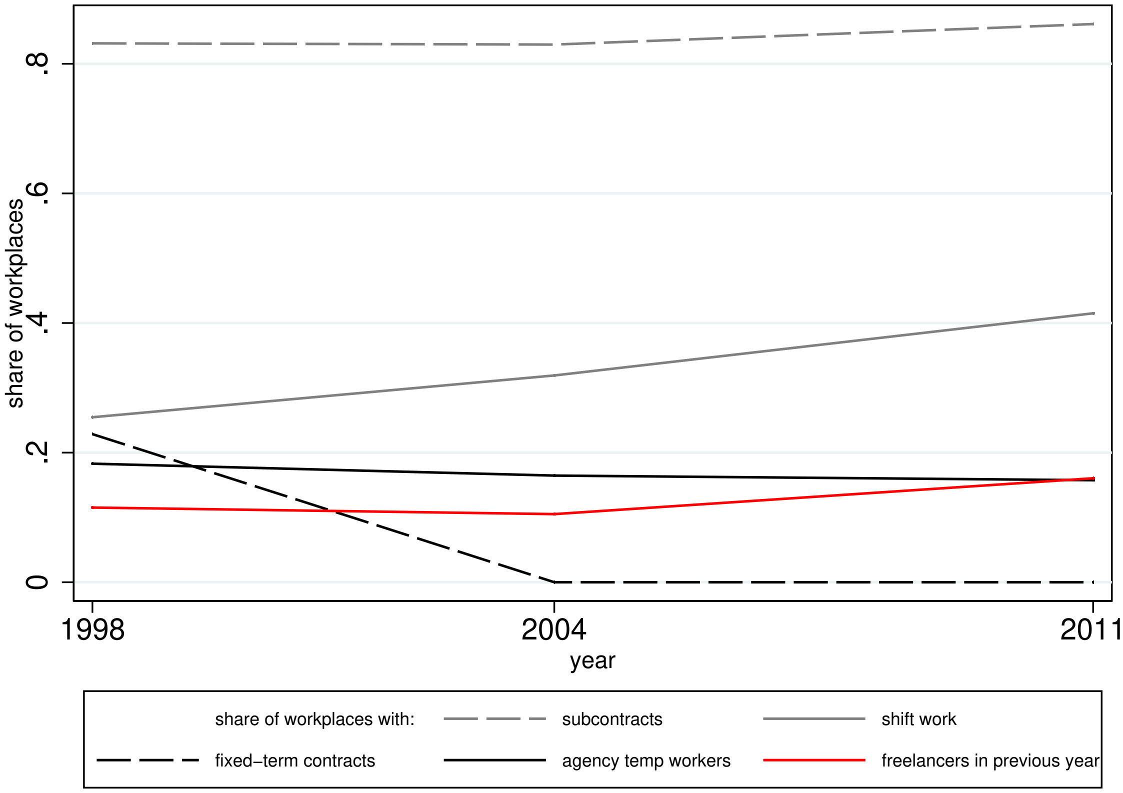
(c) Flexible vs. Inflexible



(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.

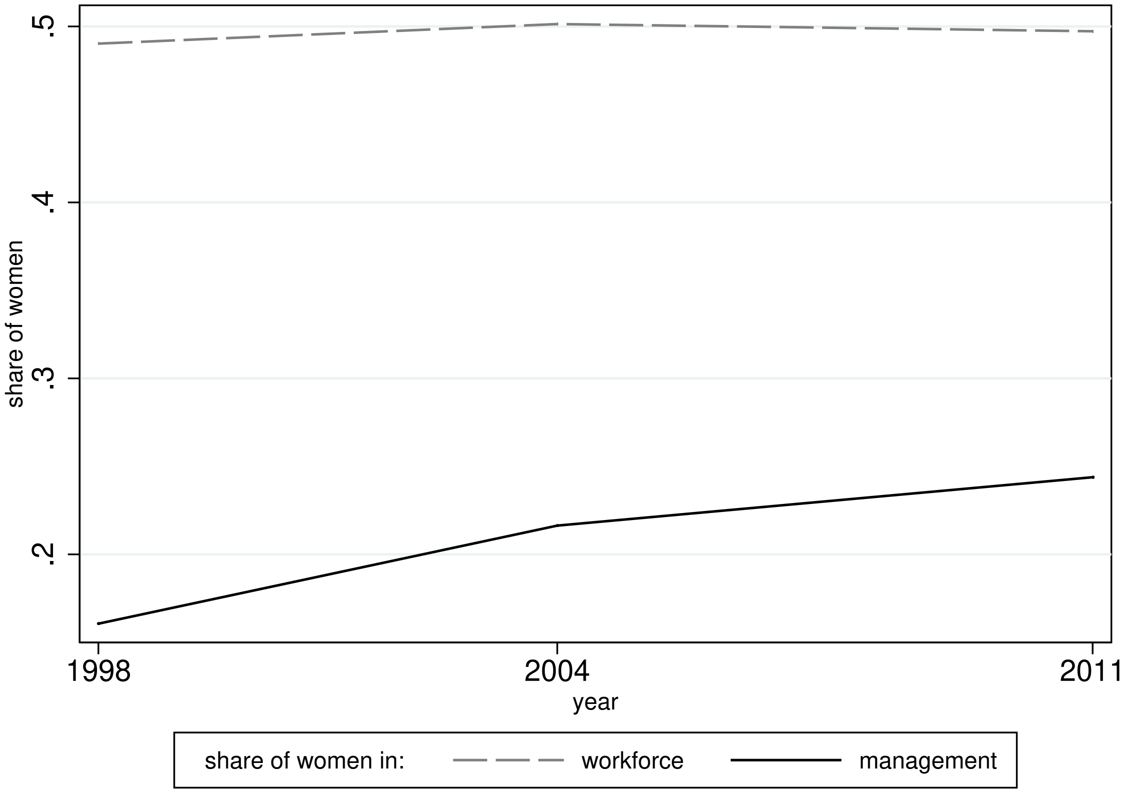
FIGURE 2.9: Share of Workplaces with Flexible Working Arrangements



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 2.10: 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.

TABLE 2.3: 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 2.4: 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 shows results from OLS regressions of male and female labour force participation and 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). Average wage is the average wage for a given age group and sex in a year, whereas average wage, flexible and average wage, inflexible are the average wages in flexible and inflexible occupations respectively for a given age group and sex in a year. Married and Child 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.

TABLE 2.5: 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.

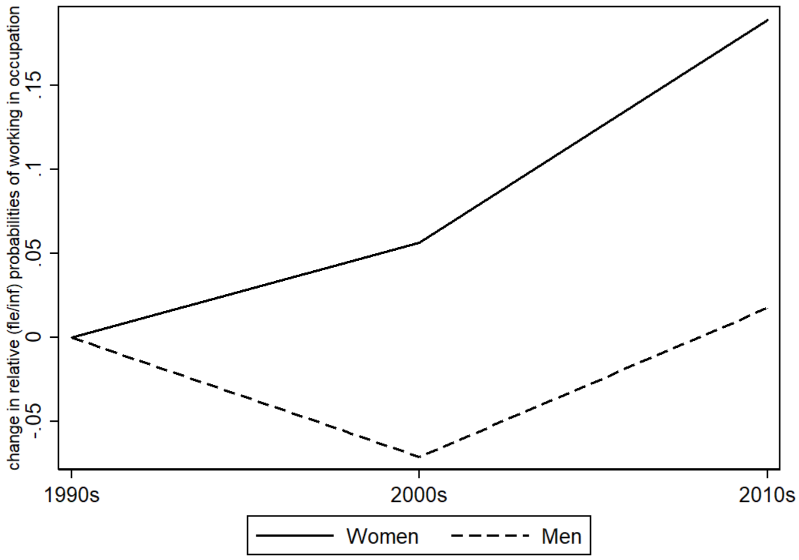
TABLE 2.6: Parameter Estimates: Time-varying Preferences for Occupations

	Estimates
Age-, sex- specific preference for occupations, fixed over time	
$\psi_{0,f,25-34,inf}$: Female, 25-34, inflexible	0.1443
$\psi_{0,f,25-34,fle}$: Female, 25-34, flexible	-0.2159
$\psi_{0,f,35-44,inf}$: Female, 35-44, inflexible	-0.0959
$\psi_{0,f,35-44,fle}$: Female, 35-44, flexible	-0.2416
$\psi_{0,f,45-55,inf}$: Female, 45-55, inflexible	-0.0723
$\psi_{0,f,45-55,fle}$: Female, 45-55, flexible	-0.2439
$\psi_{0,m,25-34,inf}$: Male, 25-34, inflexible	0.5906
$\psi_{0,m,25-34,fle}$: Male, 25-34, flexible	0.3494
$\psi_{0,m,35-44,inf}$: Male, 35-44, inflexible	0.2041
$\psi_{0,m,35-44,fle}$: Male, 35-44, flexible	0.0503
$\psi_{0,m,45-55,inf}$: Male, 45-55, inflexible	0.0695
$\psi_{0,m,45-55,fle}$: Male, 45-55, flexible	-0.0390
Cohort-, sex- specific preference for occupations, fixed over ages	
$\psi_{0,f,90s,inf}$: Female, 1990s, inflexible	0.7226
$\psi_{0,f,90s,fle}$: Female, 1990s, flexible	-0.1739
$\psi_{0,f,00s,inf}$: Female, 2000s, inflexible	0.4442
$\psi_{0,f,00s,fle}$: Female, 2000s, flexible	-0.3112
$\psi_{0,f,10s,inf}$: Female, 2010s, inflexible	0.4085
$\psi_{0,f,10s,fle}$: Female, 2010s, flexible	-0.0606
$\psi_{0,m,90s,inf}$: Male, 1990s, inflexible	-0.0477
$\psi_{0,m,90s,fle}$: Male, 1990s, flexible	-0.5485
$\psi_{0,m,00s,inf}$: Male, 2000s, inflexible	-0.3887
$\psi_{0,m,00s,fle}$: Male, 2000s, flexible	-1.0641
$\psi_{0,m,10s,inf}$: Male, 2010s, inflexible	-0.1467
$\psi_{0,m,10s,fle}$: Male, 2010s, flexible	-0.6244

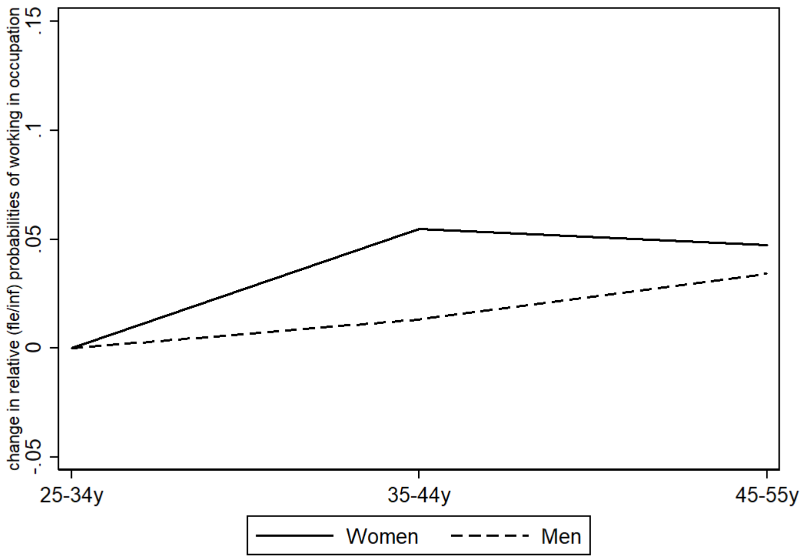
Notes: This table reports the estimates for parameters on the supply side of the model related to time-varying preferences for working in flexible and inflexible occupations.

FIGURE 2.11: Estimates of Changes in Relative Probabilities of Working in Flexible Occupations Over the Life Cycle and Time

(a) Cohort-Specific Preferences, Fixed over Ages

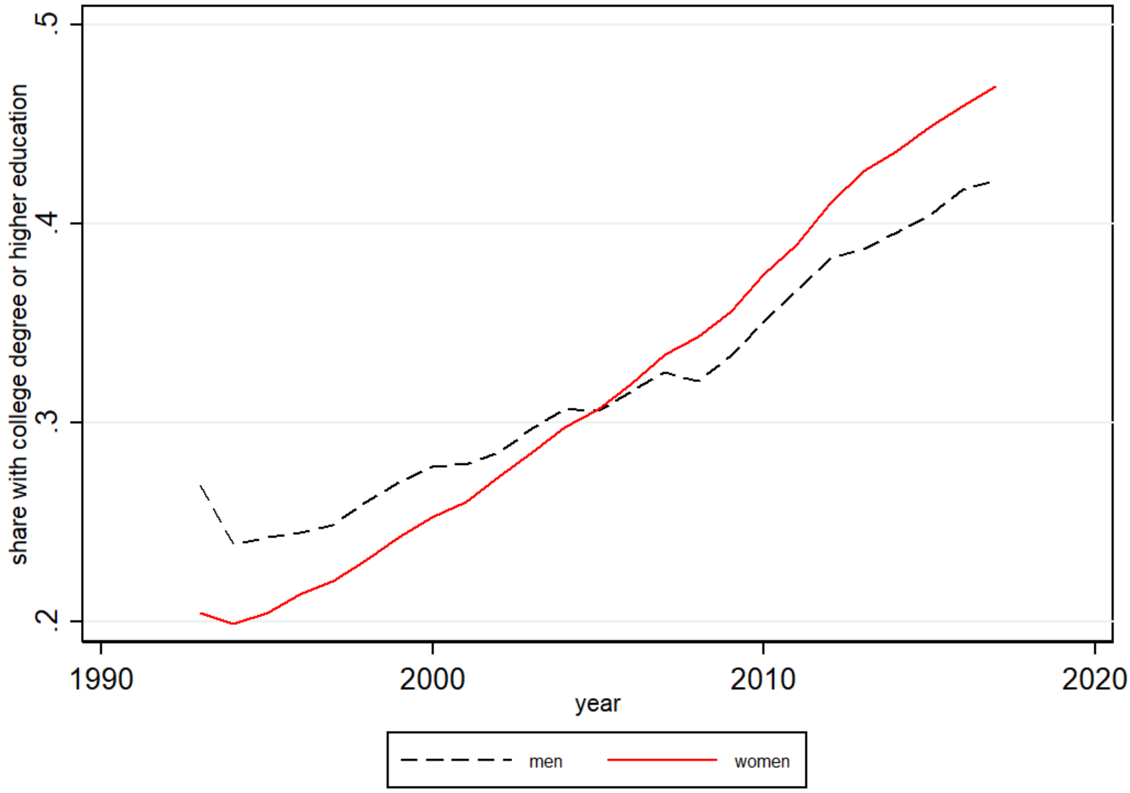


(b) Age-Specific Preferences, Fixed over Time



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 2.12: 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.

TABLE 2.7: Counterfactual Exercises

	(1) Data	(2) Model	(CF1) Demand	(CF2) Cohort	(CF3) Age	(CF4) Fertility	(CF5) Marriage	(CF6) Benefits	(CF7) Childcare
100 $\times\Delta$ 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 $\times\Delta$ 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 $\times\Delta$ 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.

Chapter 3

Child malaria mortality decline, fertility, and female labour force participation in Tanzania

Abstract

This chapter presents quasi-experimental estimates of the fertility and labour market effects of a decline in malaria mortality among children under five as national malaria control interventions increased coverage of treated bed-nets in Tanzania from 2004. Exposure to the decline in child mortality did not affect the likelihood of birth but reduced labour force participation for women aged 15–40, where this reduction in labour force participation was driven by women with children. Separate analysis by maternal age finds that there was a significant increase in the probability of first birth for women aged 15–25 because of the reduction in child malaria mortality, as malaria was especially risky during pregnancy for first-time mothers. The reduction in labour force participation came from women aged 26–40 with children under five in the household, consistent with their child-rearing responsibilities having increased as a result of improvements in child survival. The effects on fertility also varied by endemicity, with the increased likelihood of first birth among women aged 15–25 driven by women in non-endemic areas, whereas higher order births were less likely among women in endemic areas, where the need for precautionary childbearing would have reduced. The negative effects on labour force participation was driven by women in areas with low levels of labour force participation at baseline, and from women in non-polygamous households, indicating the importance of social norms and access to informal sources of childcare in determining women's work.

3.1 Introduction

Malaria killed about 405,000 people globally in 2018, with the African continent accounting for more than nine out of every ten malaria deaths. Although they bore the majority of the malaria burden, the WHO African region also accounted for 85% of the reduction in global malaria deaths between 2010 and 2018 due to the implementation of large-scale malaria control programs across the continent. In areas of stable transmission, children aged five years and younger are most vulnerable to malaria morbidity and mortality, accounting for two-thirds of all malaria deaths worldwide in 2018 (WHO, 2019; Hay et al., 2004; Snow et al., 2005). This chapter investigates the effect of these large scale exogenous declines in child malaria mortality on the fertility and labour force participation of women in Tanzania (which accounted for 5% of the global malaria mortality burden in 2018).

Results show that while fertility overall did not change as a result of the decline in under five malaria mortality, exposure to the decline in child mortality during their fertile years reduced the labour force participation of women with children Separating analysis by the age of women shows that there was a positive effect on the likelihood of first birth for women aged 15–25. On the other hand, the reductions in labour force participation were driven by women aged 26–40 who had children under five in the household consistent with increased child survival imposing an opportunity cost on the labour market time of women.

This research question links to a long-running question in economics research on the relationship between mortality and fertility. Existing research focusing on the demographic transition has emphasised that high child mortality results in high fertility, as uncertainty about child survival leads to parents having larger families as a precautionary 'insurance' (Doepke, 2005; Wilson, 2015; McCord et al., 2017; Kalemli-Ozcan, 2003). There may also be a causal link running in the other direction between fertility and mortality, so that higher levels of fertility may also reduce child survival because of poorer maternal health and short birth intervals leading to higher risk of child fatality (Ronsmans, 1996; McCord et al., 2017). From a more macroeconomic perspective, mortality and fertility may both be interlinked through economic growth as higher levels of economic growth reduce mortality rates and increase fertility rates as the returns to investment in human capital increase (Galor and Weil, 2000; Galor, 2012). Narayan and Smyth (2006) find using Granger causality tests on Australian data from 1960–2000 that in the short run, there is a unidirectional relationship from fertility rates to female labour force participation rates and from infant mortality rates to female labour force participation rates but that there is neutrality between fertility rates and infant mortality rates. This is in line with the results we find overall that show no link between infant mortality rates and fertility rates for women of childbearing age as a whole, though lower infant mortality rates negatively affect their labour force participation.

Malaria has a direct effect on both fertility and child mortality, as it is especially risky to first-time mothers through anaemia, but also increases risk of adverse birth outcomes through low birth weight (Lucas, 2013; WHO, 2017; Brabin, 1991; Guyatt and Snow, 2004). Similarly, Ager et al. (2018) found that the introduction of the smallpox vaccine reduced fertility in Sweden, whereas Wilson (2015) finds in a review of the literature that the effect of disease burden on fertility varies by whether the majority of the burden is borne by adults or children, and whether the burden is primarily mortality or morbidity. This chapter considers this question using exogenous variation in a disease where the burden is primarily borne by children, by examining the effect of reduced under five mortality arising from malaria. A wide set of papers has looked specifically at the relationship between malaria and other disease mortality and fertility, but results have been inconclusive. McCord et al.

(2017) investigate the relationship between variation in malaria ecology and fertility rates and find that conditions that encourage malaria spread lead to higher fertility rates. On the other hand, Lucas (2013) found that malaria eradication in Sri Lanka in the 1960s led to higher fertility and a younger maternal age at first birth, as well as an increase in the probability of survival of first-born children. This is consistent with the results we find for younger women, for whom we find that the probability of first birth increased. Malaria is especially risky to mothers pregnant for the first time, so that a reduction in malaria risk should have increased the likelihood of first birth – this is what we find, with about 80% the effect not explained by a mechanical increase in child and fetal survival due to reduced malaria risk. This was driven by women in areas where malaria was not endemic. This suggests that the reduced risk of poor obstetric outcomes arising from malaria during pregnancy for women with low levels of acquired immunity to malaria in adulthood encouraged fertility among these women.

A related literature tests the quantity-quality model of fertility put forward in Becker (1960) and Becker and Lewis (1973) that states that quantity and quality are substitutes with regards to fertility. Aaronson et al. (2014) extended this approach to differentiate between the extensive and intensive margins of fertility, finding that women's fertility declined along the intensive margin as the price of child quality fell for rural black women in the United States, and the share of rural black women who had any children increased (increase in extensive margin fertility), suggesting quantity and quality of children are complements along the extensive margin, or at low fertility levels. A related paper by Bhalotra et al. (2018) allows for women's responses to declines in child mortality as a result of the introduction of sulfa drugs in the USA to vary along both fertility margins as well as by the timing of fertility, and also considers their labour force participation decisions. Where Aaronson et al.

(2014) predicted that a decline in cost of child quality would increase extensive margin fertility and reduce intensive margin fertility, Bhalotra et al. (2018) found that women exposed to declines in child mortality in their childbearing years reduced both extensive and intensive margin fertility, as they were more likely to delay fertility and increase their labour force participation. There is little evidence, however, for developing country contexts with high existing female labour force participation, the nature of extensive and intensive margin fertility responses to reductions in child mortality, and how such fertility responses are related to changes in female labour force participation. It particularly remains to be seen how these responses may vary in contexts where mortality rates are high at the same time that cultural norms may encourage high levels of fertility McCord et al. (2017).

This chapter exploits the quasi-experimental decline in malaria mortality rates among children under five in Tanzania resulting from the increased investment in malaria reduction programmes. These programmes primarily focused on the increased provision of insecticide treated bed-nets and successfully reduced malaria mortality rates from the beginning of the millennium (Figure 3.1). The national voucher programme to increase bed net coverage introduced in Tanzania in 2004 led to increases in the household ownership of bed-nets, the number of children under five sleeping under treated bed-nets, as well as a reduction in under five child mortality and morbidity due to malaria (Smithson et al., 2015; Renggli et al., 2013; Bhatt et al., 2015; Weiss et al., 2019). However, while the bed-net voucher programme was implemented across Tanzania in stages between 2004 and 2006, it was not possible to use the staggered roll out of the programme to directly examine the effect of the implementation of the programme on a specific region on the decline in child mortality and subsequent effects on fertility and women's labour force participation. Instead, the analysis in this chapter exploits the fact that as a result of the nationally implemented programme, the decline in child mortality was more pronounced in areas where the level of child malaria mortality was initially higher. Therefore, areas with higher baseline levels of child malaria mortality were more affected by the implementation of the bed-net programme, so that 'treatment intensity' was higher in these areas. This analysis therefore does not take into account the different timing of implementation across areas, as well as the fact that the bed-net programme was implemented as part of a bundle of policies aimed at reducing malaria prevalence and mortality.[1] The analysis therefore relies on the key assumption that the regional variation in levels of baseline child mortality are not correlated with fertility and labour force participation, after taking into account region-specific levels and trends in these outcomes of interest.

Detailed data on the fertility history and labour force participation of women of reproductive age were obtained from the Tanzanian Demographic and Health Surveys (DHS) in the years 1999,2003/4, 200/5, 2007/8, 2009/10, 2011/12, and 2015/16 and matched to yearly gridded data at 0.5 degree resolution on under five malaria mortality rates from 1990–2017, provided by the Global Burden of Disease Study and the Malaria Atlas Project. The analysis follows Bhalotra et al. (2018) in using a difference-in-differences strategy which considers the effect of exposure to the decline in under five malaria mortality during women's reproductive period on their fertility outcomes. The effect on total likelihood of birth as well as first versus higher order birth are considered separately, for different age groups as well as by degree of malaria endemicity in the region. Labour market outcomes are analysed similarly considering the effect of exposure to the decline in child malarial mortality during

[1] Appendix Tables C.7 and C.11 exclude the period of implementation from analysis, which does not impact the nature of the results. Appendix Table 3.30 additionally controls for the coverage of ACT and IRS interventions when estimating the effect on labour market outcomes, and does not find significant associations with changes in female labour force participation. It is not possible to account for these interventions in the fertility analysis as this information is not available from 1992 onwards, which is the period for the fertility analysis.

women's reproductive years on their labour force participation.

Note that the analysis makes use of repeated cross section data and therefore, while it can take into account changes in overall trends that affect the changes in the outcomes of interest, it cannot account for any individual specific time varying factors that may affect fertility and labour force participation. The inclusion of region-specific year fixed effects take into account regional changes in the outcomes of interest over time but there may be unaccounted for differences in the regional composition of respondents over time in terms of their preferences for fertility or labour force participation due to migration. However, it is expected that the effect of these is likely to be small, as the DHS is a representative survey of women between the ages of 15–49, and there are not likely to be significantly large migratory patterns over the period of analysis.

Results show that while overall likelihood of birth did not change as a result of the interventions, women aged 15–25 were more likely to give birth to their first child. In particular, among women aged 15–25 who had secondary or higher levels of schooling, the probability of first, higher order and overall birth increased. This is consistent with existing research by Lucas (2013) who found using a difference-in-differences approach that malaria elimination in Sri Lanka led to an increased likelihood of pregnancy and increased likelihood of first birth in particular. This finding also aligns with the theoretical prediction by Cigno (1998) that under conditions of uncertainty, parents see a decline in mortality as an increase in the 'productivity' of births (by increasing the ratio of surviving children), and therefore increase their desired number of births. About 80% of the positive effect on probability of births cannot be explained by mechanical increases in child survival due to reduced malaria mortality, or to reduced risk of stillbirths, as malaria is associated with adverse pregnancy outcomes (Paintain et al., 2020; Dellicour et al., 2016). Nobles et al. (2015)

found that women who had lost children in the Indian Ocean tsunami in Indonesia had higher fertility, whereas in the hardest hit communities, women were more likely to have earlier first births, emphasising that women adjust fertility timing by bringing forward births in order to achieve target fertility, especially in response to differences in child survival.

Existing research that has investigated the relationship between family size and female labour force participation has made use of exogenous changes in fertility (using either twins at first birth (Bronars and Grogger, 1994; Jacobsen et al., 1999; Cáceres-Delpiano, 2012; Bhalotra and Clarke, 2019) or sex composition of existing children (Angrist and Evans, 1998; Cruces and Galiani, 2007) to establish a largely negative relationship between fertility and female labour force participation. However, in this context, female labour force participation is high especially among mothers aged 26 and older, more than 80% of whom are likely to be active in the labour force. Note that the definition of labour force participation in this chapter is taken from women's responses to questions about working at the time of the survey. The two main labour market outcomes of interest are whether the respondent was working at the time of the survey, and whether the respondent was working either at the time of the survey or in the twelve months preceding the survey. This definition of labour force participation includes seasonal and temporary work, and a majority of women in the survey report working as unpaid labour on family enterprises and in the family farm. It also includes women working across their working life, and thus is not directly comparable to the analysis in the previous chapters where women's work fell after marriage due to constraints related to domestic and childcare responsibilities. In this developing country context where agriculture is the dominant economic sector, women contribute greatly to economic activity as predicted by the U-shaped relationship between labour force participation and economic development (Goldin, 2006). The decline in under five malaria mortality reduced labour force participation primarily for such older women aged 26–40 with children, who were more likely to have had to care for an increased number of surviving children as a result of the decline in child mortality, consistent with child-rearing imposing an additional cost to women's labour market time, absent any fertility adjustments.

Malaria risk also varies crucially by endemicity, as adults in more endemic areas are more likely to have acquired immunity and are therefore less vulnerable to severe disease and death arising from infection. This makes malaria more risky for women during pregnancy in non-endemic areas due to lower levels of immunity and therefore a higher risk of adverse birth outcomes (Lucas, 2013; Luxemburger et al., 2001). Results show that the increased likelihood of first birth was driven by women aged 15–25 in non-endemic areas, consistent with this hypothesis that malaria was especially risky during pregnancy for women in non-endemic areas. There were also significant reductions in the probability of higher order births among women in this age group in endemic areas, where malaria mortality rates would have been higher, consistent with reductions in precautionary childbearing or child hoarding behaviour, as well as with reductions in the number of children in favour of child quality as suggested by the quantity-quality tradeoff. The effects on labour force participation did not vary by malaria endemicity, as women aged 26–40 in both endemic and non-endemic areas reduced their labour force participation.

Research that has analysed the effect of changes to child survival and quality on fertility has mostly been conducted in settings where returns to education have been high or increasing, so that increased child survival presents parents with a choice between a higher number of children, or fewer children in whom they can invest more

Becker (1960); Becker and Lewis (1973); Galor and Weil (2000); Galor (2012). However, education levels in Tanzania have remained low in the past decades (averaging four to five years of schooling for women and men), in contrast to six to nine years of schooling for women and men in 1940s America (Snyder, 1993). Estimates separating the effects on fertility by women's education level find that the reduction in child mortality increased fertility overall as well as along the extensive and intensive margins for more educated women. Though this does not align with the theoretical predictions of a quantity-quality trade-off in a post-demographic transition setting, returns to education in Tanzania are low. It may be therefore that parents increase their demand for births in response to reduced child mortality as the 'productivity' of births increases, which may be especially true for more educated women Cigno (1998).

Results using a triple difference approach to separate out the effects by baseline level of labour force participation in the local area indicate that while on average women reduced their labour force participation on average, exposure to the decline in child mortality encouraged labour force participation for women in areas with high levels of baseline labour force participation (resulting in a total nil effect in these areas), implying that social norms related to women's work may play an important role in driving women's labour market outcomes. Separate analysis by polygamous and non-polygamous households allows further consideration of the importance of social norms. These results indicate that while effects on fertility do not differ by household polygamy, the effects on labour force participation are driven by women in non-polygamous households. This may be due to women in polygamous households being more able to access informal sources of childcare, reducing the effect of the child mortality decline on their labour force participation (Cudeville et al., 2017).

The remainder of the chapter is organised as follows: the next section (Section 3.2) describes the setting with respect to malaria, fertility and female labour force participation in the Tanzanian context and describes the implementation and roll out of the program. Section 3.3 describes the empirical strategy, first establishing a first stage effect on child malaria mortality and then describing the model used in analysis. Section 3.4 describes the data and variables used in each of the estimation approaches, Section 3.5 discusses the key results as well as checks to validate the robustness of the main results, Section 3.6 discusses how results differ by factors of interest, and finally Section 3.7 concludes.

3.2 Background on Tanzania

3.2.1 Malaria and related policy interventions in Tanzania

Malaria is caused by Plasmodium parasites that are spread to people through the bites of infected female mosquitoes called *malaria vectors*, with *Plasmodium falciparum*, which is the most prevalent malaria parasite in Africa, responsible for most malaria-related deaths globally. Typically, children under five and pregnant women have a higher risk of contracting the disease. While young children have not yet developed immunity to the disease, pregnant women also temporarily lose their immunity. Nearly 80% of global malaria deaths in 2017 were concentrated in 17 countries in the WHO African Region and India. Seven of these countries accounted for 53% of all global malaria deaths, with Tanzania accounting for 5% of these deaths (WHO, 2018). Malaria contributed to about 36% of all deaths in Tanzania in children under five years of age (National Malaria Control Programme, 2010; WHO, 2019).

Malaria transmission in Tanzania is stable, meaning that there are higher inoculation levels (a higher probability of being bitten by an infected mosquito) and higher endemicity of the pathogen in the population. Therefore, the mortality rates in children are large but individuals surviving repeated infections develop effective immunities (Cervellati et al., 2018). Where *Plasmodium falciparum* malaria transmission is stable, the prevalence of infection is high and endemicity is relatively insensitive to climatic changes. The 'age peak' of affected cases decreases with the level of malaria stability, with recent estimates suggesting that the share of severe cases in children under five varied from around 60% to 10% when moving from areas with high to low stability of transmission. The opposite pattern prevails for individuals aged fifteen or older, who are not very affected in high stability areas, and up to 60% are affected severely in low transmission areas (Murray et al., 2012; Macdonald, 1956; Griffin et al., 2014).

Interventions to prevent malaria include insecticide-treated bed-net coverage, indoor residual spraying, intermittent preventive treatment uptake during pregnancy, mosquito repellent usage, drain cleaning, and larvicidal chemical treatments of standing water. Sleeping under a long-lasting insecticidal net (LLIN) is considered to be the most cost-effective mechanism to prevent malaria. Since the late 1990s efforts to fight malaria have been increased under the Malaria Roll Back program of the WHO. Under this initiative and funding from a number of international aid organisations and NGOs, Tanzania instituted a national voucher scheme (Tanzania National Voucher Scheme, also called *Hati Pungozo*) in October 2004 to provide vouchers for insecticide treated nets to pregnant women at a large scale, and then expanded to include infants in 2007 (Smithson et al., 2015). These nets are typically effective for about a year since the insecticide treatment. Implementation was in decreasing order of malaria prevalence with areas with higher levels of malaria prevalence getting the programme first. It was launched in early districts between Oct 2004 and May 2005, middle districts between Jun 2005 and Oct 2005, and in late districts between Nov 2005 and May 2006); it was expanded in 2007 to cover children under five as well, first in fifteen regions, with a further expansion to 21 regions in the following year. Beginning in 2010, the NATNETS programme was introduced to provide universal coverage of LLINs.[2]

3.2.2 Program implementation

Figure 3.1 plots the annual national malaria mortality and incidence rates between 1990 and 2017 from the GBD 2017 data for children under five, women of child-bearing age (aged 15 to 49), and the whole population. There was a sharp drop in under five malaria mortality rates in Tanzania coinciding with the post-intervention period, with smaller proportionate declines among other age groups. There is an extensive medical / epidemiological literature on first order effects of the programmes to increase bed net coverage in Tanzania. In terms of the very immediate effects of the programme, there were a series of impact evaluation studies to analyse whether the voucher programme actually increased bed net coverage and usage (rather than just provision). It was found that there was an increase in bed net coverage post introduction of the voucher programme in 2004 (as well as 2011), though there remained gaps in coverage for the poorest groups (Hanson et al., 2009; Gingrich et al., 2011; Beer et al., 2010; Marchant et al., 2010; Bernard et al., 2009; Kramer et al., 2017; Renggli et al., 2013). In addition to increased household ownership of bednets, there was also an increase in the number of children under five sleeping under LLINs / ITNs / treated bednets as a result of the programme with a reduction in under five child mortality and morbidity due to malaria as a result of increased malaria targeting through bed net programmes, documented using nationally representative data (Smithson et al., 2015; Renggli et al., 2013; Bhatt et al., 2015; Weiss et al., 2019; Alba

[2]Universal coverage of LLINs is defined as one bednet per two individuals in a household.

et al., 2014; Gansey, 2020). They also provide evidence of other contributing factors such as increased ACT (artemisin combination therapy) which also contributed to more effective malaria control. Programme evaluation reports and national statistics show that the decline in under-five mortality rates was greater in rural areas and in medium- to high- malaria risk areas, indicating that the interventions worked well to target and reach at risk populations (USAID, 2017; Tanzania Malaria Impact Evaluation Research Group, 2012; Tanzania Ministry of Health et al., 2016, 2017).

3.2.3 Program rollout

Figure 3.2 shows how coverage of malaria control programmes in Tanzania varied over time in the DHS clusters in the sample. The data for this graph is calculated using Bhatt et al.'s modelled estimates of malaria interventions in Africa provided in gridded annual maps at 5km $\times$ 5km resolution for Africa, available as part of the Malaria Atlas Project. ACT, refers to artemisinin-based combination therapies, which is the recommended treatment solution to being diagnosed with malaria. IRS is indoor residual spraying – spraying buildings and other infrastructure in communities with insecticides. Estimates of time series models of coverage of these interventions within each country in this dataset were calculated using survey data on access to ACTs, ITN usage and coverage from around 1 million households combined with national malaria control programme data on ACT, IRS, and ITN (insecticide-treated nets) provision in country reports. Data on ACT and IRS coverage does not vary within country for Tanzania, and only vary over time. These programs did seem to be initially implemented around the same time as the bed net program (between 2002 and 2004) as seen in Figure 3.2, though timings of follow up programs varied and do not seem to be as consistently followed up as the bed-net program.

Hanson et al. (2009) and other program implementation reports provide details of the launch dates of the insecticide program in select districts in Tanzania, with districts grouped by implementation phase as early, middle, or late, and stating that by the end of all implementation phases in 2006, the program had achieved nationwide coverage. The early phase districts had the voucher scheme launched between October 2004 and 1 June 2005, the middle phase between 1 June 2005 and 30 Nov 2005, and the late phase districts between 1 Dec 2005 and 30 May 2006. While the available reports are not clear about whether rollout was at district level or regional, where dates are available for more than one district within a region, these dates only differ by weeks, so that it might be reasonable to assume that the program was phased out regionally, with some logistical delays between districts within the region.[3] The program is taken to have come into effect post-2004 for the period of analysis as this matches the period when the large scale intervention commenced.

3.2.4 Demographic and economic characteristics

Malaria is a key factor contributing to Tanzania's high child mortality rates, accounting for 22.7% of deaths of children under five in 2007 (World Health Survey, 2007). Under-five mortality rates in Tanzania fell from 112 per 1000 children in 2004-5 to 81 in 2010, with malaria control interventions having accounted for 57.7% of this reduction (Gansey, 2020; Tanzania Ministry of Health, 2016).

[3]Appendix Figure C.1 graphs the mean under five malaria mortality rates for the regions grouped together by their assumed phase of implementation - there were declines in malaria mortality across all three groups of regions before the start of the program due to piloting of this and other malaria control programs in these regions before 2004. From these results, it is not clear that declines in malaria mortality varied by phases of implementation, at least according to the region data available. It is also not possible to use more disaggregated information on malaria incidence and mortality rates (such as predicted monthly variation in mortality using monthly climactic variation and malaria suitability indices) to infer the dates of program roll out, as the monthly variation in mortality generated from climate data is unrelated to the drop in malaria mortality rates (modelled annually by the IHME and GBD Weiss et al. (2019)).

Tanzania has one of the highest fertility rates in the world, with a total fertility rate of 4.9 births per woman in 2018 (World Bank, 2018). Figure 3.3 shows that women in DHS had about 2.3 children on average. However, the distribution of fertility was skewed to the right, as women aged 40 years and older (who are assumed to have 'completed' their childbearing) had an average of 5.1 children. Motherhood also arrives early in this setting, as 26.4% of girls aged 15–19 had had children or were currently pregnant at the time of the 2017 DHS survey interview. Figure 3.4 plots the distribution of women's age at birth in the DHS surveys from 1999 to 2016 and shows that about half of the women in the DHS surveys between 1999 and 2016 had had children by age 25.

Tanzania's economy is mainly dependent on the agricultural sector, which employs about 80 percent of the population (Idris, 2018; World Bank, 2009). Women and men are about equally likely to be active in the labour force, with labour force participation rates of about 88% and 91%, respectively (World Bank, 2009). While 71% of formal sector employees were men in 2009, only 4% of women were employed in paid jobs at all, whether in the informal or formal sector. Figure 3.5 plots the regional distribution of female labour force participation rates in the DHS surveys, showing that there is significant variation in female economic activity across regions. Women's work is not strictly positively associated with education level. Figure 3.6 shows the relationship between education level and fertility and female labour force participation. Figure 3.6a shows that labour force participation rates are higher among women educated up to primary levels compared to those with secondary or higher education. Fertility is also higher among women with lower levels of education, with childless increasing in education level, as seen in Figure 3.6b.

Figure 3.7 also shows that the labour force participation rate is increasing in the number of children, as childless women are less likely to be working than mothers, and mothers of more children are more likely to be working than those with fewer children. Aaronson et al. (2021) shows using compiled cross-national census and survey data that the hypothesised negative relationship between fertility and labour force participation only holds for countries in later stages of economic development, finding effects of fertility on female labour froce participation close to zero at low levels of development. From an economic history perspective, Goldin (2006) describes the evolution of women's economic roles through twentieth century America as access to birth control and women's education both increased, increasing women's labour force participation from low levels as returns to education and economic opportunities increased. However, in the Tanzanian context, education rates are very low, and women primarily work as unpaid workers in agriculture, suggesting that the U-shaped relationship between female labour force participation and economic development holds. According to this theory, at low levels of economic development women are active in the labour force to a great degree, but their labour force participation rates fall as incomes rise, increasing their labour market opportunities and the time cost of fertility, so that their labour is implicitly bought by their households (Goldin, 1995; Aaronson et al., 2021). Indeed, Figure 3.8 shows that women in Tanzania had, on average, four years of schooling in 1999 and a significant proportion were not educated at all (Figure 3.8a), though this varied by region (Figure 3.9). Education levels continued to be quite low, averaging between four to five years for both men and women through to the most recent birth cohorts in the sample, shown in Figure 3.8b.

3.3 Empirical Strategy

3.3.1 Tests of trend breaks and convergence in malaria mortality and incidence rates

Table 3.1 formally tests for existence of trend breaks in malaria mortality and incidence rates among children under five and women aged 15-49 in 2004, as captured by a linear trend interacted with a post-2004 dummy variable, at different levels of geographic aggregation. The results show that a trend break existed, but the rate of decline in malaria mortality rates slowed since 2004. Table 3.2 includes tests of convergence in under five and adult female malaria mortality rates after 2004. The first regression for each mortality rate shows that there was a fall in malaria mortality rates after 2004, confirming the change in year-on-year mortality rates shown in Table 3.1 for levels of mortality rates. The second regression for each mortality rate in Table 3.2 shows that clusters with higher under five and adult female malaria mortality rates in 2000 had larger declines in mortality post 2004. These regressions also show that the decline in mortality rates post-2004 was much greater for children under five than for adult women. Figure 3.10 plots this graphically, to show that regions and DHS clusters with higher average malaria mortality and incidence rates in 2000-3 also had greater changes (declines) in under five malaria mortality rates between 2000-3 and 2017. Note that the pre-existing levels of malaria mortality among adult women are close to zero even before the intervention.

3.3.2 Event studies of first stage malaria outcomes

Figure 3.11 plots results from an event study specification on under five malaria mortality and incidence rates. Malaria mortality rates are defined as the number of deaths per 100,000 individuals in each year and malaria incidence rates are the number of new malaria cases per 100,000 individuals in each year. The graph shows a substantial and long-lasting decline in under five malaria mortality rates after 2004. There is some evidence of pre-trends in malaria mortality rates before 2004 as the coefficients are not zero (relative to the programme intervention start in 2004), but this is consistent with there being an uptick in malaria control measures after 2000 with the Roll Back Malaria Initiative. However, there is a substantial change in the slope of decline after 2004, which is consistent with the intervention accelerating the rate of decline in under five malaria mortality rates.[4]

3.3.3 Model

This chapter follows the modelling outlined in Bhalotra et al. (2018), which extends the quantity-quality fertility framework beyond considering price effects on extensive and intensive margin fertility to allow for responses in fertility timing and female labour force participation as well. Changes to factors affecting fertility (as prices of child quality and quantity are theorised to be) would also plausibly affect the opportunity cost of women's time (and given their career progression, this may also vary over the life cycle), and therefore also influence women's decisions about labour force participation, which may be made jointly with fertility. Aaronson et al. (2014) extended Becker's standard quantity-quality fertility model (Becker, 1960; Becker and Lewis, 1973) to consider how fertility responses to changes in prices of child quality varied along the extensive versus intensive margins, and found that reductions in the price of child quality meant that fertility declined along the intensive margin as women substituted out of quantity into quality, but childlessness

[4] Appendix Figure C.2 shows the event studies for under-five malaria incidence rates and mortality and incidence rates for women aged 15-49. For these outcomes, there is less clear evidence of a sharper decline happening after 2004.

would reduce as more women were likely to have at least one child, so there was an ambiguous effect on total fertility. However, Bhalotra et al. (2018) found that total fertility declined, and that fertility declined both along the extensive and intensive margins in response to a reduction in child mortality in the US due to the introduction of antibiotics that treated pneumonia, a significant contributor to the under five mortality burden. The reversal of the extensive margin fertility response hypothesised by Aaronson et al. (2014) was driven by the increased likelihood of child survival which meant that women had more freedom to space pregnancies to achieve target fertility, allowing them to delay childbearing to stay in the labour market for better potential career progression, which combined with positive wage shocks, life cycle declines in fecundity, could lead to increased childlessness. This updated model therefore finds declines in total (and both extensive and intensive margin) fertility, and that women were more likely to work, and to work in more skilled occupations and work longer hours, and less likely to have ever married, in response to a reduction in child mortality and morbidity.

The analysis in this chapter treats the trend break in malaria mortality rates as quasi-experimental variation to identify whether the programme had a significant impact on fertility and labour market outcomes using a difference-in-difference estimation strategy, represented as a simplified equation (for all outcomes considered) as follows:

$$Y_{ict} = \alpha_0 + \alpha_1 treatment \times baseu5mr_c + age_{it} + \alpha_2 educ_i + \gamma_c + \delta_t + \lambda_{c,t} + \epsilon_{ict} \quad (3.1)$$

where Y_{ict} is the fertility or labour market outcome of interest for woman i in region c at time t, the coefficient α_1 on the intervention term $post2004 \times baseu5mr_c$ is the post-2004 dummy interacted with the pre-intervention under five malaria mortality rate in the region, and represents the effect of the intervention on the outcome considered, age_{it} and $educ_i$ control for woman i's background characteristics, γ_c are sample cluster fixed effects, δ_t are year fixed effects, and $\lambda_{c,t}$ are region-year fixed effects.

Fertility

A hazard model is used to estimate the effects of the reduction in child mortality on fertility and birth timing outcomes. It models the hazard (likelihood) of birth occurring in each year for each woman in the sample considered in the years 1992-2016, using an expanded woman-year level panel data set for each potential birth year between 1992-2016:

$$Pr(B)_{icrt} = \mu_0 + \mu_1 post2004_{it} \times baseu5mr_c + \gamma_c + \delta_t + \lambda_{r,t} ... \quad (3.2)$$
$$+ \mu_1 educ_i + H_{it} + \eta_i + \nu_{icrt}$$

The outcome variable is the probability that the woman i in DHS cluster c gave birth to a child in a given year t (for all woman-year observations). Separate regressions are run for the probability of giving birth to a first child in the calendar year (for woman-year observations at risk of a first birth), and the probability of a higher order birth in the calendar year (for woman-year observations at risk of second or higher order births). The treatment variable of interest is $post2004_{it} \times baseu5mr_c$ which interacts an indicator for the potential birth happening after 2004 with the base under five malaria mortality rate in the DHS cluster. Given that there was convergence in malaria mortality rates as a result of the intervention, sample clusters with higher under five mortality rates at baseline in 2000 enjoyed a larger decline in child malaria mortality rates on average. The treatment variable therefore includes a measure of treatment intensity in addition to the standard difference-in-differences estimation given by $post2004_{it}$. All specifications include sample cluster and birth year fixed effects (γ_c and δ_t, respectively), with mother's level of education ($educ_i$) also included as controls. Indicators for the count of years since the woman's last birth starting at age fifteen and restarting after every birth, as well as indicators for the birth order of the next birth are included in H_{it}. The preferred specifications include region-year fixed effects ($\lambda_{r,t}$) to control for time-varying unobservable endogeneity, with the tightest specifications additionally including woman fixed effects (η_i) to account for other unobserved individual-specific selection issues.

Labour force participation

The effect on labour force participation is estimated differently on a dataset that pools together the DHS survey data for the sample period between 1999 and 2016. This model is estimated on repeated cross-section data in the absence of individual level panel data. The model estimates the effect on labour force participation at the time of the survey of having been exposed to the reduction in child mortality:

$$\begin{aligned} P_{icrt} = \beta_0 + \beta_1 fertileyearsexposure_{it} \times baseu5mr_c + \beta_2 educ_i + ... \\ + \psi_i + \gamma_c + \delta_t + \lambda_{r,t} + \varepsilon_{icrt} \end{aligned} \tag{3.3}$$

The labour market outcomes of interest $P_{ict}$are whether the respondent is working at the time of the survey, and whether the respondent has been working either at the time of the survey or in the twelve months preceding the survey. The treatment variable of interest is $fertileyearsexposure_{it} \times baseu5mr_c$ which interacts the number of years women were exposed to the decline in child mortality post-2004 during their fertile years with the base under five malaria mortality rate in the DHS cluster. As in the hazard specification above, the base under five malaria mortality rate varies the intensity of 'treatment' as clusters with higher under five malaria mortality rates at baseline had larger declines in these rates post-2004. The $fertileyearsexposure_{it}$ variable additionally varies treatment intensity by the number of years during which women were of childbearing age after 2004. Figure 3.12 plots the distribution of this variable separately for women of childbearing age and with completed fertility at interview. Data on menarcheal age is not available and so women's fertile period is assumed to last between ages 15 and 40, or 25 years at most. Women aged 25 in 2004 therefore have 15 years during which they are exposed to the post-2004 decline in malaria mortality, whereas women aged 15 in 2004 are fully treated and have 25 years of exposure.[5] Analysis is conducted separately for women aged 15–40 at interview (childbearing age women) and women aged 40 years and older in 2004 (assumed to have completed fertility).[6] Additional controls in the stock model include sample cluster and survey year fixed effects (γ_c and δ_t, respectively)education ($educ_i$), and mother's birth year fixed effects (ψ_i). The preferred specifications additionally include region-year fixed effects ($\lambda_{r,t}$) to account for time-varying unobservable effects that vary over time and across regions and are correlated with the outcomes and regressors of interest.

3.4 Data

Identification of the treatment variable of interest relies on geographical variation in malaria mortality rates before the intervention. Estimates of annual national malaria mortality and incidence rates by age and sex for 1990 to 2017 are available from the Global Burden of Disease Study 2017 (GBD, 2018), and these rates were merged

[5]Exposure years include years beyond the interview year as fertility choices are assumed to be made dynamically including forward-looking expectations the future.

[6]Figure 3.4 shows that the distribution of fertility in the sample is concentrated between ages 12-13 and 39, consistent with the age cut-offs used here to determine fertility. The lower bound of fertile years are underrepresented in the sample as the DHS surveys only interview women aged 15–49.

with 5km × 5km gridded raster data on the plasmodium falciparum mortality and incidence rates in each year between 2000 and 2017 from the Malaria Atlas Project to get age- and sex- specific local malaria mortality rates for Tanzania between 2000 and 2017 (Weiss et al., 2019).[7] The constructed geographically disaggregated data on malaria mortality and incidence rates are used to measure the treatment effect of interest at the DHS cluster level.

Data on women's individual outcomes are taken from the Tanzania DHS and Malaria Indicator Surveys, available for 1999, 2003/4, 2004/5, 2007/8, 2009/10, 2011/12, and 2015/16, with the 1999 (and 2003/4 to some extent) survey providing pre-programme information. Information is collected in the DHS on women of reproductive age (15-49), their fertility (ages and dates of birth for all living and dead children,[8] as well as desired fertility), as well as information on whether they were working at the time of the survey, and if not, if they were absent from a job in the last week or in the last 12 months.

3.4.1 Hazard model: Fertility outcomes

The dataset for the hazard model analysis is constructed by pooling together fertility histories of women in the DHS, restricting births to those occurring in a symmetric twelve year window around the intervention year of 2004 (i.e., between 1992 and

[7]The Malaria Atlas Project data publishes estimates of the clinical burden from malaria in the form of predicted all-age *Plasmodium falciparum* mortality rates (deaths per 100,000 population per annum) and incidence rates (clinical cases per 1000 population per annum) in high resolution maps available at their website `https://malariaatlas.org/data-directory/`. The Global Burden of Disease Study provide national estimates of the count and proportion of malaria incidence and mortality accrued to different sexes and age groups annually between 1990–2019, on their website `http://ghdx.healthdata.org/gbd-results-tool`. The GBD data is used to calculate the proportions of the malaria deaths and clinical cases in the year occurring among children under five and women aged 15–49. For analysis in this chapter, the age-specific local mortality and incidence rates n each DHS cluster are calculated by multiplying the 5km gridded location specific mortality and incidence rates by the relevant proportions for each group of interest.

[8]The DHS birth histories list all of a woman's live births, including children who later died, but omit stillbirths, miscarriages, or abortions.

2016). The dataset is constructed as a panel dataset with entries for each potential fertile year for each woman, trimmed to include only women within their fertile years (assumed to be between ages 15 to 40) any time within this window. This is therefore a woman-year panel dataset where each woman in the panel was aged 15–40 in the period between 1992 and 2016, capturing women's fertility choices during this window around the intervention. Though age at menarche is not available and the duration and timing of the fertile period is unknown, Figure 3.4 plots the distribution of mother's age at birth of all women in the DHS surveys (where women between 15-49 are respondents), showing that the assumption of a fertile period of ages 15 to 40 fits well with the data.

Table 3.3 summarises the main variables used in analysis for the hazard model (that are not also in the stock model analysis). The variable *Birth* takes the value one if the woman gave birth to a child in a particular year, and zero otherwise, and has a mean of 0.168 over all years and women in the sample. The variable post2004 is equal to one if the fertility year considered is 2004 or later, and zero if earlier than 2004. *Current birth order* is the birth order of the next potential child and equals one if the woman is childless, two if the woman has one child, and so on. On average, women in the sample are between their 2nd and 3rd child. Years since last birth is a counter indicating the number of years elapsed since the woman's last childbirth, and equals zero in the year of menarche or the most recent pre-1992 birth, and restarts at one in the year following childbirth. On average, women in this sample had about 4.7 years since their last childbirth.[9] Finally, the cohorts of women

[9] Appendix Figure C.3 plots the distribution of the time since birth and shows that the distribution is skewed rightwards as there is a long tail for women aged close to 40 in the sample period for whom their most recent birth was when they were quite young. Though these average birth intervals are quite high, qualitative studies of Tanzania report ideal birth intervals of about four to five years in rural communities versus shorter ideal birth intervals of three years in urban communities (Yoder et al., 2013). Birth intervals were also found to be longer in regions in Tanzania where Islamic teachings on longer periods of breast feeding and post-partum abstinence are adhered to more closely. Previous research has also suggested that women in polygamous unions have fewer children and

in the hazard dataset were born between 1952-2001 (by construction, as they were aged between 15–40 in 1992-2016), and the average birth year was 1977.

The dataset for the analysis of labour market outcomes consists of pooling together the waves of the DHS between 1999 and 2016, including women from birth cohorts 1949-1998, who were aged between 15-49 at time of the survey. Women aged five and under in 2004 are excluded from analysis as they may have been themselves benefited from the decline in under five malaria mortality as a result of the programme. Analysis is further restricted to women who were exposed to the programme in their childbearing years, assumed to be between 15-40, so that only those who fell in this age range after 2004 are included in analysis.

Table 3.4 shows the summary statistics for the main variables related to fertility in the sample as well as those used in analysis for the stock model. On average, women in the sample were exposed to the programme post-2004 for about 16 years, with women of childbearing age exposed for about 17 years compared to about 5 years for women with completed childbearing. Figure 3.12 shows the distribution of this variable and that women of childbearing age were more likely to be exposed for all their fertile years than those with completed childbearing. *Pre-under 5 mortrate* is the annual under-five malaria mortality rate in the DHS sample cluster in 2000 (pre-intervention), and is about 9 per 1000 individuals. On average, the majority of women in the sample (about 80%) were educated to primary level, with close to 20% of women having secondary education. More women had at least some education in the younger childbearing-aged sample compared to the sample of women with completed fertility, though not by much, showing that educational attainment increased slightly over time.

longer birth intervals so that the prevalence of polygamy in Tanzania, though this varies by region, may also explain these figures being higher than in other developing countries (Rossi, 2019; Garenne and De Walle, 1989).

The variables defining labour force participation are defined as follows: *Currently working* takes the value one if the woman reports working at the time of the survey and zero if not, and *Working 12 months* is equal to one if the woman reports working at the time of the survey or if not, in the preceding twelve months, and zero if she was not working in either case. On average, female labour force participation is high among the women in the sample, with between 74% and 77% of women working by these definitions, though it is higher among women with completed fertility as about 90% were working, compared to about 75% of women of childbearing age. Women with children were more likely to work than those without, with the difference much more pronounced among those of childbearing age. 77% of mothers in this age group were likely to be working compared to only half of non-mothers, whereas 84% and 89% of both non-mothers and mothers aged 40 years or older were likely to be working. The results from the estimation of above defined empirical strategy are shown in Section 3.5, with regressions including controls for age and education of the woman as well as fixed effects for cluster, mother year of birth, survey year, as well as region-year fixed effects.

3.5 Results

3.5.1 Hazard model estimates of effects on fertility

The hazard model, as presented in Section 3.3, describes how the probability of giving birth in a calendar year changed after the decline in under five malaria mortality after 2004, using a woman-year panel dataset of women of childbearing age (aged 15–40) between 1992 and 2016 (a twelve year window around 2004). These estimates are useful to know how fertility behaviour changed in that they help determine whether women were more likely to give birth in response to the reduction in child mortality, and whether their likelihood of giving birth differed by birth order or parity.

Table 3.5 presents results from hazard model estimation of the effect of the decline in under five malaria mortality on the probability of birth, overall and at the extensive and intensive margins. The first specification for each outcome is the naïve specification that does not control for selection issues. The second specification adds woman fixed effects to control for selection in the type of women affected by the decline in under five malaria mortality, and the coefficients in this specification can be seen as the within-woman effect over her own fertile period. The third specification adds region $\times$ year fixed effects to control for any region-specific factors that vary over time that may affect the probability of birth, and the fourth specification controls for both selection issues by including woman fixed effects and region-year fixed effects.

Results in Table 3.5 suggest that considering the naïve specification and controlling only for woman-specific selection, there was an increase in the overall probability of women giving birth after the decline in under five malaria mortality in 2004, as well as a decline in the likelihood of giving birth to a first child and an increase in the probability of giving birth to a second or higher order child.

Figure 3.2 shows that the increase in ITN coverage in DHS clusters started before 2004, suggesting that there were pretrends in the intervention, while Figure 3.11 also shows evidence of pretrends in the under five malaria mortality rate, so that the latter two specifications for each outcome in Table 3.5 include region-year fixed effects in order to control for these and other endogeneity issues arising from unobserved time-varying characteristics that may vary across regions. Including these controls explains away the effects of the reduction in child mortality on the likelihood of giving birth. This suggests that the effects on the likelihood of giving birth discussed earlier were largely driven by unobserved time-varying region-specific factors that were correlated with the reduction in under five mortality as well as with fertility. For instance, programme rollout is likely to not have been random as malaria control interventions may have been especially targeted towards regions with higher levels of malaria mortality, which may also have been correlated with maternal health and fertility.'[10,11,12,13]

Across all these specifications, the likelihood of giving birth is decreasing in education, as women with higher levels of education are less likely to have more children, which is consistent with the hypothesised negative relationship between female education and fertility in the literature(Becker, 1981; Osili and Long, 2008).

Table 3.6 estimates the hazard model for women aged 40 to 49 years, that is, women whose fertile years are assumed to have been completed, so that childbearing is not as prevalent as among younger mothers. Figure 3.4 shows that this assumption is relevant as the majority of births among Tanzanian women happened by age forty. Considering the tightest specifications in the fourth column for each outcome, results suggest that there was no systematic effect of the decline in child mortality on the probability of birth for older women as well. Women in this age group do report a reduction in higher order births that is significant at 10% which may indicate a reduction in precautionary childbearing behaviour as child mortality fell. Such 'child hoarding' or 'precautionary childbearing' behaviour would be especially likely to decline among older women who are more restricted in terms of

[10] Appendix Table C.1 shows that the effect on the probability of higher order births does not change with birth order.

[11] Appendix Table C.2 presents results looking at net births instead of gross births - the number of births resulting in children who were still alive at the time of the survey. Results are qualitatively similar and show no significant effects on the likelihood of giving birth to a child who was still alive.

[12] Appendix Table C.3 shows that results do not change when using infant malaria mortality rates instead of under five malaria mortality rates.

[13] Appendix Table C.4 shows that results do not change when using regional average malaria mortality rates at baseline instead of the malaria mortality rates for the DHS cluster at baseline.

their fertile period, in addition to being more susceptible to poor obstetric outcomes (Cleary-Goldman et al., 2005).[14,15]

Event studies

The event study graphs in this subsection present results for fertility outcomes using the hazard dataset, which is in a longitudinal woman-year panel. Analysis is similar to Table 3.5, except that instead of interacting the exposure variable *base under five mortality rate* with an indicator for post-2004 years, it is interacted with indicators for every year in the sample period 1992-2016 (with 2004 as the reference year).[16]

Figure 3.13 plot the coefficients from event study specifications for the probability of birth, by interacting exposures to under-five malaria mortality decline with indicators for every year in the hazard sample period (1992-2016). These event studies control for sample cluster and year fixed effects, education and birth timing fixed effects, as well as region-year fixed effects (the fourth specification for each outcome in Table 3.5).[17] These figures are in line with the main results presented here, showing no systematic effects on the likelihood of birth in the years following the decline in child mortality, suggesting that parents do not engage in compensatory fertility

[14]Appendix Table C.5 estimates the hazard model for women aged 12-38 between 1992 and 2016, the age group falling within two standard deviations of the median age at birth, showing similar effects to those seen in Table 3.5, though effects are slightly more pronounced such that there is a weakly significant positive effect on the likelihood of first birth, which would be expected considering that this group of women is younger on average.

[15]As 12.23% of women in the sample aged 15–40 were still in school at the time of the survey, results for women aged 18–40 are reported separately in Appendix Table C.6 — however, results are qualitatively similar to the results for 15–40 year old women.

[16]Since the rollout of the malaria control interventions were staggered with the exact dates of implementation unknown, Appendix Table C.7 excludes roll-out years 2004-2006 from analysis in Panel A, but this does not change results substantially. Panel B of Appendix Table C.7 excludes years after 2011 from analysis as the malaria control interventions dropped off after this point (as seen in Figure 3.2) but this also does not change the nature of the results.

[17]Appendix Figure C.4 presents event studies including controls from the second specification for each outcome in Table 3.5, excluding region-year fixed effects, which therefore does not control for pre-trends that are evident particularly for the likelihood of all and higher order births. The event study graph for the likelihood of first birth, shows a marked reduction after 2004, however, with no evidence of pre-trends in the years before 2004.

behaviour as a result of this increased likelihood of child survival, in line with the predictions in Cigno (1998).

3.5.2 Effect on women's labour force participation

The results presented in this section estimate the effects of the reductions in under five malaria mortality on women's labour force participation at the time of the surveys, looking separately at how the effects differ by those with and without children, as well as by childbearing age. The first panel in each table presents results for all women, with the second and third panels showing separately the results for childless women and mothers.

Considering women of childbearing age only in Table 3.7, there was a significant negative effect of the reduction in under five malaria mortality on women's labour force participation, driven by women with children. An additional year of exposure to the decline in under five mortality during their fertile years made women less likely to be working at the time of the survey by about 2.37 percentage points, and less likely to have been working at the time of the survey or in the preceding twelve months by 1.92 percentage points, a reduction of 3.3% and 2.5% on their baseline means, respectively. These negative effects on labour force participation were systematic and strong for women with children only, for whom labour force participation fell by 3.6% and 2.7% on their baseline mean levels, indicating a slightly stronger effect. Note that these effects show the effect of the reduction in child mortality, given that no effects on fertility were observed in the above discussed results. This reduction in women's labour force participation is therefore consistent with an exogenous increase in the number of surviving children, absent any compensating changes to fertility or births. This increase in the ratio of surviving children to births would increase childcare responsibilities for women in this age group, who are likely to be young mothers, increasing their opportunity cost of time spent at work and reducing their labour force participation.[18,19,20]

On the other hand, Table 3.8 shows that exposure to the decline in mortality in their fertile years did not affect the labour force participation of women aged 40–49 (who are assumed to have completed their childbearing) significantly. This is consistent with the assumption that women aged 40–49 would be a control group whose fertility would not have been affected by the reduction in child mortality that happened after their fertile period was over, as proposed in Bhalotra et al. (2018). Therefore the exogenous increase in child survival would have little effect on the opportunity cost of work time for women in this age group who were less likely to have given birth over the period of analysis.

The reduction in labour force participation observed among women of childbearing age would be consistent with the observed lack of changes to fertility if this was concentrated among women who had to take care of more surviving children as a reduction in child mortality rates, increasing their opportunity cost of working. Table 3.9 estimates the effect on labour force participation separately by whether women had children younger than five who were living with them in the household. Results indicate that the negative effects on labour force participation were driven by women with children under five in the household. This indicates that the reduction in labour force participation as a result of the exposure to reduced child

[18] Appendix Table C.8 estimates effects on labour force participation of women aged 18–40, removing the youngest women from analysis in order to account for any changes in educational attainment as a result of the decline in child mortality. Results are not qualitatively different from those for women aged 15–40.

[19] Appendix Table C.9 shows that the estimated reduction in labour force participation is not sensitive to using infant malaria mortality rates instead of under five malaria mortality rates, though magnitudes of the reduction in labour force participating are stronger as women's labour force participation is likely more affected by having an infant at home due to breastfeeding.

[20] Appendix Table C.10 shows that the effects on labour force participation do not change when using regional average malaria mortality rates at baseline instead of the malaria mortality rates for the DHS cluster at baseline.

mortality was driven by mothers of very young children at interview.

Note that the variable of interest here interacts fertile years exposure since 2004 with the under five malaria mortality rate in 2000 in the DHS cluster. This is different from the hazard fertility specification which interacts the indicator for the potential birth happening after 2004 with the base under five malaria mortality rate in the DHS cluster. The effect measured here is therefore diluted as the labour force response is not measured close to the fertility response.[21,22]

The results for labour market outcomes in the tables above also show a negative association between labour force participation and women's education for younger women, whereas the effect is more likely to be positive for older women. This negative relationship between education and labour force participation is also seen in Figure 3.6, with Figure 3.6a showing that women with no education were most likely to be working, while Figure 3.6b shows that women with higher levels of education are also less likely to have children, and when they do have children, to have a smaller number of children.

The results discussed so far in the main specifications show that fertility did not change in response to the decline in child malaria mortality, whereas labour force participation of women with children fell in response to this reduction in child mortality. This is indicative of a setting where women do not adjust fertility as child mortality changes, but the increased child survival results in women having more children to take care of, reducing their labour force participation. This is in line with the low returns to education in this context, so that incentives to invest in child quality are lower.

[21] Since panel data is not available for labour market outcomes, it is not possible to the present event studies for labour force participation.

[22] Appendix Table C.11 excludes rollout years 2004 to 2006 from analysis as implementation was phased in over this period, but results remain qualitatively similar. Appendix Table C.12 excludes years after 2011 from analysis to reduce noise arising from interviews measured too long after 2004 but results do not change substantially.

3.5.3 Results by maternal age

Table 3.10 shows that the observed lack of effect on the probability of birth masks heterogeneous fertility responses by the age of the mother. In fact, for women aged 15–25, who were of the age likely to adjust the start of their childbearing, the probability of first birth was significantly likely to increase as a result of the reduction in under five child malaria mortality, as seen in Panel A of Table 3.10. Young mothers in this age group also reduced their intensive margin fertility in response to this reduction in child mortality, though this effect was only weakly statistically significant in the tightest specification controlling for region-year and woman fixed effects. In particular, malaria is especially risky for women in their first pregnancy and therefore a reduction in malaria infection should result in an increase in first-time births, as observed by Lucas (2013), which is therefore consistent with the results observed here. Aaronson et al. (2014) also hypothesise that a reduction in the cost of child quality would lead to increases in extensive margin fertility and reductions in intensive margin fertility, as the quantity and quality of children are necessarily complements along the extensive margin, which is also consistent with these results, though the reductions in intensive margin fertility are less pronounced, indicating higher average levels of fertility in this context.

On the other hand, Panel B of Table 3.10 shows that there was no effect on the probability of birth, overall as well as along both intensive and extensive margins, for women aged 26–40. The fact that these fertility responses are concentrated among younger women aged 15-25 therefore indicates that adjustments to fertility in response to changes in mortality are likely among younger women who are more likely to have not started their families yet and among whom childbearing is also concentrated, as seen in Figure 3.4.

Medical evidence suggests that first time mothers are especially at risk from malaria infections, both in terms of increased mortality risk for themselves as well as higher risk of still births and spontaneous abortions. However, in high transmission areas, despite the infection being largely asymptomatic for mothers (as a result of high levels of acquired immunity), the adverse effects of malaria infection in pregnancy are most pronounced for women in their first pregnancy (WHO, 2017; Brabin, 1991; Brabin et al., 2001; Steketee et al., 2001; Guyatt and Snow, 2004; Lucas, 2013). This suggests that malaria control interventions would reduce the chance of stillbirths and adverse outcomes in first pregnancy and increase the probability of first pregnancies resulting in live births. This is a direct mechanical effect of malaria mortality decline on fertility, but fertility preferences could result in different outcomes. The increased likelihood of survival and the corresponding lower price of a surviving child would work to increase fertility, whereas the reduced need for precautionary childbearing as well as lower price of quality relative to quantity could reduce fertility. Wilson (2015) suggests in a review of the literature that the effect of disease burden on fertility may differ by whether the burden was borne by adults or children, and whether the burden is primarily mortality or morbidity.[23]

Table 3.2 shows that an additional 2.29 out of every 1000 children were likely to survive due to the malaria control interventions after 2004, which allows us to calculate the proportion of this increase that arose mechanically. 8% of the reported 28.49 percentage point increase in the probability of first birth in each year for women aged 15–25 can therefore be attributed to he mechanical increased likelihood of child survival. Similarly, malaria during pregnancy is also associated with an increased

[23]Since malaria control interventions have the potential to improve not just child mortality, but also maternal pregnancy and health outcomes, reductions in maternal malaria incidence and mortality may be additional mechanisms through which fertility may be affected. Results do not change with inclusion of alternative measures such as maternal and child malaria incidence and maternal malaria mortality. Appendix C.2 provides a detailed discussion of the estimates considering the effect of the malaria control interventions on maternal survival and health.

risk of adverse birth outcomes such as miscarriage and stillbirths, especially for first-time mothers (Lucas, 2013; McCord et al., 2017; WHO, 2019; Paintain et al., 2020), so that the increases in fertility may also be arising due to reductions in these. Life tables of pregnancy provide estimates of the likelihood of pregnancy loss, with one fetal loss (miscarriage or stillbirth) for every five live births globally (Sedgh et al., 2014; Bearak et al., 2020). Research on miscarriage in malarious areas have also found rates close to 20%, whereas miscarriage rates of 10-22% have been found in non-malarious areas (Dellicour et al., 2016). The effects on fertility therefore also mask a reduction in miscarriages and stillbirths (assuming that every percentage point increase in fertility was accompanied by a 0.2 percentage point reduction in miscarriages and stillbirths). This means that the effects can be bounded by considering the mechanical increase in child survival as well as the likelihood of miscarriages and stillbirths – 21.8 percentage points of the 28.5 percentage point increase (77% of the effect size) in the probability of first birth could be attributed to non-mechanical increases in fertility as opposed to arising from increased likelihood of survival during pregnancy and childhood.[24]

Tables 3.11 and 3.12 consider the effect on labour force participation for younger and older women respectively. The first group of younger women are most likely to not have had children yet and are therefore of the ages most relevant in terms of delaying their first birth. The latter group, on the other hand, are more likely to have already had children, and therefore would be relevant for examining the effects of the higher likelihood of child survival on labour force participation. Results from

[24]Though the effects are not strongly significant, the reduction in the probability of higher order birth would have been 5.5% larger – 43.8 percentage points instead of 41.5 percentage points – were it not for a mechanical increase in child survival due to the reduction in malaria mortality rates. This reduction in the probability of higher order births would also have been 27% larger if it was not attenuated by increased likelihood of survival during both pregnancy and childhood as the risk of miscarriage also reduced – the effect size would have been 52.5 percentage points instead of 41.5 percentage points.

Table 3.11 indicate that younger women did not change their labour force participation as a result of the reduction in child mortality. Conversely, Table 3.12 shows that the reduction in labour force participation as a result of the decline in child mortality was driven by women aged 26–40 who had children. This is consistent with women having to give up working in order to take care of more (surviving) children as a result of the malaria control interventions. Tables 3.13 and 3.14 illustrate this – the reduction in labour force participation among women aged 26–40 came from those with children under five in the household, as opposed to those without. On the other hand, there were no effects on labour force participation among younger women aged 15–25, regardless of whether they had children under five in the household, as they were also less likely to be working at baseline. This suggests that while younger women are in their fertile period, they are less likely to be working, as they stay at home to take care of children, and return to work when they do not have young children at home.

Table 3.15 also establishes that descriptively, conditional on education and other controls, there is a negative relationship between fertility and female labour force participation for women of childbearing age, that is, the likelihood of working is decreasing in the number of children, though being childless is also associated with working less, which is likely indicative of younger women in education or older unmarried women who are more likely to be childless and also not in work. On the other hand, fertility and labour force participation are not strongly associated for women with completed childbearing or older women aged 26–40. This supports that the reduction in child mortality primarily affected the participation of women who were less likely to make fertility responses, and instead adjust labour force participation in response to increased child survival. The results discussed so far also suggest that the increased likelihood of first birth is temporary, as there is no observed reduction in childlessness among older women aged 26–40, suggesting earlier first births among younger women due to a a reduction in malaria risk during pregnancy, but this fertility change does not significantly affect their labour force participation. This temporary fertility adjustment would be in line with evidence suggesting that while in the long run fertility rate and infant mortality rate both cause changes in female labour force participation, in the short run, the infant mortality rate affected female labour force participation rates but its causal relationship with fertility rates was neutral (Narayan and Smyth, 2006).

3.5.4 Robustness checks

Local variation in malaria endemicity

Malaria immunity among the adult population differs by the degree of endemicity in the area, as adults in areas where malaria is more endemic are more likely to have had been infected, and therefore less vulnerable to severe disease and death arising from infection. Tanzania has the third largest population at risk of malaria in Africa, with over 90% of the population living in malarious areas and about 80,000 annual deaths from malaria, mostly children (Makundi et al., 2007). However, there is substantial heterogeneity in malaria endemicity and transmission risk across the country due to differences in local environments and ecologies as well as through variation in cultural, socioeconomic, and genetic factors (Greenwood, 1989; Hagenlocher and Castro, 2015; Thawer et al., 2020). Since levels of acquired immunity in adults differ between endemic and non-endemic areas, the risks arising to child and maternal mortality during pregnancy vary by levels of endemicity, which may lead to differences in how these mechanisms operate on fertility and labour market outcomes across areas with different levels of malaria endemicity.

These different mechanisms can be examined using grid-level climate data provided by the NOAA[25] to categorise the DHS clusters in the sample as endemic or non-endemic as defined in Kudamatsu et al. (2012) (following Tanser et al. (2003)). According to this definition, in endemic areas there is a high risk of malaria for a substantial portion of every year (defined in Kudamatsu et al. (2012) as five or more months every year), in epidemic areas malaria transmission is more seasonal (stable when due to annual variations in rainfall and temperature, or unstable when present only in some years), whereas in non-malarious areas climactic conditions are not suitable for malaria vectors to engender high levels of infection. Therefore, the degree to which malaria risk is prevalent in a locality varies crucially by the climactic conditions in the locality, which would also affect how much malaria control interventions led to declines in mortality and morbidity in these localities.[26]

Table 3.16 presents results for the probability of birth among women aged 15–40 separately by endemic and non-endemic areas.[27] In non-endemic areas, malaria is more risky during pregnancy due to lower levels of acquired immunity among adults, leading to higher risk of infant death during pregnancy (Lucas, 2013; Luxemburger et al., 2001) and so the reduction in malaria risk due to malaria control measures would lead to a mechanical increase in fertility. Consistent with this hypothesis, there were weakly significant increases in the probability of first birth and all births in non-endemic areas, where mothers were especially susceptible to malaria

[25] GPCC Precipitation and GHCN Gridded V2 data provided by the NOAA/OAR/ESRL PSL, Boulder, Colorado, USA, from their Web site at `https://psl.noaa.gov/` (Schneider et al., 2011; Fan and van den Dool, 2008).

[26] Event studies of first stage malaria mortality and incidence presented in Appendix Figures C.5 and C.6 show that while there was a sharp decline in under five malaria mortality in 2004 in both endemic and non-endemic areas, the decline in adult female mortality was more notable in non-endemic areas than in endemic areas.

[27] Appendix Tables C.13 and C.14 alternatively present results categorised by four degrees of endemicity: non-malarious areas, low epidemic, high epidemic, and endemic areas. However, since the sample is dominated by non-malarious and endemic areas, the results are driven by these regions, so the main results are presented collapsing these categories for ease of interpretation.

risk in pregnancy and therefore reductions in malaria had the most improvement for maternal and infant health.[28,29] Results in Table 3.17 and 3.18 show that the negative effect of the reduction in child mortality on labour force participation were stronger for women in non-endemic areas, driven by those with children.

Heterogeneity by age and local malaria endemicity The effects on fertility by birth order may vary by the age of the mothers considered, especially given that malaria is differently risky to primigravidae compared to multiparous mothers in endemic and non-endemic areas. Tables 3.19 and 3.20 present the effects of the reduction in child mortality in endemic and non-endemic areas, for women aged 15–25 and 26–40 respectively.

The results in Panel A of Table 3.19 show that the significant increase in the likelihood of first birth was driven by women in non-endemic areas, for whom total births were also more likely, though this effect was weakly statistically significant. This is consistent with malaria during pregnancy being more risky in non-endemic areas due to lower levels of immunity among adult women, increasing the risk of pregnancy complications (Lucas, 2013; Luxemburger et al., 2001). The non-mechanical increase in the probability of first birth in a given year was 63.7 percentage points, whereas the probability of birth overall increased by 42.1 percentage points non-mechanically as a result of the reduction in child malaria mortality in non-endemic areas among women aged 15–25 – about 80% of the original effect sizes in the preferred specifications with region-year and woman fixed effects.

Panel B of Table 3.19 shows that there were significant negative effects on the

[28] Appendix Table C.15 shows that only the positive effect on total fertility in non-endemic areas remains weakly significant when considering net births instead of gross births. This suggests that the effects on gross births exaggerate the effect on fertility arising due to the mechanical increase in the likelihood of child survival during and after pregnancy as a result of reduction in malaria risk.

[29] Back-of-the-envelope calculations suggest that approximately 78-79% of the increased likelihood of overall birth and first birth in non-endemic areas can be attributed to non-mechanical increases in fertility as opposed to mechanical increases in child survival.

likelihood of higher order births in endemic areas, where malaria prevalence is higher and therefore children under five were at higher risk of death at baseline. This reduction in the likelihood of higher order births would have been about 15% larger than the observed effect of a 59 percentage point reduction — reducing by 69 percentage points instead — were it not for the mechanical increases in child survival and reduced likelihood of stillbirths due to the reduction in malaria risk.

Tables 3.21 and 3.22 show that there were no effects on labour force participation among women aged 15–25 in both non-endemic and endemic areas. Table 3.20 shows that the reduction in child mortality did not affect fertility for women in both non-endemic and endemic areas. Similarly, Tables 3.23 and 3.24 show that there were negative effects on labour force participation of women aged 26–40 in both types of areas, though the effects were less systematic in endemic areas.

Putting these results together, local levels of malaria endemicity matter for differentiating the fertility responses of women aged 15–25, who were more likely to alter these fertility decisions in response to changes in malaria risk during pregnancy differently by local malaria endemicity. However, the effects on labour force participation did not vary by local malaria endemicity, suggesting that other mechanisms affect these responses.

Baseline levels of labour force participation in area

It may be that differences in gender attitudes across regions mean that women's fertility and labour market responses to the decline in child mortality varies across regions. For instance, though average labour force participation in Tanzania was high among women, there was significant regional variation. Figure 3.5 shows that there is regional variation in the proportion of women working, as regions with the lowest levels of female labour force participation have fewer than 60% of women working, whereas in the regions with the highest levels of female labour force participation, more than 85% tended to be working. The distribution of female labour force participation rates across DHS clusters is plotted in Figure 3.14, showing that the 81.2% of women were working in the median cluster in 1999, which is quite substantial. There is also evidence that gender inequalities in rural employment are high in particular regions, with gender inequalities in agricultural landholding highest in the West, where women form only 16% of landholders, and significant regional differences in self-employed agricultural income too, with the highest levels of gender disparities seen in the North (Idris, 2018; FAO, 2014).

Tables 3.25 and 3.26 include controls for being in DHS clusters with high baseline labour force participation (average female labour force participation in 1999 being higher than the median for all clusters), and uses a triple differences approach and additionally interact baseline labour force participation with the exposure variable of interest. Additionally controlling for being in a DHS cluster with high baseline labour force participation (interacted with the exposure to the decline in mortality in women's fertile years) does not change the nature of the responses to the decline in malaria mortality.

Table 3.25 tests whether fertility effects vary by the baseline levels of labour force participation in the cluster. Results suggest that while there is no effect on fertility outcomes for women in clusters with low levels of baseline labour force participation rate, women living in clusters with high levels of baseline LFP were less likely to give birth as a result of the reduction in child malaria mortality rates, though the total effect was only weakly significant. These results suggest that women in clusters with high baseline LFP are more likely to face a higher opportunity cost of fertility and child rearing (in terms of labour market time), and may be influenced by weaker social norms restricting working, and are therefore more likely to adjust their fertility in response to the reduction in child mortality.

Results from Table 3.26 show that the negative effects on labour force participation were driven by women in clusters with low labour force participation rates in 1999. In the regressions with the triple difference approach, while labour force participation overall fell in response to the decline in child malaria mortality, labour force participation increased among women in regions with high levels of baseline labour force participation. Furthermore, this effect is driven purely by those with children, suggesting that high levels of labour force participation engender higher probabilities of working, even among women with children. Putting the fertility and labour force participation results together also suggests that the negative effect on labour force participation occurred among women who did not adjust their fertility, but rather saw increased child survival as a result of the reduction in malaria risk. On the other hand, though the likelihood of giving birth reduced in clusters with low levels of baseline LFP, this effect was only weakly significant and did not translate to higher labour force participation among these women for whom labour force participation rates were likely high.

Appendix Tables C.16, C.17, C.18, and C.19 present results controlling for and interacting with baseline levels of labour force participation in cluster, separately by age of mother. Results show that the significant increase in the probability of first birth for younger women was driven by women aged 15–25 in clusters with low levels of labour force participation at baseline, whereas there were no effects on fertility for older women regardless of local level of labour force participation. Similarly, the negative effects on labour force participation were driven by women aged 26–40 in clusters with low levels of baseline LFP while baseline LFP did not matter for younger women. These results suggests that while age and baseline level of labour force participation matter separately in determining the fertility and labour force responses to reductions in child mortality, their interactions do not matter as much.

Returns to education

Research evaluating the quantity-quality trade-off with respect to the different margins of fertility have considered exogenous changes to child quality in the USA in the early twentieth century (Bhalotra et al., 2018; Aaronson et al., 2014). Furthermore, there is evidence that malaria reduction programmes have resulted in increased lifetime schooling and/or productivity of those in utero at time of eradication (Barreca, 2010; Bleakley, 2010; Cutler et al., 2010; Lucas, 2010), suggestive of increased investment in child quality. However, 1900s America was considerably different from Tanzania in 2004, as child mortality and fertility rates were much lower in the USA (11.1 per 1000 children and two to three births per women, respectively). Furthermore, the levels of education differed considerably, suggesting that returns to education were much lower in Tanzania. Appendix Figure C.7 compares the average years of schooling in Tanzania and historical USA, showing that the Tanzanian population in 2005 had on average about five years of schooling, which is much lower than the early 1900s average for USA at about seven years of schooling[30]. Therefore, in contrast to much of the literature looking at the quality quantity trade-off with respect to changes in mortality and fertility, returns to education are low in this context, suggesting that the trade-off may not exist in this setting where there may be low demand for human capital absent the fertility transition (Galor, 2012). Challengers of the quantity-quality theory of fertility have also argued that larger family sizes may be associated with higher child quality in the presence of

[30]Women in the USA in the 1940s had between six to nine years of education on average – similar to that of men at the time, and much higher than that of Tanzanian women in the period of analysis (Snyder, 1993).

economies of scale as well as the higher probability of parental time spent at home (Black et al., 2005). Cigno (1998) proposes an alternative model of fertility choice where parents make fertility decisions under uncertainty, and believe that child survival is exogenous to their own choices, so that an exogenous fall in child mortality would encourage (or have no effect on) fertility.

Table 3.27 considers whether the effects on fertility varied by women's education level, as more educated women were more likely to have higher aspirations for child education, and may place a higher value on child quality. Results indicate, however, that there was a significant reduction in the likelihood of birth overall (and a weakly significant increased likelihood of first birth) for less educated women. In contrast, there was a significant increase in overall, first, and higher order births for more educated women.[31] These results suggest that the income effect of having more children outweighs the substitution effect (of substituting child quantity with quality) in this setting as average returns to education are low, and fertility tends to be high among women of all education levels (Goldin, 1995).

This increase in fertility for more educated women is consistent with the model of fertility choice proposed by Cigno (1998) where parents make fertility decisions under uncertainty, and believe child survival is exogenous to their own choices, so that an exogenous fall in child mortality would encourage fertility. The results presented here are consistent with this model where parents believe child survival is not affected by their actions so they choose to optimise the number of births (which do not generate direct utility), so that an increased likelihood of survival increases the 'productivity' of births (by increasing the ratio of surviving children). That this

[31] Results by women's age and education level in Appendix Tables C.20 and C.21 show that while fertility was likely to fall for less educated women (only statistically significantly for higher order births for less educated women aged 15–25), there were positive effects on fertility for more educated women of both age groups. This is broadly aligned with the overall results by education level showing negative effects for less educated women and increases in fertility for women with higher levels of education.

increase in fertility is observed among women with high education (who are likely to have higher aspirations for child education and therefore consider additional children to be more productive), is consistent with the predictions of this model.

Table 3.28 shows that labour force participation fell for less educated women, driven by women with children, whereas it increased among more educated women, though the results do not indicate systematic patterns separated by women with and without children.[32] These effects on labour force participation are contrary to the expected direction given the fertility results, and may be indicative of women needing to earn more in order to support higher levels of household spending on larger families. As seen in Table 3.15, fertility and labour force participation are only strongly negatively correlated for young women who are also less likely to be working than older women.[33,34]

Further robustness checks

Effects on male labour force participation In order to check whether other labour market factors may be driving the labour force participation results, Table 3.29 presents results from a regression of the exposure to the programme on male labour force participation. These results show no significant negative effects on male labour force participation as a result of the decline in child mortality, unlike for female labour

[32] Appendix Tables C.22 and C.23 show that women's education levels do not matter additionally once age is controlled for. There are no significant effects on the labour force participation of women aged 15–25 with any level of education, while labour force participation reduces for women aged 26–40 with high and low education. However, when considering women with and without children separately, the negative effects on labour force participation are primarily driven by less educated women aged 26–40 with children.

[33] Appendix Tables C.24 and C.25 present estimates separately by baseline education level in cluster instead to test whether effects varied in areas with higher schooling rates. Results indicate that there were no effects on fertility for both types of clusters, whereas the negative effects on labour force participation were driven by women with children in low education clusters.

[34] Appendix Table C.26 additionally tests whether educational attainment changed as a function of the treatment and finds no effects in the specification controlling for region-year fixed effects.

force participation, indicating that it is not likely that general labour market or business cycle effects are driving the results.

Controlling for other malaria control interventions Table 3.30 adds controls for coverage of ACT and IRS interventions to the estimation of the labour market outcomes.[35] ACT is the recommended malaria control drug treatment, particularly for malaria in pregnancy, and is especially effective in treating and reducing the transmission of malaria (Pousibet-Puerto et al., 2016). IRS coverage was implemented at larger scale across communities in short bursts of time and is also associated with increased likelihood of first birth. The levels of ACT and IRS coverage in the DHS cluster are not associated with female labour force participation, suggesting that there are no direct effects of these programmes on female labour force participation over and above the effects operating through the decline in child mortality.

3.6 Heterogeneity

3.6.1 Polygamous households

Fertility decline in sub-Saharan Africa has been much smaller than expected, which research has linked to higher male bargaining power, especially in the context of polygynous societies, as men tend to desire higher fertility than women (Rossi, 2019). In polygynous societies (up to 25% of married men were in polygynous unions in Tanzania (Tertilt, 2005; Fenske, 2015; Arthi and Fenske, 2018)), the number of children per woman tends to be higher than in monogamous contexts (Tertilt, 2005, 2006; Schoellman and Tertilt, 2006) due to co-wife rivalry, where giving birth to children increases women's ability to claim shared household resources controlled

[35] Estimates of the predicted coverage of these interventions are available at a geographically disaggregated level from the Malaria Atlas Project on their website https://malariaatlas.org/data-directory/. Since this data is only available yearly from 2000-2015 it is not possible to run the hazard analysis controlling for these interventions, as the hazard dataset spans 1992-2016.

by the husband (Rossi, 2019). In such contexts, changes to the risk of infant mortality and maternal mortality may increase individual wives' bargaining power by making them more likely to be able to fulfil their husband's desired fertility themselves at lower cost to themselves.

Table 3.31 considers whether the effects on fertility vary for women in polygamous households. The definition of polygamous households is taken from a question in the survey that asks respondents to report the number of other wives that their partner has - though this is consistently defined throughout all survey rounds used, it is likely an underestimate the true prevalence of polygamy (estimated at about a quarter of married men for Tanzania (Tertilt, 2006)), as on average less than 5% of the households in the survey are polygamous by this definition.[36] Estimates show that there were no effects on fertility in both non-polygamous and polygamous households.

Table 3.32 indicates that exposure to the decline in child mortality during women's fertile years only had a systematically significant negative effect on the probability of working for women in non-polygamous households. This is consistent with evidence that polygyny increases female labour force participation as women whose husbands take on additional wives compensate for their reduced share of household resources, or are able to make use of domestic labour sharing (Cudeville et al., 2017). This result is also supported by macroeconomic evidence that fertility decline contributes less than expected (as predicted by theories of the fertility transition) to increased female labour force participation in Tanzania (and other developing countries), where options exist to use informal or family sources for childcare (Klasen, 2019).

[36] An alternative definition of polygamy that counts the number of wives of the household head in the household roster reports about 15% of households to be polygamous, but this is only available in the survey years from 2004 and therefore cannot be used in analysis as it would confound the reported effect of the intervention, which also came into effect in 2004.

3.6.2 Desired fertility

One mechanism through which declines in child malaria mortality may influence fertility and female labour force participation is through affecting desired fertility, as fewer births may be required to achieve a given desired number of surviving children. In addition to this potential fall in fertility, forward planning mothers may also plan to delay childbearing and spend more time working, especially if desired fertility is low. Women who have achieved their desired levels of fertility at the point of intervention may not respond to the declines in infant mortality by as much as those whose actual fertility levels are lower than desired. Cigno (1998) also hypothesises that falls in infant mortality could increase desired fertility as it would generate an exogenous fall in the cost of having children (in terms of the ratio of surviving children to births) would fall - reductions in child mortality may reduce precautionary childbearing on the part of risk-averse parents who were previously engaging in short-term replacement or hoarding behaviour (Doepke, 2005).

Results in this section consider whether desired fertility makes a difference to the observed results. Desired fertility was available in four out of the seven DHS Tanzania survey rounds (1999, 2004, 2010, 2016). Tables 3.33 and 3.34 look at whether results differ for women who had achieved their desired fertility by the time of the intervention compared to those who had not, by running analysis separately for women whose fertility at the time of the program starting in 2004 was lower than their desired amount, versus women whose fertility in 2004 was higher than or equal to their desired amount.[37] Results indicate that there was a strong negative effect on the likelihood of giving birth to their first child for women with desired fertility equal to zero (whose fertility was equal to desired but had not previously given

[37] For years after 2004, desired fertility was compared to dates of child births to assess whether fertility by 2004 was higher or lower than reported desired fertility. For 1999, fertility was just compared to desired fertility.

birth) – the magnitude of this effect is improbable, though this is due to the nature of the linear probability estimates that do not restrict estimated effects on probabilities to be between zero and one. This indicates that the reduction in malaria risk may have reduced precautionary childbearing among women who may have previously had more children than they desired due to the high risk of child mortality may have been more able to align their actual fertility with their wishes. Similarly, the probability of first birth weakly significantly increased for those whose fertility was lower than desired in 2004, who were more likely to respond to this lower risk of child mortality by increasing their fertility. However, there was also a weakly significant positive effect on the probability of higher order births for those whose fertility was higher than desired in 2004. This may be indicative of changes to desired fertility, in line with Cigno (1998), or to desired fertility being lower in comparison to actual fertility particularly for women with more children who may regret these decisions more than those with lower actual fertility.

While it is not possible to examine parental preferences in more detail using this data, it may be that reported desired fertility at the time of the surveys may be different from the desired fertility at the time of the intervention, as changes in infant mortality since then may have resulted in changes to desired fertility, especially due to reduced necessity to have additional children as replacement or insurance in contexts of high child mortality. It may also be that in settings with more conservative gender attitudes, norms around fertility targets may be high due to strict expectations around traditional family roles, which would tend to push realised fertility towards men's desired fertility levels (which typically tends to be higher than those of women) (Doepke and Tertilt, 2009, 2018).

The negative effects on labour force participation were driven by women with fertility lower than desired in 20044, whose fertility was more likely to increase along the extensive margin and therefore change labour market status. [38]

3.6.3 Regional levels of domestic and sexual violence

The level of domestic violence is an indicator of social norms that underlie women's bargaining power relative to men, which influences their decision making in the areas of fertility and labour force participation. High levels of domestic violence may be indicative of strongly gendered societies, where conservative social norms dictate fertility and family planning behaviour. High levels of domestic violence may be indicative of strongly gendered societies, where conservative social norms prevent women from seeking work freely, or where women's work challenges men's roles as breadwinners within the family, whereas on the other hand, women's work may also allow them financial independence and autonomy, and therefore less vulnerable to remaining in abusive or violent situations (Aizer, 2010; Anderberg et al., 2016; Bhalotra et al., 2019). The DHS collected a detailed set of information on women's experiences of domestic violence of different types including emotional, physical, and sexual violence (within marriage) but only in some years, and not before 2004. The data on domestic violence was aggregated regionally, with regions classified as high-domestic violence regions if the levels of domestic violence in the region exceeded the median for all regions. Similar calculations were made for sexual violence.

Tables 3.35 and 3.36 show how the effects of the decline in child malaria mortality on fertility varied by the regional levels of domestic and sexual violence in 2010, respectively. Controlling for the levels of domestic and sexual violence in the region of residence does not affect the nature of the fertility results. The triple difference

[38] Instead of separating analysis by women's desired fertility, additionally controlling for desired fertility in Appendix Tables C.27 and C.28 does not change the nature of the main results for both fertility and labour force participation.

specifications in the hazard model however indicate that women in regions with high levels of domestic violence or sexual violence were less likely to give birth as a result of the reduction in malaria mortality. This, combined with the weakly significant positive effect on fertility on average led to a weakly significant reduction in the probability of giving birth in any given year in regions with high levels of domestic or sexual violence. These results are contrary to the hypothesis that women have lower levels of autonomy over fertility decisions in these regions. These results may be indicative of effects on women's health that may hinder fertility in regions with high levels of domestic or sexual violence – furthermore, the timing of measurement may mean that the causal nature of the relationship is not easily inferred from these results.

Tables 3.37 and 3.38 show how the effects of the decline in child malaria mortality on female labour force participation varied by the levels of domestic and sexual violence, respectively, in the region of residence in the 2010 DHS survey. The triple difference results indicate that women were more likely to work in regions where the levels of domestic or sexual violence were higher than the median for all regions in 2010. These results could be explained by the fact that levels of domestic violence are positively correlated with female labour force participation, as seen in Figure 3.15, which has been attributed to male backlash in previous literature investigating the relationship between female labour force participation and domestic violence (Siddique, 2018; Bhalotra et al., 2019; Lenze and Klasen, 2017).

3.7 Conclusion

This chapter uses a difference-in-difference strategy exploiting quasi-experimental variation in malaria mortality rates for children under five to identify the effect of malaria control programmes, primarily through increased bed-net coverage, on women's fertility and labour force participation in Tanzania. This relates to a long-running research question investigating the relationship between mortality and fertility. It also ties into a literature assessing the quantity-quality model related to fertility, and extensions to this framework along the extensive and intensive margins, as well as related to fertility timing, as introduced by Aaronson et al. (2014) and Bhalotra et al. (2018). This chapter also investigates a related research literature on the link between fertility and female labour force participation, as well as the fertility transition in developing countries where female labour force participation rates are high (Bloom et al., 2009; Klasen, 2019).

Results indicate that declines in under-five malaria mortality did not affect the likelihood of birth among women of childbearing age, and reduced labour force participation among women with children. The fall in labour force participation was driven by those with children under five in the household, for whom the opportunity cost of time at work most likely increased as child-rearing needs increased due to higher surviving births.

Separating analysis by women's age finds that women aged 15–25 were significantly likely to bring forward their first birth in response to the reduction in child mortality and (weakly) decrease higher order births, consistent with an extension to the quantity-quality tradeoff framework where the quality and quantity of children are complements along the extensive margin (Aaronson et al., 2014). Increases in first birth among women aged 15–25 were driven by women in non-endemic areas, lower acquired levels of malaria immunity in adulthood played an important role in reducing pregnancy and birth risk, and therefore encouraged fertility. Results by women's level of schooling showed that fertility increased overall as well as along both intensive and extensive margins for more educated women in the sample. This is consistent with behavioural responses suggesting an increased demand for children in response to reduced child mortality in contexts where fertility decisions are made under uncertainty (Cigno, 1998). Note that there was no effect on fertility when considering women of all ages pooled together, which suggests that the decline in child mortality did not have a lasting effect on the overall levels of fertility in this context where it may not just have been child replacement or hoarding behaviour due to mortality that drove high fertility when child mortality was high. As social norms around fertility encourage large family sizes, the declines in child mortality may not have resulted in a fall in women's target fertility levels (as suggested by the quantity-quality trade-off), as desired levels of fertility tend to be quite high in this context. This is also in line with low returns to education in this context, so that incentives to invest in greater child quality (rather than quantity) are low.

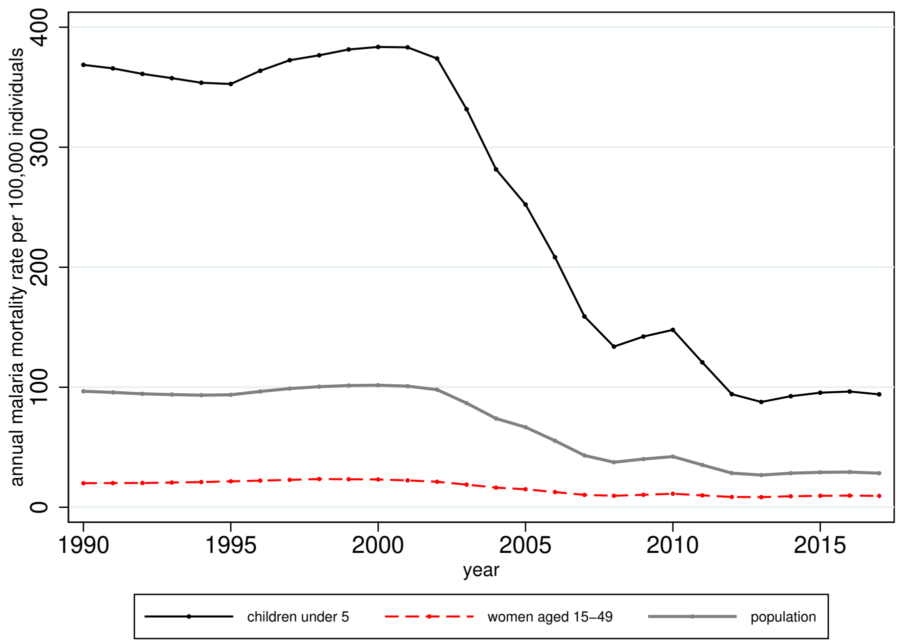
The reductions in female labour force participation were driven by women with children in non-polygamous households, suggesting that informal childcare arrangements may play an important role in determining women's work. The reduction in female labour force participation was also driven by women in clusters with low levels of labour force participation at baseline, suggesting the importance of social norms around working. These results suggest that policy measures to improve access to childcare and improve gender norms around working would encourage women's labour force participation. The existing levels of female labour force participation in this context are quite high, with the majority of women working in the agricultural sector as unpaid labour, often in family farms and enterprises. Labour force participation is especially high among women aged 26–40, rather than younger women, who are more likely to devote their time away from the labour market due to childbearing. Thus, it is for these women that declines in child mortality led to reduced labour force participation due to the greater number of surviving children, given that desired fertility levels are high. These findings are also in line with macroeconomic evidence that suggests that fertility decline contributed less than expected to increase female labour force participation in developing country contexts where informal and family sources of childcare are more prevalent. In such contexts, women's work may not be as constrained by the availability of formal sources of childcare.

These results are in line with evidence suggesting that a short-run causal relationship exists between infant mortality rates and female labour force participation rates, but that in the short run, the relationship between the fertility and infant mortality rates is neutral (Narayan and Smyth, 2006). It may also be that in developing country settings with high levels of uncertainty around mortality and conservative gender norms, declines in child mortality would not lead to lasting permanent declines in fertility as there may be strong social norms underlying desired fertility. In this context where labour force participation rates are high, the relationship between fertility and labour force participation may also be less clear among younger women who are more likely to be responsible for child-rearing while older women work.

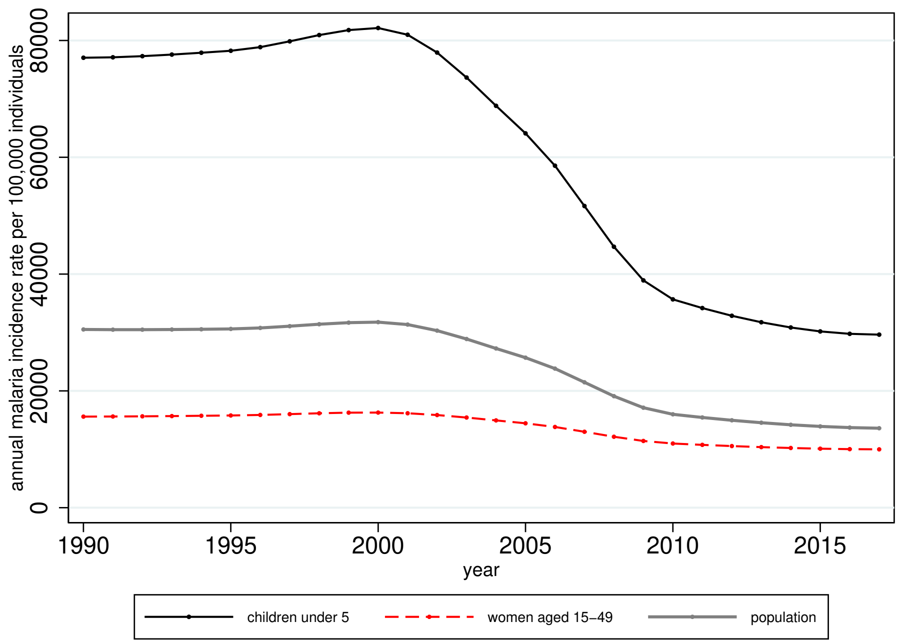
3.8 Tables and Figures

FIGURE 3.1: Annual malaria mortality and incidence rates in Tanzania, 1990 to 2017

(a) Malaria mortality rates



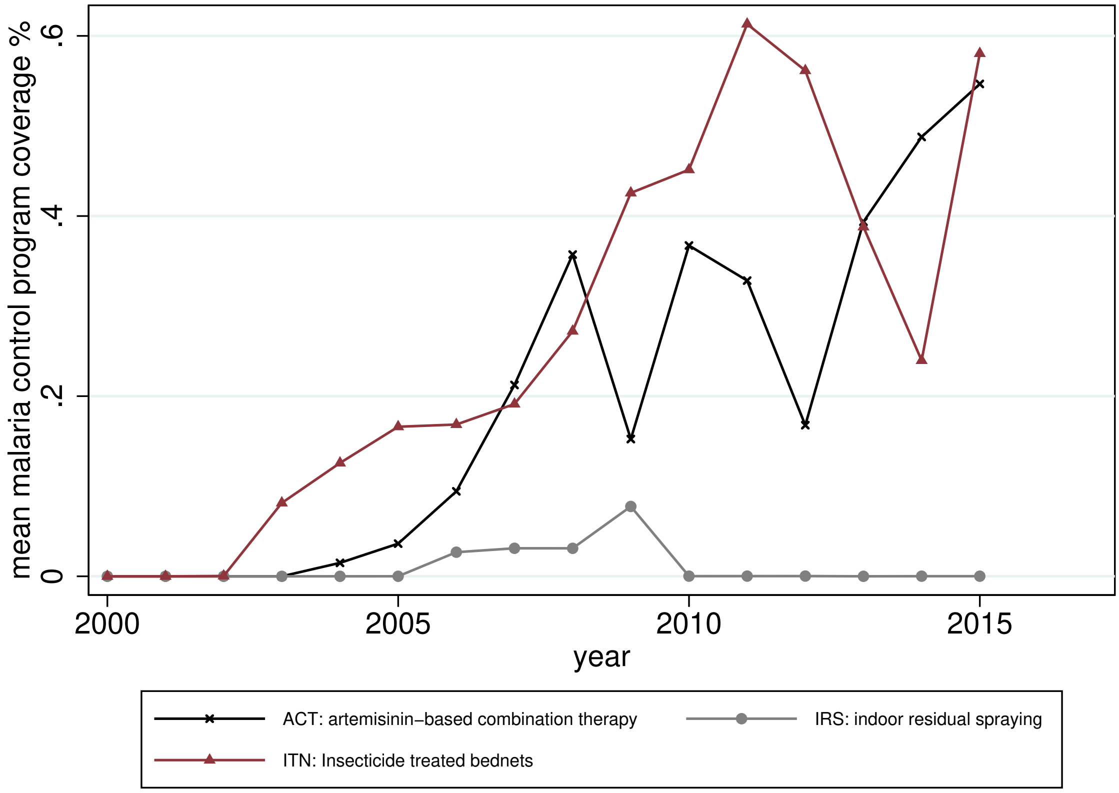
(b) Malaria incidence rates



Source: Global Burden of Disease Study 2017 Results (GBD, 2018), Roser and Ritchie (2013)

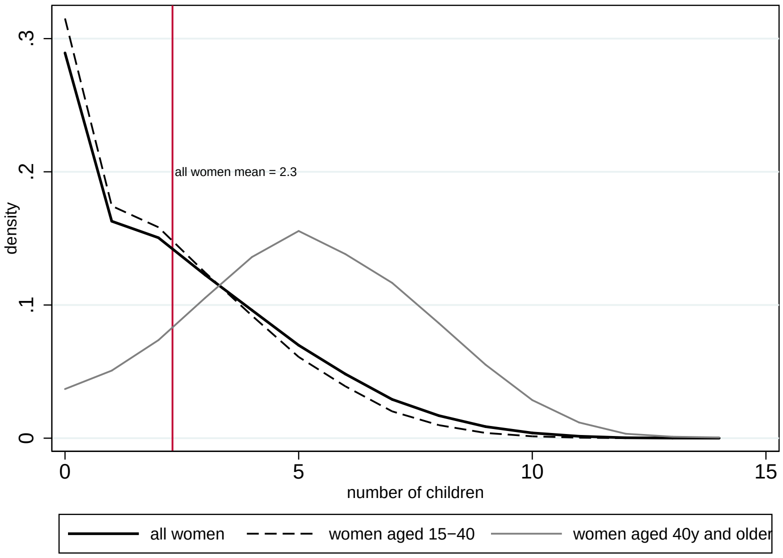
Notes: The figures show the annual malaria mortality and incidence rates in Tanzania for 2000 to 2017, defined as the number of deaths per 100,000 individuals and the number of new malaria cases per 100,000 individuals, respectively, in each year.

FIGURE 3.2: Mean program coverage in DHS clusters from 2000-2015



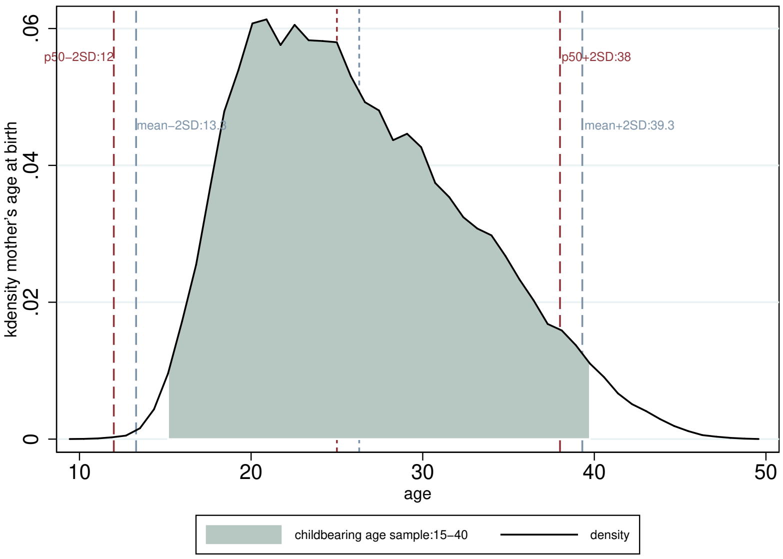
Notes: Data on access to ACTs and ITN usage from household surveys was aggregated along with country year reports on malaria control programme data on IRS, ITN, and ACT by the Malaria Atlas Project in the 5km × 5km resolution dataset, using time-series models of coverage of these interventions within each country (Bhatt et al., 2015).

FIGURE 3.3: Fertility distribution by age group



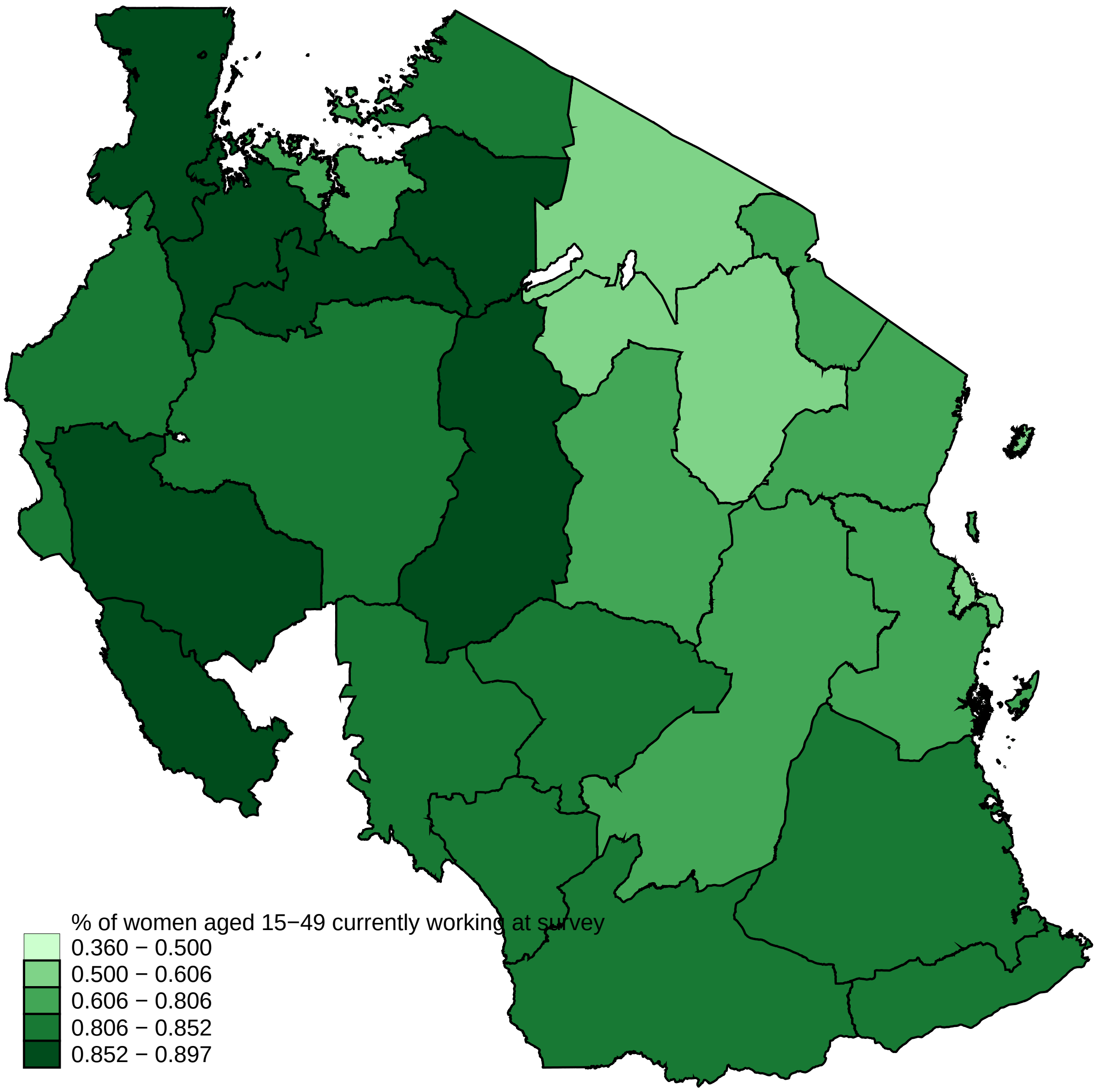
Notes: The graph plots the number of children for women in the sample, separately for all women, women aged 15-40 at interview, and women aged 40-49 at interview.

FIGURE 3.4: Distribution of mother's age at birth



Notes: This graph plots the distribution of mother's ages at birth in the DHS surveys, with the shaded area representing the sample of women aged 15–40, and the two groups of dotted lines showing the regions in the intervals two standard deviations around the mean and median.

FIGURE 3.5: Female labour force participation rates by region, DHS

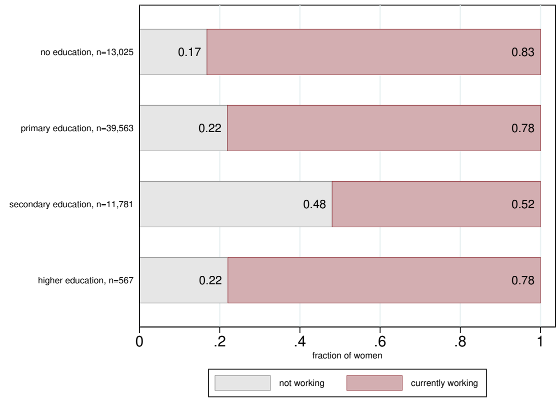


Source: DHS surveys (1999, 2003/4, 2004/5, 2007/8, 2009/10, 2011/12, and 2015/16)

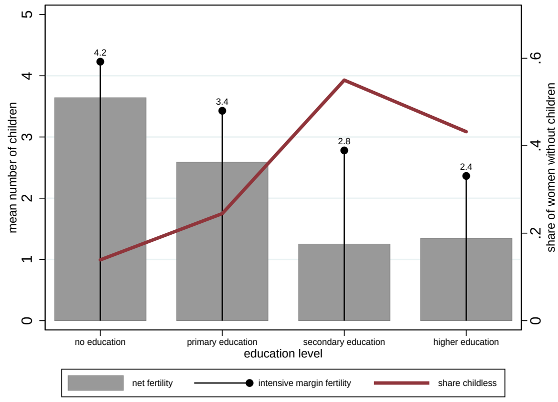
Notes: The map shows the proportion of women aged 15-49 in the sample who were working at the time of interview, across all surveys.

FIGURE 3.6: Fertility and female labour force participation rates by education level

(a) Share of women working



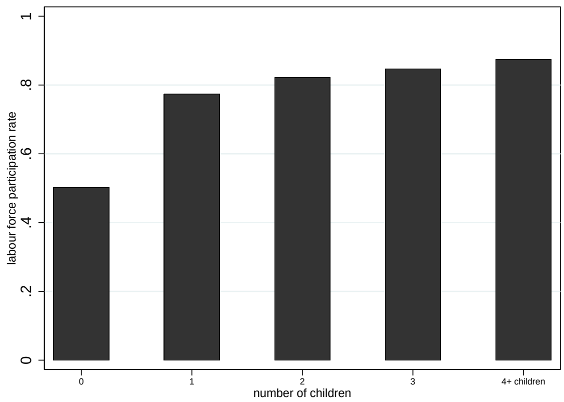
(b) Fertility



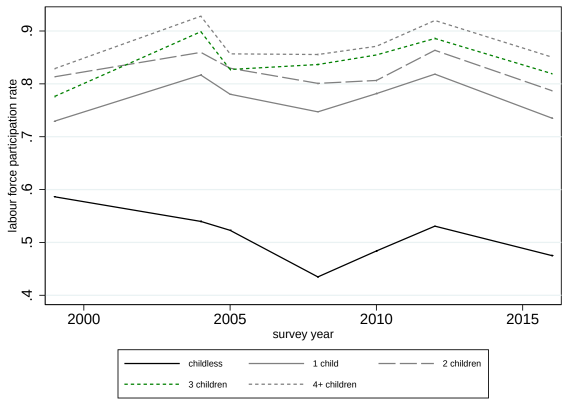
Notes: These graphs show the relationship between education level and fertility and female labour force participation. The graph in panel (a) plots the proportion of women aged 15-49 working at the time of interview across all DHS surveys, by the highest level of education they have achieved. The graph in panel (b) plots the average number of children by education level, both including and not including childless women, as well as the average proportion of women who are childless by education level.

FIGURE 3.7: Labour force participation rates by fertility

(a) Average share of women working



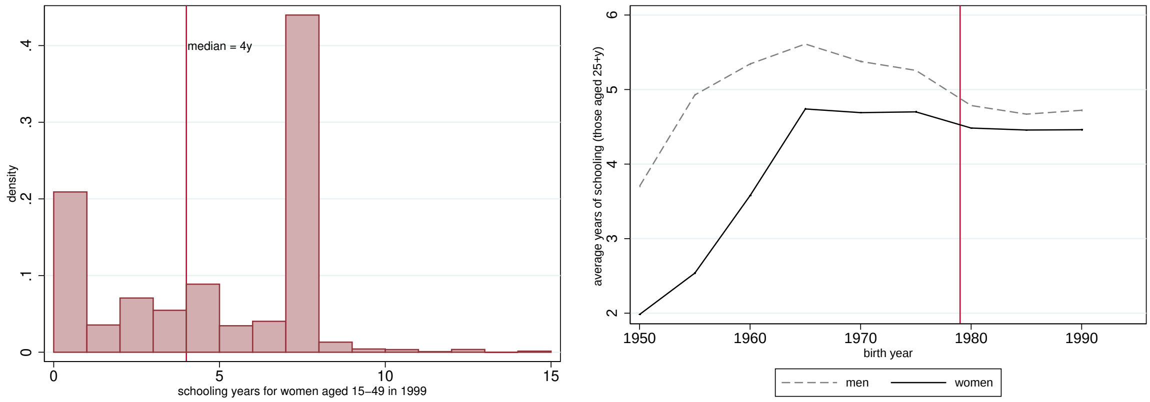
(b) Trends over time



Notes: These graphs show the proportion of childless women and mothers aged 15-49 who were working at the time of survey interview. Panel (a) plots the average share of women working by number of children across all surveys, whereas panel (b) plots the trends in women working over time by fertility.

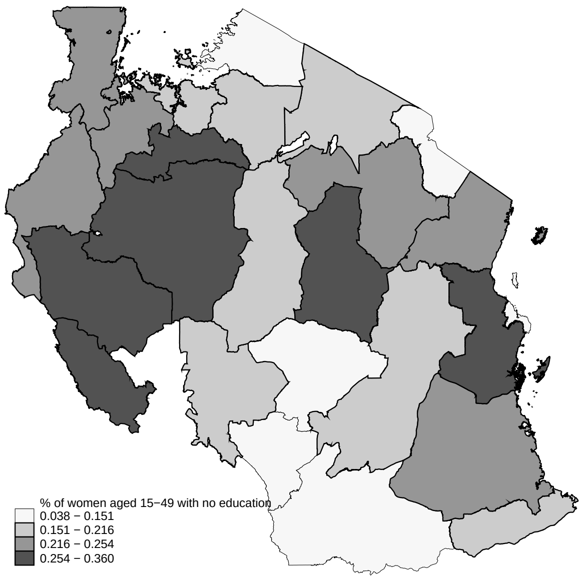
FIGURE 3.8: Years of schooling in the DHS sample

(a) Distribution of female schooling years (b) Average education by sex



Notes: The graphs describe educational attainment in the DHS sample. Panel (a) plots the average years of schooling for men and women aged 25 years and older in the sample, by birth year. Panel (b) shows the distribution of the years of schooling for women aged 15-49 in the DHS clusters at the time of survey interview in 1999.

FIGURE 3.9: Share of women with no education by region, DHS



Source: DHS surveys (1999, 2003/4, 2004/5, 2007/8, 2009/10, 2011/12, and 2015/16)

Notes: The map shows the proportion of women aged 15-49 in the sample reported having had no education, across all surveys.

TABLE 3.1: Trend breaks in yearly changes in malaria mortality and incidence rates

	Δ mortality		Δ incidence	
	under 5	women 15-49	under 5	women 15-49
Panel A: DHS cluster-year level regressions				
year * post2004	-0.0072***	-0.0004***	-0.2106***	-0.2199***
	(0.0001)	(0.0000)	(0.0074)	(0.0077)
year	0.0063***	0.0004***	0.1634***	0.1681***
	(0.0001)	(0.0000)	(0.0073)	(0.0077)
post2004	-0.0087***	-0.0007***	-0.0149	-0.0078
	(0.0003)	(0.0000)	(0.0167)	(0.0175)
R-squared	0.331	0.267	0.282	0.272
Number of observations	42,738	42,738	44,149	44,149
Panel B: Region-year level regressions				
year * post2004	-0.0031***	-0.0001**	-0.1218***	-0.1274***
	(0.0008)	(0.0001)	(0.0449)	(0.0471)
year	0.0023***	0.0001	0.0692	0.0692
	(0.0008)	(0.0001)	(0.0445)	(0.0467)
post2004	0.0003	-0.0000	0.2787***	0.3007***
	(0.0018)	(0.0001)	(0.0989)	(0.1036)
R-squared	0.307	0.260	0.318	0.308
Number of observations	527	527	527	527

Notes: *** p<0.01, ** p<0.05, * p<0.1. Table shows OLS regressions with standard errors in parentheses. The dependent variables are the year-on-year changes in malaria mortality and incidence rates. Malaria mortality rates are defined as the number of deaths per 100,000 individuals in each year and malaria incidence rates are the number of new malaria cases per 100,000 individuals in each year. The regressions also include fixed effects for the relevant geographic area. Year is a linear time trend variable, and post2004 equals one for the years 2004 and later, and zero otherwise.

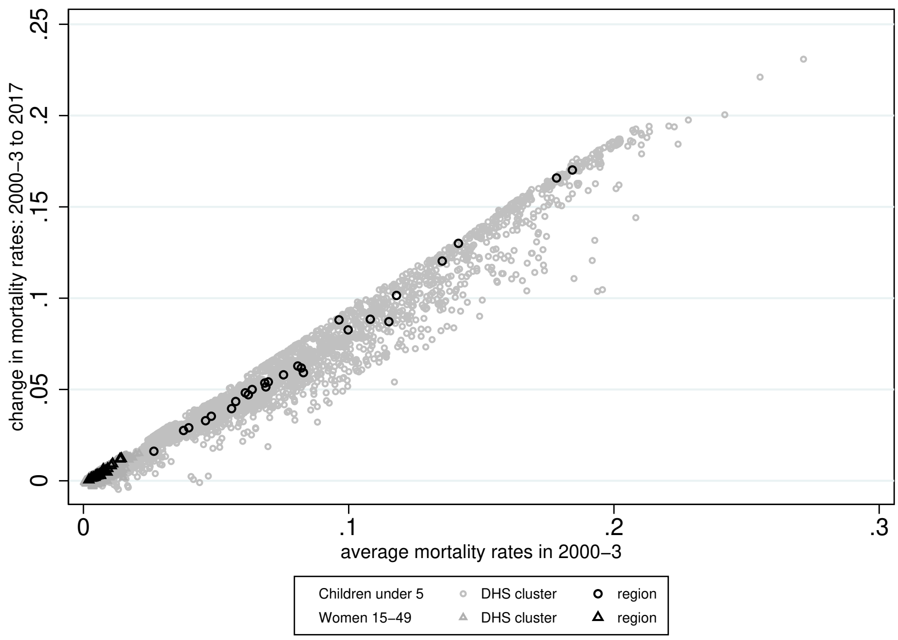
TABLE 3.2: Tests of convergence in levels of malaria mortality rates

	Under 5 mortality rate		Women 15-49 mortality rate	
	(1)	(2)	(3)	(4)
year * post2004	0.0029***		0.0004***	
	(0.0003)		(0.0000)	
year	-0.0054***		-0.0005***	
	(0.0003)		(0.0000)	
post2004	-0.0229***		-0.0014***	
	(0.0008)		(0.0001)	
base mortality rate under five * post2004		-0.7285***		
		(0.0072)		
base mortality rate women 15-49 * post2004				-0.0528***
				(0.0006)
Cluster FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
R-squared	0.835	0.937	0.862	0.939
Number of observations	45,252	45,252	45,252	45,252

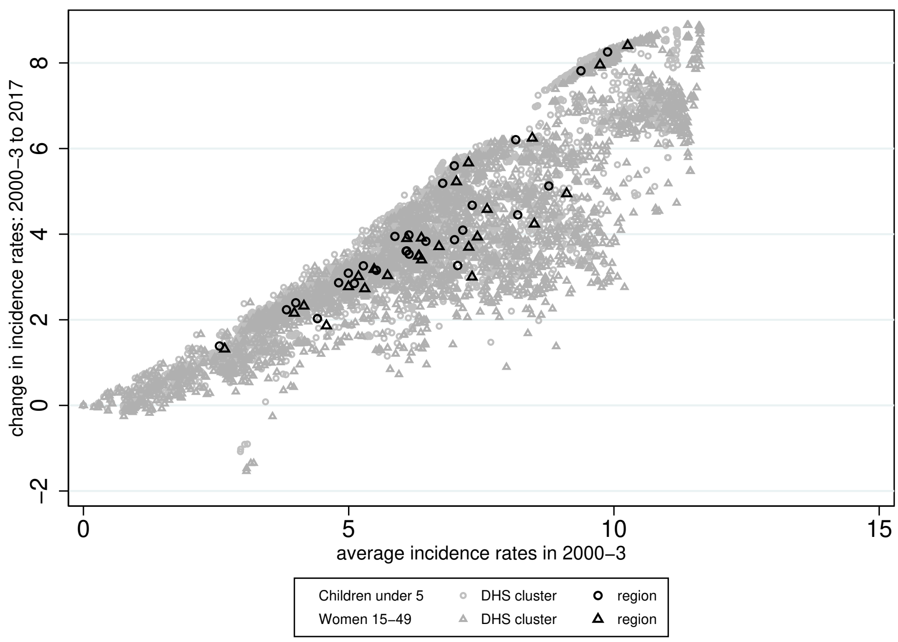
Notes: *** p<0.01, ** p<0.05, * p<0.1. Table shows OLS regressions at cluster-year level with standard errors clustered at sample cluster in parentheses. The dependent variables are the malaria mortality rate for children under five and women aged 15-49. Malaria mortality rates are defined as the number of deaths per 100,000 individuals in each year.

FIGURE 3.10: Convergence of malaria mortality and incidence rates for under fives and women aged 15-49 post 2004

(a) Malaria mortality convergence post-2004

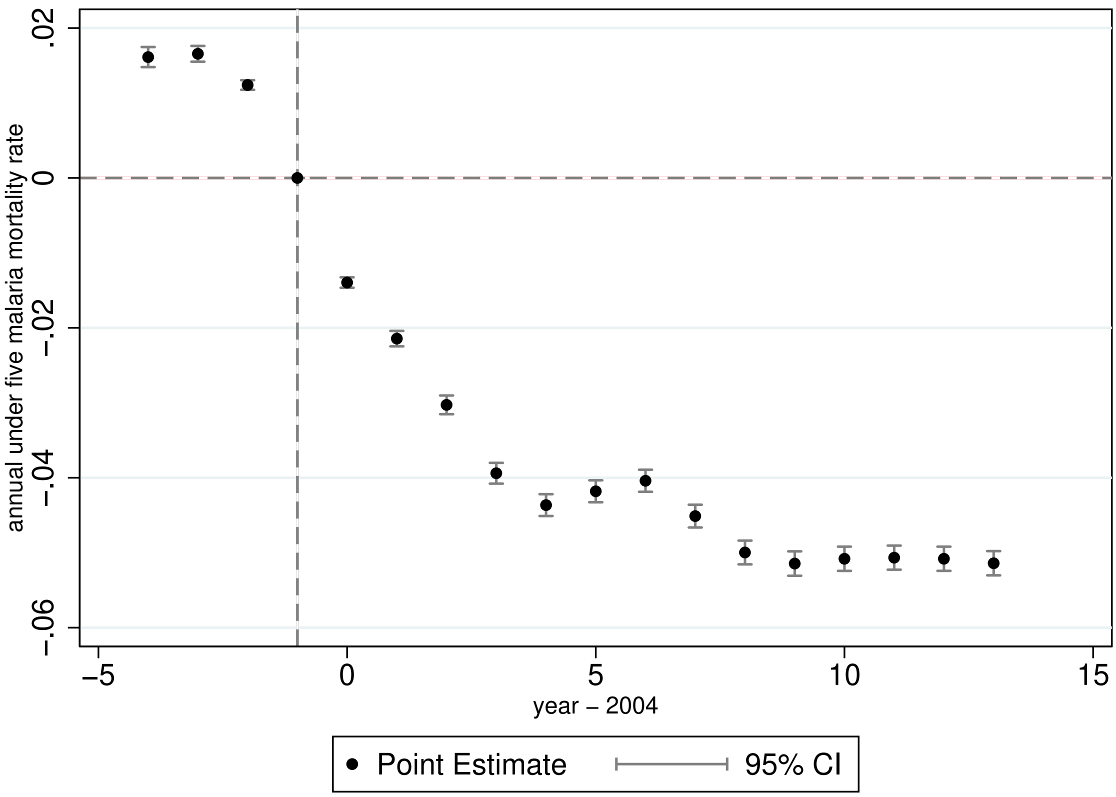


(b) Malaria incidence convergence post-2004



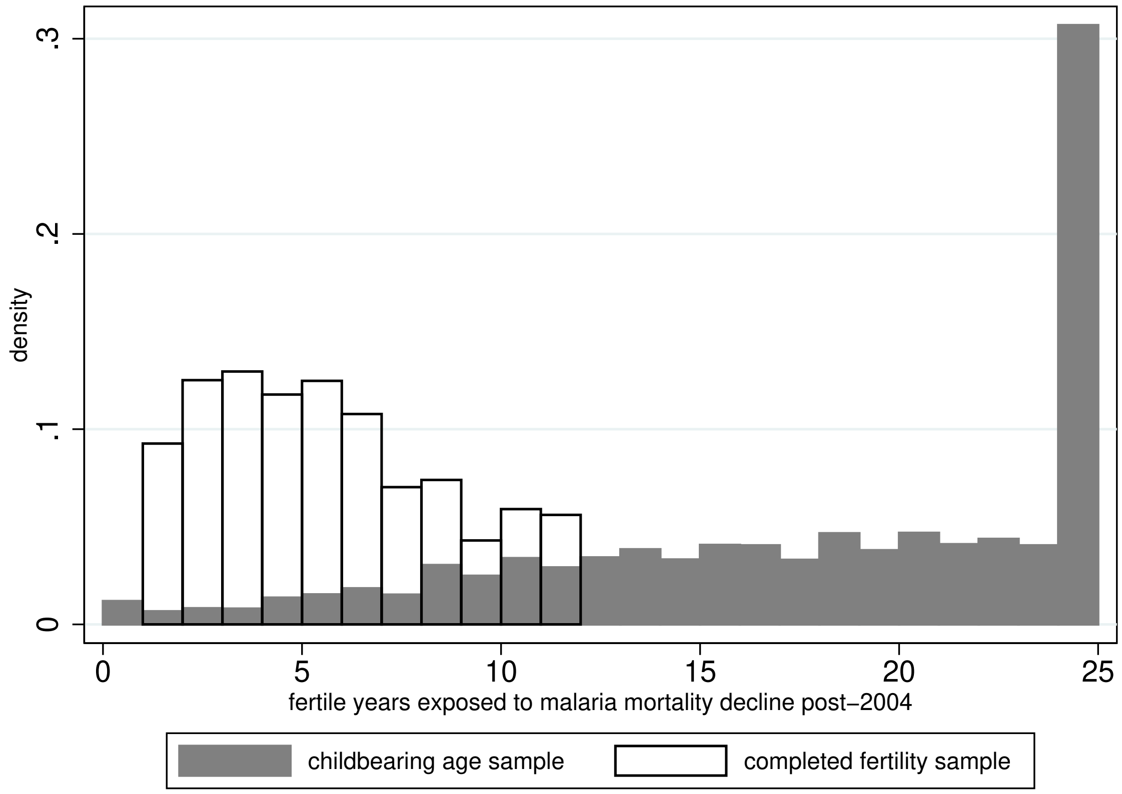
Notes: The figures show the relationship between the 2000-2003 levels of malaria mortality (panel a) and incidence (panel b) rates among children under five and women aged 15-49 and the change in these rates from 2004-2017. Malaria mortality rates are defined as the number of deaths per 100,000 individuals in each year and malaria incidence rates are the number of new malaria cases per 100,000 individuals in each year.

FIGURE 3.11: Event study of under-five malaria mortality rate



Notes: The figures plot the lag and lead coefficients and 95% confidence intervals from panel event study models, where the lags and leads are calculated relative to the year 2004, as the intervention start year. The outcomes of interest are the mortality and incidence rates in the years leading up to and following on from 2004. The event study models include DHS cluster fixed effects and standard errors are clustered at the DHS cluster. These figures were plotted using the eventdd command on Stata.

FIGURE 3.12: Distribution of years of exposure during fertile period to decline in child malaria mortality post-2004



Notes: The graph shows the distribution of the number of years during which they were of childbearing age that women were exposed to the decline in child malaria mortality post-2004.

TABLE 3.3: Descriptive statistics: hazard sample for fertility estimation

	Mean	S.D.
Birth	0.168	0.374
post2004	0.433	0.495
Current birth order	2.568	2.075
Years since last birth	4.743	5.121
Mother year of birth	1977.6	8.606
N	597056	

Notes: This table shows the mean and standard deviation of the main variables used in hazard model analysis of a woman-year panel dataset consisting of women aged 15–40 between 1992-2016.

TABLE 3.4: Descriptive statistics: stock sample for LFP estimation

	Childbearing aged sample		Completed fertility sample		All women	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Net fertility	2.05	2.07	5.15	2.57	2.33	2.30
Net extensive margin fertility	0.68	0.46	0.96	0.19	0.71	0.45
Net intensive margin fertility	2.99	1.85	5.34	2.41	3.28	2.08
Fertile years exposure post-2004	17.60	6.93	5.15	2.91	16.44	7.58
Pre-under 5 mortrate	0.09	0.05	0.09	0.06	0.09	0.05
Mother year of birth	1982.52	8.17	1969.15	2.91	1981.27	8.74
Maternal education level						
No education	0.18	0.38	0.22	0.42	0.18	0.39
Primary education	0.62	0.49	0.66	0.47	0.62	0.49
Secondary education	0.20	0.40	0.11	0.31	0.19	0.39
Higher education	0.01	0.10	0.01	0.07	0.01	0.09
Currently working	0.72	0.45	0.89	0.32	0.74	0.44
Working 12 months	0.76	0.43	0.92	0.28	0.77	0.42
LFP by fertility status						
No children	0.50	0.50	0.84	0.36	0.51	0.50
One or more children	0.77	0.42	0.89	0.31	0.77	0.42
N	52872		5419		58291	

Notes: This table summarises the main variables used in stock model analysis from a dataset consisting of repeated cross section of women aged 15-49 in the DHS surveys between 1999 and 2016 in Tanzania. Statistics presented are the mean and standard deviation of these variables for women of childbearing age at survey (aged 15–39), those with completed fertility at survey (aged 40–49), as well as all women (aged 15–49).

TABLE 3.5: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation, sample of women aged 15–40 in 1992-2016

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post-2004 * base under 5 malaria mortality rate	0.0375	0.1462***	-0.0508	0.0320	-0.1170***	-0.1687***	0.0219	0.1023	0.1228***	0.2011***	-0.0896	0.0169
	(0.0237)	(0.0403)	(0.0408)	(0.0682)	(0.0254)	(0.0399)	(0.0473)	(0.0802)	(0.0354)	(0.0569)	(0.0583)	(0.0997)
primary education	-0.0268***	0.0000	-0.0219***	0.0000	-0.0170***	0.0000	-0.0157***	0.0000	-0.0322***	0.0000	-0.0252***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0021)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0733***	0.0000	-0.0688***	0.0000	-0.0857***	0.0000	-0.0828***	0.0000	-0.0620***	0.0000	-0.0555***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0025)	(.)	(0.0025)	(.)	(0.0038)	(.)	(0.0037)	(.)
higher education	-0.0955***	0.0000	-0.0840***	0.0000	-0.1045***	0.0000	-0.1011***	0.0000	-0.0968***	0.0000	-0.0747***	0.0000
	(0.0040)	(.)	(0.0042)	(.)	(0.0045)	(.)	(0.0045)	(.)	(0.0102)	(.)	(0.0101)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.103	0.141	0.110	0.151	0.058	0.144	0.065	0.154	0.118	0.215	0.130	0.222
Number of observations	597,056	597,056	597,056	597,056	284,752	284,752	284,752	284,752	312,304	312,304	312,304	312,304
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,542		55,542		45,849		45,849		35,626		35,626

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016, born between 1952 and 2001. Between 1992 and 2003, the average probability of birth was 0.16, 0.08 for women without children (who were likely to give birth to their first child), and 0.24 for women who had children (who were likely to have higher order births).

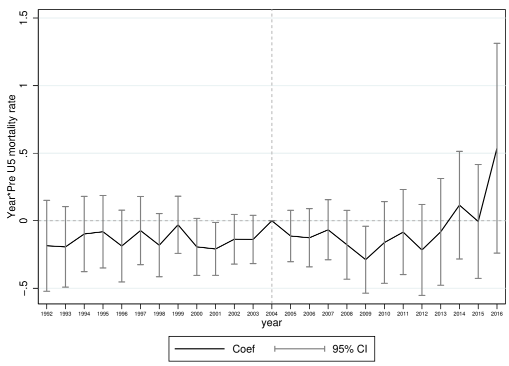
TABLE 3.6: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation, sample of women aged 40–49 in 1992-2016

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post-2004 * base under 5 malaria mortality rate	0.1936***	0.1343*	0.0748	-0.0983	0.2123***	0.1740***	0.1428*	0.0334	0.0522	-0.1590	-0.0464	-1.1155*
	(0.0387)	(0.0731)	(0.0728)	(0.1925)	(0.0412)	(0.0594)	(0.0832)	(0.1501)	(0.1186)	(0.2100)	(0.2480)	(0.5977)
primary education	-0.0124***	0.0000	-0.0063	0.0000	-0.0110**	0.0000	-0.0048	0.0000	-0.0178	0.0000	-0.0175	0.0000
	(0.0042)	(.)	(0.0043)	(.)	(0.0045)	(.)	(0.0046)	(.)	(0.0153)	(.)	(0.0156)	(.)
secondary education	-0.0373***	0.0000	-0.0318***	0.0000	-0.0343***	0.0000	-0.0273***	0.0000	-0.0736***	0.0000	-0.0716***	0.0000
	(0.0056)	(.)	(0.0061)	(.)	(0.0065)	(.)	(0.0069)	(.)	(0.0186)	(.)	(0.0225)	(.)
higher education	-0.0452***	0.0000	-0.0305*	0.0000	-0.0496***	0.0000	-0.0346**	0.0000	0.0338	0.0000	0.0636	0.0000
	(0.0166)	(.)	(0.0169)	(.)	(0.0152)	(.)	(0.0164)	(.)	(0.1021)	(.)	(0.0831)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.053	0.353	0.073	0.370	0.062	0.032	0.085	0.061	0.147	0.265	0.228	0.342
Number of observations	35,184	35,184	35,184	35,184	29,294	29,294	29,294	29,294	5,890	5,890	5,890	5,890
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		7,508		7,508		7,508		7,508		1,546		1,546

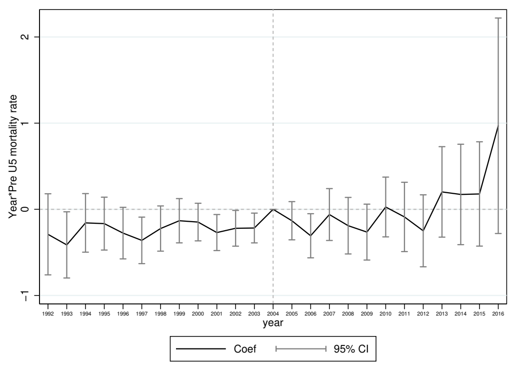
Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 40 to 49 between 1992 and 2016, born between 1943 and 1976. Between 1992 and 2003, the average probability of birth in this sample was 0.08, both for women without children (who were likely to give birth to their first child), as well as women who had children (who were likely to have higher order births).

FIGURE 3.13: Event studies of probability of birth

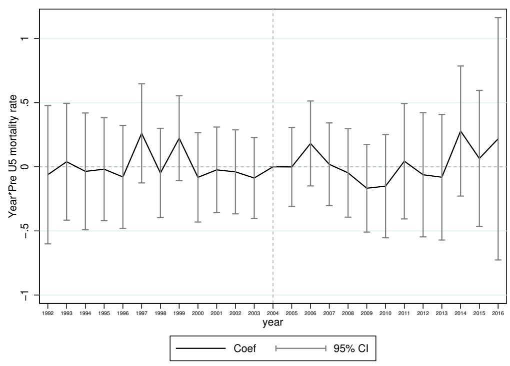
(a) Probability of birth



(b) Probability of first birth



(c) Probability of higher order birth



Notes: The figures plot the coefficients and 95% confidence intervals from panel event study models looking at the evolution of the probability of birth in the years leading up and following the intervention in 2004. Panel a plots the coefficients on variables $pre\_u5mortality * year$ on the probability of birth overall, panel b on the probability of first birth, and panel c on the probability of the higher order birth. The dependent variable is a dummy variable taking the value 1 if the women gave birth in that year and 0 otherwise. The dataset is a woman-year panel of birth outcomes for women aged 15–40 between 1992 to 2016. The regressions include sample cluster fixed effects, year fixed effects, education fixed effects, woman fixed effects, and region-year fixed effects. Confidence intervals (at 95%) around the plotted coefficients are calculated using standard errors clustered at the DHS sample cluster.

TABLE 3.7: Labour force participation after the malaria intervention: results for women of childbearing age

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0267***	-0.0237***	-0.0281***	-0.0192***
	(0.0042)	(0.0051)	(0.0042)	(0.0051)
primary education	-0.0203***	-0.0144***	-0.0237***	-0.0201***
	(0.0064)	(0.0055)	(0.0060)	(0.0049)
secondary education	-0.1874***	-0.1407***	-0.1995***	-0.1561***
	(0.0097)	(0.0086)	(0.0095)	(0.0082)
higher education	-0.0383*	0.0148	-0.0568***	-0.0112
	(0.0232)	(0.0217)	(0.0217)	(0.0204)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.204	0.262	0.220	0.276
Number of observations	52,859	52,859	52,859	52,859
Panel B: 15-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0208***	-0.0062	-0.0203***	0.0000
	(0.0049)	(0.0082)	(0.0050)	(0.0081)
primary education	-0.1074***	-0.0849***	-0.1274***	-0.1059***
	(0.0149)	(0.0138)	(0.0139)	(0.0125)
secondary education	-0.3614***	-0.3130***	-0.3937***	-0.3465***
	(0.0177)	(0.0166)	(0.0170)	(0.0159)
higher education	-0.2629***	-0.2129***	-0.3041***	-0.2608***
	(0.0370)	(0.0360)	(0.0368)	(0.0359)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.240	0.293	0.259	0.312
Number of observations	16,649	16,649	16,649	16,649
Panel C: 15-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0275***	-0.0277***	-0.0291***	-0.0226***
	(0.0052)	(0.0061)	(0.0050)	(0.0057)
primary education	0.0038	0.0036	0.0047	0.0020
	(0.0065)	(0.0055)	(0.0059)	(0.0048)
secondary education	-0.0450***	0.0053	-0.0487***	-0.0024
	(0.0103)	(0.0097)	(0.0097)	(0.0087)
higher education	0.0842***	0.1289***	0.0686***	0.1062***
	(0.0231)	(0.0227)	(0.0223)	(0.0218)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.106	0.191	0.109	0.194
Number of observations	36,210	36,210	36,210	36,210

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.58 and 0.65 respectively for women without children, and 0.78 and 0.83 respectively for women with children.

TABLE 3.8: Labour force participation after the malaria intervention: results for women with completed childbearing

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 40-49 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0235	-0.0384	-0.0216	-0.0311
	(0.0279)	(0.0313)	(0.0243)	(0.0265)
primary education	0.0293**	0.0255**	0.0301***	0.0255**
	(0.0125)	(0.0126)	(0.0107)	(0.0105)
secondary education	0.0321	0.0582***	0.0218	0.0467**
	(0.0215)	(0.0225)	(0.0191)	(0.0201)
higher education	0.0808	0.1334**	0.0639	0.0991*
	(0.0584)	(0.0586)	(0.0558)	(0.0549)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.208	0.278	0.222	0.296
Number of observations	5,419	5,419	5,419	5,419
Panel B: 40-49 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.2762	0.0000	-0.2762	0.0000
	(0.6739)	(0.0000)	(0.6739)	(0.0000)
primary education	-0.3337	0.0000	-0.3337	0.0000
	(0.4170)	(0.0000)	(0.4170)	(0.0000)
secondary education	-0.0674	0.0000	-0.0674	0.0000
	(0.5232)	(0.0000)	(0.5232)	(0.0000)
higher education	0.3660	0.0000	0.3660	0.0000
	(1.4524)	(0.0000)	(1.4524)	(0.0000)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.958	0.981	0.938	0.972
Number of observations	200	200	200	200
Panel C: 40-49 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0188	-0.0362	-0.0171	-0.0279
	(0.0287)	(0.0324)	(0.0253)	(0.0277)
primary education	0.0249*	0.0192	0.0286***	0.0234**
	(0.0128)	(0.0129)	(0.0110)	(0.0108)
secondary education	0.0192	0.0428*	0.0168	0.0399*
	(0.0216)	(0.0227)	(0.0195)	(0.0205)
higher education	0.0579	0.1022*	0.0589	0.0840
	(0.0619)	(0.0618)	(0.0588)	(0.0556)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.213	0.285	0.227	0.302
Number of observations	5,219	5,219	5,219	5,219

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Mean labour force participation rates for women in this analysis overall were 0.89 and 0.91 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.85 and 0.90 respectively for women without children, and 0.89 and 0.92 respectively for women with children.

TABLE 3.9: Labour force participation as a function of exposure to the malaria intervention: results for women with child under five

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women without child under 5 in household				
fertile years post-2004 * base u5 malaria mortrate	-0.0155***	-0.0056	-0.0187***	-0.0067
	(0.0059)	(0.0082)	(0.0058)	(0.0079)
primary education	-0.0420***	-0.0343***	-0.0459***	-0.0402***
	(0.0133)	(0.0126)	(0.0121)	(0.0114)
secondary education	-0.2315***	-0.1966***	-0.2413***	-0.2102***
	(0.0158)	(0.0150)	(0.0152)	(0.0144)
higher education	-0.0950***	-0.0529	-0.1078***	-0.0745**
	(0.0344)	(0.0338)	(0.0326)	(0.0327)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.281	0.323	0.296	0.339
Number of observations	12,840	12,840	12,840	12,840
Panel B: 15-40 year old women with child under 5 in household				
fertile years post-2004 * base u5 malaria mortrate	-0.0321***	-0.0323***	-0.0325***	-0.0260***
	(0.0046)	(0.0058)	(0.0046)	(0.0056)
primary education	-0.0142**	-0.0102*	-0.0178***	-0.0158***
	(0.0067)	(0.0057)	(0.0061)	(0.0050)
secondary education	-0.1582***	-0.1099***	-0.1722***	-0.1261***
	(0.0107)	(0.0097)	(0.0103)	(0.0091)
higher education	0.0066	0.0556**	-0.0117	0.0314
	(0.0260)	(0.0269)	(0.0243)	(0.0247)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.191	0.260	0.205	0.271
Number of observations	40,019	40,019	40,019	40,019

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. The baseline labour force participation rate was 0.88 for women without children under five in the household and 0.75 for women with children under five in the household at the time of interview.

TABLE 3.10: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation grouped by women's ages in 1992-2016

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: 15-25 year old women												
post-2004 * base under 5 malaria mortality rate	-0.0243	-0.0404	-0.0102	0.0944	-0.1141***	-0.2863***	0.0670	0.2849***	0.1721***	0.0829	-0.1447	-0.4147*
	(0.0232)	(0.0494)	(0.0434)	(0.1085)	(0.0260)	(0.0495)	(0.0486)	(0.1100)	(0.0532)	(0.1162)	(0.0931)	(0.2406)
primary education	-0.0260***	0.0000	-0.0228***	0.0000	-0.0215***	0.0000	-0.0203***	0.0000	-0.0312***	0.0000	-0.0253***	0.0000
	(0.0021)	(.)	(0.0020)	(.)	(0.0026)	(.)	(0.0025)	(.)	(0.0037)	(.)	(0.0035)	(.)
secondary education	-0.0907***	0.0000	-0.0873***	0.0000	-0.0977***	0.0000	-0.0946***	0.0000	-0.0636***	0.0000	-0.0610***	0.0000
	(0.0024)	(.)	(0.0025)	(.)	(0.0028)	(.)	(0.0028)	(.)	(0.0060)	(.)	(0.0060)	(.)
higher education	-0.1368***	0.0000	-0.1286***	0.0000	-0.1363***	0.0000	-0.1326***	0.0000	-0.1521***	0.0000	-0.1332***	0.0000
	(0.0038)	(.)	(0.0041)	(.)	(0.0043)	(.)	(0.0043)	(.)	(0.0241)	(.)	(0.0243)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.115	0.164	0.120	0.176	0.063	0.145	0.070	0.160	0.153	0.346	0.170	0.364
Number of observations	343,432	343,432	343,432	343,432	228,262	228,262	228,262	228,262	115,170	115,170	115,170	115,170
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		49,695		49,695		44,765		44,765		26,202		26,202
Panel B: 26-40 year old women												
post-2004 * base under 5 malaria mortality rate	0.0999***	0.2559***	-0.0795	0.0243	-0.0737	0.0825	-0.0453	-0.0337	0.0977***	0.2903***	-0.0575	0.0512
	(0.0331)	(0.0503)	(0.0543)	(0.0938)	(0.0529)	(0.0601)	(0.1026)	(0.1080)	(0.0371)	(0.0645)	(0.0613)	(0.1215)
primary education	-0.0253***	0.0000	-0.0189***	0.0000	-0.0003	0.0000	-0.0003	0.0000	-0.0293***	0.0000	-0.0231***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0033)	(.)	(0.0033)	(.)	(0.0027)	(.)	(0.0026)	(.)
secondary education	-0.0331***	0.0000	-0.0286***	0.0000	0.0002	0.0000	0.0013	0.0000	-0.0516***	0.0000	-0.0439***	0.0000
	(0.0034)	(.)	(0.0034)	(.)	(0.0054)	(.)	(0.0054)	(.)	(0.0041)	(.)	(0.0041)	(.)
higher education	-0.0223***	0.0000	-0.0083	0.0000	0.0193	0.0000	0.0188	0.0000	-0.0656***	0.0000	-0.0451***	0.0000
	(0.0078)	(.)	(0.0079)	(.)	(0.0164)	(.)	(0.0160)	(.)	(0.0106)	(.)	(0.0106)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.109	0.207	0.119	0.215	0.106	0.133	0.127	0.153	0.103	0.227	0.115	0.235
Number of observations	253,624	253,624	253,624	253,624	56,490	56,490	56,490	56,490	197,134	197,134	197,134	197,134
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		29,759		29,759		7,612		7,612		26,032		26,032

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run separately on woman-year panel datasets, separated by women's age: in Panel A for women aged 15 to 25 between 1992 and 2016 and in Panel B for women aged 26 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth for women aged 15–25 was 0.15, 0.10 for women without children (who were likely to give birth to their first child), and 0.27 for women who had children (who were likely to have higher order births). For women aged 26–40, the average probability of birth between 1992 and 2003 was 0.18, 0.02 for women without children (who were likely to give birth to their first child), and 0.23 for women who had children (who were likely to have higher order births).

TABLE 3.11: Labour force participation after the malaria intervention: results for women aged 15–25 at survey

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-25 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0212***	-0.0030	-0.0212***	0.0059
	(0.0045)	(0.0072)	(0.0046)	(0.0070)
primary education	-0.0830***	-0.0636***	-0.0915***	-0.0734***
	(0.0098)	(0.0087)	(0.0092)	(0.0079)
secondary education	-0.3530***	-0.2942***	-0.3757***	-0.3189***
	(0.0128)	(0.0117)	(0.0128)	(0.0114)
higher education	-0.4277***	-0.3573***	-0.4684***	-0.4045***
	(0.0491)	(0.0475)	(0.0501)	(0.0480)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.243	0.306	0.268	0.330
Number of observations	25,278	25,278	25,278	25,278
Panel B: 15-25 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0203***	-0.0055	-0.0195***	0.0030
	(0.0051)	(0.0089)	(0.0052)	(0.0088)
primary education	-0.1499***	-0.1241***	-0.1720***	-0.1463***
	(0.0163)	(0.0151)	(0.0152)	(0.0136)
secondary education	-0.4574***	-0.4099***	-0.4985***	-0.4507***
	(0.0191)	(0.0181)	(0.0187)	(0.0174)
higher education	-0.5425***	-0.4965***	-0.6163***	-0.5751***
	(0.0552)	(0.0549)	(0.0580)	(0.0573)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.246	0.307	0.268	0.327
Number of observations	14,596	14,596	14,596	14,596
Panel C: 15-25 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0242***	-0.0038	-0.0246***	0.0069
	(0.0068)	(0.0102)	(0.0064)	(0.0092)
primary education	-0.0232**	-0.0133	-0.0228**	-0.0148
	(0.0114)	(0.0099)	(0.0104)	(0.0090)
secondary education	-0.1304***	-0.0627***	-0.1327***	-0.0698***
	(0.0189)	(0.0178)	(0.0183)	(0.0172)
higher education	-0.0706	-0.0536	-0.0745	-0.0602
	(0.1364)	(0.1219)	(0.1265)	(0.1106)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.172	0.289	0.179	0.294
Number of observations	10,682	10,682	10,682	10,682

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.62 and 0.69 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.55 and 0.62 respectively for women without children, and 0.71 and 0.78 respectively for women with children.

TABLE 3.12: Labour force participation after the malaria intervention: results for women aged 26–40 at survey

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 26-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0261***	-0.0279***	-0.0271***	-0.0221***
	(0.0060)	(0.0079)	(0.0056)	(0.0074)
primary education	0.0197***	0.0167***	0.0196***	0.0145***
	(0.0070)	(0.0061)	(0.0063)	(0.0054)
secondary education	-0.0013	0.0443***	-0.0043	0.0377***
	(0.0113)	(0.0110)	(0.0102)	(0.0097)
higher education	0.1081***	0.1544***	0.0887***	0.1293***
	(0.0213)	(0.0213)	(0.0183)	(0.0185)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.094	0.166	0.100	0.171
Number of observations	24,952	24,952	24,952	24,952
Panel B: 26-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0577**	-0.0129	-0.0323	0.0148
	(0.0286)	(0.0470)	(0.0259)	(0.0440)
primary education	0.0621	0.0644	0.0736*	0.0699
	(0.0462)	(0.0503)	(0.0422)	(0.0453)
secondary education	0.0410	0.0973	0.0679	0.1178**
	(0.0535)	(0.0598)	(0.0479)	(0.0530)
higher education	0.1560**	0.2421***	0.1690***	0.2359***
	(0.0702)	(0.0771)	(0.0622)	(0.0697)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.399	0.518	0.416	0.519
Number of observations	1,662	1,662	1,662	1,662
Panel C: 26-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0242***	-0.0282***	-0.0260***	-0.0227***
	(0.0063)	(0.0082)	(0.0059)	(0.0077)
primary education	0.0173**	0.0143**	0.0166***	0.0114**
	(0.0072)	(0.0062)	(0.0064)	(0.0054)
secondary education	-0.0032	0.0414***	-0.0087	0.0321***
	(0.0115)	(0.0112)	(0.0105)	(0.0100)
higher education	0.1049***	0.1403***	0.0846***	0.1155***
	(0.0227)	(0.0223)	(0.0216)	(0.0212)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.097	0.171	0.102	0.176
Number of observations	23,290	23,290	23,290	23,290

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.81 and 0.86 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.81 and 0.88 respectively for women without children, and 0.81 and 0.86 respectively for women with children.

TABLE 3.13: Labour force participation as a function of exposure to the malaria intervention: results for women with child under five for women aged 15–25

	currently working (1)	(2)	worked in the last 12 months (3)	(4)
Panel A: 15-25 year old women without child under 5 in household				
fertile years post-2004 * base u5 malaria mortrate	-0.0151**	0.0004	-0.0164**	0.0032
	(0.0069)	(0.0119)	(0.0068)	(0.0115)
primary education	-0.0950***	-0.0767***	-0.1101***	-0.0940***
	(0.0230)	(0.0214)	(0.0206)	(0.0189)
secondary education	-0.3909***	-0.3467***	-0.4263***	-0.3874***
	(0.0247)	(0.0242)	(0.0239)	(0.0228)
higher education	-0.3908***	-0.3277***	-0.4590***	-0.4080***
	(0.0689)	(0.0693)	(0.0719)	(0.0719)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.288	0.347	0.315	0.372
Number of observations	7,195	7,195	7,195	7,195
Panel B: 15-25 year old women with child under 5 in household				
fertile years post-2004 * base u5 malaria mortrate	-0.0260***	-0.0052	-0.0250***	0.0054
	(0.0051)	(0.0084)	(0.0051)	(0.0081)
primary education	-0.0760***	-0.0585***	-0.0835***	-0.0656***
	(0.0104)	(0.0095)	(0.0097)	(0.0086)
secondary education	-0.3175***	-0.2578***	-0.3370***	-0.2764***
	(0.0144)	(0.0133)	(0.0140)	(0.0128)
higher education	-0.4551***	-0.4235***	-0.4931***	-0.4597***
	(0.0745)	(0.0720)	(0.0789)	(0.0758)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.250	0.322	0.273	0.342
Number of observations	18,083	18,083	18,083	18,083

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. The baseline levels of labour force participation for working at time of survey and working in the preceding 12 months were 0.59 and 0.65 respectively for women aged 15–25 without children under five in the household. These rates were 0.63 and 0.70 respectively for women aged 15–25 with children under five in the household at the time of interview.

TABLE 3.14: Labour force participation as a function of exposure to the malaria intervention: results for women with child under five for women aged 26–40

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 26-40 year old women without child under 5 in household				
fertile years post-2004 * base u5 malaria mortrate	-0.0346***	-0.0271	-0.0394***	-0.0242
	(0.0123)	(0.0179)	(0.0112)	(0.0165)
primary education	-0.0074	-0.0153	-0.0045	-0.0125
	(0.0164)	(0.0161)	(0.0147)	(0.0145)
secondary education	-0.0242	0.0041	-0.0050	0.0237
	(0.0228)	(0.0229)	(0.0205)	(0.0204)
higher education	0.0510	0.0785*	0.0538	0.0750**
	(0.0432)	(0.0423)	(0.0356)	(0.0362)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.187	0.248	0.192	0.252
Number of observations	5,195	5,195	5,195	5,195
Panel B: 26-40 year old women with child under 5 in household				
fertile years post-2004 * base u5 malaria mortrate	-0.0229***	-0.0284***	-0.0232***	-0.0218***
	(0.0066)	(0.0088)	(0.0063)	(0.0083)
primary education	0.0253***	0.0221***	0.0242***	0.0189***
	(0.0077)	(0.0067)	(0.0067)	(0.0057)
secondary education	0.0037	0.0547***	-0.0056	0.0406***
	(0.0130)	(0.0127)	(0.0120)	(0.0117)
higher education	0.1133***	0.1612***	0.0964***	0.1384***
	(0.0255)	(0.0279)	(0.0223)	(0.0241)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.110	0.193	0.117	0.198
Number of observations	19,757	19,757	19,757	19,757

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. The baseline levels of labour force participation for working at time of survey and working in the preceding 12 months were 0.82 and 0.88 respectively for women aged 26–40 without children under five in the household. These rates were 0.80 and 0.86 respectively for women aged 26–40 with children under five in the household at the time of interview.

TABLE 3.15: Relationship between labour force participation and fertility

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
total living children	-0.0173***	-0.0189***	-0.0202***	-0.0209***
	(0.0014)	(0.0014)	(0.0013)	(0.0013)
childless	-0.1634***	-0.1488***	-0.1757***	-0.1607***
	(0.0062)	(0.0061)	(0.0061)	(0.0059)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.215	0.272	0.234	0.290
Number of observations	52,859	52,859	52,859	52,859
Panel B: 15-25 year old women				
total living children	-0.0366***	-0.0418***	-0.0472***	-0.0512***
	(0.0053)	(0.0049)	(0.0048)	(0.0046)
childless	-0.1297***	-0.1133***	-0.1486***	-0.1325***
	(0.0111)	(0.0107)	(0.0104)	(0.0102)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.246	0.310	0.273	0.335
Number of observations	25,278	25,278	25,278	25,278
Panel C: 26-40 year old women				
total living children	0.0018	0.0012	0.0014	0.0017
	(0.0015)	(0.0015)	(0.0014)	(0.0014)
childless	-0.0182	-0.0072	-0.0104	0.0020
	(0.0112)	(0.0108)	(0.0105)	(0.0102)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.093	0.166	0.098	0.170
Number of observations	24,952	24,952	24,952	24,952
Panel D: 40-49 year old women				
total living children	-0.0027	-0.0022	-0.0034*	-0.0028
	(0.0024)	(0.0022)	(0.0019)	(0.0019)
childless	-0.0601*	-0.0658**	-0.0400	-0.0450*
	(0.0320)	(0.0316)	(0.0255)	(0.0257)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.209	0.279	0.223	0.296
Number of observations	5,419	5,419	5,419	5,419

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. The baseline levels of labour force participation for working at time of survey and working in the preceding 12 months were 0.71 and 0.77 respectively for women aged 15–40. These rates were 0.62 and 0.69 for women aged 15–25, and 0.81 and 0.86 for women aged 26–40, respectively. Mean labour force participation rates for women aged 40–49 in this analysis were 0.89 and 0.91 respectively.

TABLE 3.16: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation for women aged 15–40, by endemicity

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Non-endemic areas												
post-2004 * base under 5 malaria mortality rate	0.0828**	0.4047***	0.1245	0.3327*	-0.1138***	-0.1087*	0.2958*	0.3973*	0.2493***	0.4612***	0.1417	0.3146
	(0.0359)	(0.0545)	(0.1188)	(0.1758)	(0.0410)	(0.0569)	(0.1516)	(0.2238)	(0.0515)	(0.0795)	(0.1538)	(0.2555)
primary education	-0.0237***	0.0000	-0.0167***	0.0000	-0.0138***	0.0000	-0.0100***	0.0000	-0.0266***	0.0000	-0.0149***	0.0000
	(0.0031)	(.)	(0.0028)	(.)	(0.0038)	(.)	(0.0034)	(.)	(0.0040)	(.)	(0.0037)	(.)
secondary education	-0.0658***	0.0000	-0.0584***	0.0000	-0.0794***	0.0000	-0.0719***	0.0000	-0.0430***	0.0000	-0.0307***	0.0000
	(0.0033)	(.)	(0.0032)	(.)	(0.0039)	(.)	(0.0038)	(.)	(0.0054)	(.)	(0.0050)	(.)
higher education	-0.0793***	0.0000	-0.0657***	0.0000	-0.0990***	0.0000	-0.0945***	0.0000	-0.0618***	0.0000	-0.0351**	0.0000
	(0.0068)	(.)	(0.0062)	(.)	(0.0069)	(.)	(0.0064)	(.)	(0.0149)	(.)	(0.0136)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.104	0.144	0.112	0.155	0.061	0.136	0.072	0.152	0.121	0.217	0.134	0.228
Number of observations	254,153	254,153	254,153	254,153	116,672	116,672	116,672	116,672	137,481	137,481	137,481	137,481
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		24,961		24,961		19,678		19,678		15,777		15,777
Panel B: Endemic areas												
post-2004 * base under 5 malaria mortality rate	-0.0379	-0.0547	-0.0374	-0.0101	-0.1520***	-0.2203***	0.0052	0.0354	0.0362	0.0186	-0.0423	-0.0040
	(0.0344)	(0.0563)	(0.0502)	(0.0749)	(0.0376)	(0.0538)	(0.0568)	(0.0848)	(0.0472)	(0.0781)	(0.0676)	(0.1076)
primary education	-0.0227***	0.0000	-0.0219***	0.0000	-0.0175***	0.0000	-0.0183***	0.0000	-0.0280***	0.0000	-0.0268***	0.0000
	(0.0021)	(.)	(0.0020)	(.)	(0.0027)	(.)	(0.0026)	(.)	(0.0031)	(.)	(0.0030)	(.)
secondary education	-0.0730***	0.0000	-0.0714***	0.0000	-0.0899***	0.0000	-0.0903***	0.0000	-0.0684***	0.0000	-0.0667***	0.0000
	(0.0030)	(.)	(0.0028)	(.)	(0.0035)	(.)	(0.0034)	(.)	(0.0055)	(.)	(0.0053)	(.)
higher education	-0.1001***	0.0000	-0.0983***	0.0000	-0.1178***	0.0000	-0.1177***	0.0000	-0.1040***	0.0000	-0.0975***	0.0000
	(0.0055)	(.)	(0.0056)	(.)	(0.0063)	(.)	(0.0061)	(.)	(0.0172)	(.)	(0.0178)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.110	0.141	0.116	0.151	0.069	0.153	0.078	0.164	0.130	0.215	0.139	0.223
Number of observations	342,903	342,903	342,903	342,903	168,080	168,080	168,080	168,080	174,823	174,823	174,823	174,823
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		30,581		30,581		26,171		26,171		19,849		19,849

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth in non-endemic areas was 0.15, 0.07 for women who were likely to give birth to their first child, and 0.24 for women who were likely to have higher order births. In endemic areas, the average probability of birth was 0.15, 0.07 for women who were likely to give birth to their first child, and 0.25 for women who were likely to have higher order births.

TABLE 3.17: Labour force participation as a function of exposure to the malaria intervention: results for non-endemic areas

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0545***	-0.0472***	-0.0584***	-0.0526***
	(0.0067)	(0.0085)	(0.0066)	(0.0082)
primary education	-0.0237**	-0.0240***	-0.0286***	-0.0298***
	(0.0093)	(0.0081)	(0.0085)	(0.0071)
secondary education	-0.1267***	-0.1066***	-0.1386***	-0.1197***
	(0.0136)	(0.0124)	(0.0130)	(0.0115)
higher education	0.0129	0.0512*	-0.0087	0.0275
	(0.0281)	(0.0288)	(0.0262)	(0.0271)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.250	0.297	0.265	0.312
Number of observations	22,895	22,895	22,895	22,895
Panel B: 15-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0377***	-0.0298	-0.0388***	-0.0284
	(0.0084)	(0.0182)	(0.0087)	(0.0178)
primary education	-0.0909***	-0.0825***	-0.1088***	-0.0972***
	(0.0234)	(0.0221)	(0.0226)	(0.0209)
secondary education	-0.2806***	-0.2638***	-0.3078***	-0.2878***
	(0.0266)	(0.0257)	(0.0266)	(0.0250)
higher education	-0.1842***	-0.1464***	-0.2322***	-0.1936***
	(0.0523)	(0.0528)	(0.0528)	(0.0527)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.271	0.319	0.288	0.335
Number of observations	7,995	7,995	7,995	7,995
Panel C: 15-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0721***	-0.0644***	-0.0771***	-0.0730***
	(0.0082)	(0.0106)	(0.0077)	(0.0097)
primary education	-0.0026	-0.0087	-0.0023	-0.0100
	(0.0095)	(0.0084)	(0.0082)	(0.0072)
secondary education	-0.0068	0.0154	-0.0109	0.0097
	(0.0150)	(0.0144)	(0.0136)	(0.0126)
higher education	0.1311***	0.1575***	0.1150***	0.1377***
	(0.0306)	(0.0310)	(0.0291)	(0.0302)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.178	0.246	0.181	0.250
Number of observations	14,900	14,900	14,900	14,900

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in non-endemic areas were 0.58 and 0.66 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.46 and 0.54 respectively for women without children, and 0.66 and 0.73 respectively for women with children.

TABLE 3.18: Labour force participation as a function of exposure to the malaria intervention: results for endemic areas

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0030	-0.0110*	0.0010	-0.0018
	(0.0062)	(0.0067)	(0.0060)	(0.0067)
primary education	-0.0177**	-0.0048	-0.0203***	-0.0094
	(0.0083)	(0.0071)	(0.0076)	(0.0064)
secondary education	-0.2133***	-0.1606***	-0.2261***	-0.1779***
	(0.0126)	(0.0117)	(0.0120)	(0.0112)
higher education	-0.0897***	-0.0277	-0.1086***	-0.0501
	(0.0333)	(0.0321)	(0.0332)	(0.0324)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.213	0.262	0.229	0.277
Number of observations	29,964	29,964	29,964	29,964
Panel B: 15-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	0.0006	0.0090	0.0039	0.0167
	(0.0079)	(0.0112)	(0.0081)	(0.0111)
primary education	-0.1021***	-0.0822***	-0.1239***	-0.1015***
	(0.0201)	(0.0198)	(0.0183)	(0.0179)
secondary education	-0.3900***	-0.3416***	-0.4278***	-0.3785***
	(0.0240)	(0.0238)	(0.0228)	(0.0224)
higher education	-0.3460***	-0.2966***	-0.3868***	-0.3382***
	(0.0559)	(0.0566)	(0.0573)	(0.0573)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.298	0.343	0.317	0.361
Number of observations	8,654	8,654	8,654	8,654
Panel C: 15-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0002	-0.0130	0.0039	-0.0027
	(0.0075)	(0.0080)	(0.0069)	(0.0075)
primary education	0.0039	0.0128*	0.0055	0.0119*
	(0.0084)	(0.0072)	(0.0074)	(0.0062)
secondary education	-0.0518***	0.0051	-0.0535***	-0.0026
	(0.0138)	(0.0132)	(0.0124)	(0.0118)
higher education	0.0564	0.1086***	0.0443	0.0920***
	(0.0368)	(0.0346)	(0.0354)	(0.0331)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.119	0.191	0.123	0.196
Number of observations	21,310	21,310	21,310	21,310

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in endemic areas were 0.88 and 0.92 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.73 and 0.79 respectively for women without children, and 0.93 and 0.96 respectively for women with children.

TABLE 3.19: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation for women aged 15–25, by endemicity

		probability of birth				probability of first birth				probability of higher order birth		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Non-endemic areas												
post-2004 * base under 5 malaria mortality rate	-0.0015	0.1740**	0.1976	0.5279*	-0.1280***	-0.2580***	0.2969**	0.7872***	0.3811***	0.4623***	0.4291*	0.5586
	(0.0356)	(0.0706)	(0.1334)	(0.2715)	(0.0378)	(0.0671)	(0.1433)	(0.2636)	(0.0797)	(0.1636)	(0.2463)	(0.6610)
primary education	-0.0260***	0.0000	-0.0211***	0.0000	-0.0190***	0.0000	-0.0146***	0.0000	-0.0302***	0.0000	-0.0197***	0.0000
	(0.0035)	(.)	(0.0032)	(.)	(0.0043)	(.)	(0.0039)	(.)	(0.0055)	(.)	(0.0052)	(.)
secondary education	-0.0869***	0.0000	-0.0807***	0.0000	-0.0919***	0.0000	-0.0840***	0.0000	-0.0414***	0.0000	-0.0331***	0.0000
	(0.0039)	(.)	(0.0039)	(.)	(0.0044)	(.)	(0.0043)	(.)	(0.0089)	(.)	(0.0085)	(.)
higher education	-0.1312***	0.0000	-0.1216***	0.0000	-0.1348***	0.0000	-0.1289***	0.0000	-0.1089***	0.0000	-0.0792***	0.0000
	(0.0061)	(.)	(0.0061)	(.)	(0.0067)	(.)	(0.0064)	(.)	(0.0280)	(.)	(0.0290)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.119	0.161	0.126	0.176	0.070	0.139	0.081	0.161	0.159	0.345	0.179	0.368
Number of observations	145,909	145,909	145,909	145,909	97,079	97,079	97,079	97,079	48,830	48,830	48,830	48,830
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		21,717		21,717		19,267		19,267		11,247		11,247
Panel B: Endemic areas												
post-2004 * base under 5 malaria mortality rate	-0.1018***	-0.2299***	-0.0188	-0.0104	-0.1442***	-0.2914***	0.0533	0.1656	0.0097	-0.2614	-0.1340	-0.5940**
	(0.0344)	(0.0695)	(0.0526)	(0.1183)	(0.0398)	(0.0726)	(0.0586)	(0.1193)	(0.0709)	(0.1711)	(0.1047)	(0.2536)
primary education	-0.0222***	0.0000	-0.0219***	0.0000	-0.0218***	0.0000	-0.0229***	0.0000	-0.0247***	0.0000	-0.0239***	0.0000
	(0.0026)	(.)	(0.0025)	(.)	(0.0032)	(.)	(0.0031)	(.)	(0.0046)	(.)	(0.0045)	(.)
secondary education	-0.0901***	0.0000	-0.0885***	0.0000	-0.1006***	0.0000	-0.1013***	0.0000	-0.0758***	0.0000	-0.0726***	0.0000
	(0.0033)	(.)	(0.0031)	(.)	(0.0039)	(.)	(0.0037)	(.)	(0.0080)	(.)	(0.0079)	(.)
higher education	-0.1356***	0.0000	-0.1337***	0.0000	-0.1394***	0.0000	-0.1398***	0.0000	-0.1838***	0.0000	-0.1745***	0.0000
	(0.0056)	(.)	(0.0057)	(.)	(0.0066)	(.)	(0.0066)	(.)	(0.0407)	(.)	(0.0431)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.120	0.168	0.126	0.182	0.072	0.154	0.080	0.170	0.167	0.348	0.183	0.369
Number of observations	197,523	197,523	197,523	197,523	131,183	131,183	131,183	131,183	66,340	66,340	66,340	66,340
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		27,978		27,978		25,498		25,498		14,955		14,955

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 25 between 1992 and 2016. Between 1992 and 2003, the average probability of birth for women aged 15–25 in both endemic and non-endemic areas was 0.14, 0.08 for women who were likely to give birth to their first child, and 0.27 for women who were likely to have higher order births.

TABLE 3.20: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation for women aged 26–40, by endemicity

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Non-endemic areas												
post-2004 * base under 5 malaria mortality rate	0.1807***	0.4843***	0.0332	-0.0526	0.0976	0.2357**	-0.1009	-0.2291	0.2083***	0.5422***	0.1052	-0.0214
	(0.0523)	(0.0730)	(0.1685)	(0.2461)	(0.0866)	(0.0980)	(0.3299)	(0.3612)	(0.0564)	(0.0906)	(0.1766)	(0.3127)
primary education	-0.0202***	0.0000	-0.0092**	0.0000	0.0051	0.0000	0.0070	0.0000	-0.0225***	0.0000	-0.0106**	0.0000
	(0.0040)	(.)	(0.0038)	(.)	(0.0069)	(.)	(0.0069)	(.)	(0.0046)	(.)	(0.0044)	(.)
secondary education	-0.0239***	0.0000	-0.0135***	0.0000	0.0085	0.0000	0.0127	0.0000	-0.0343***	0.0000	-0.0211***	0.0000
	(0.0051)	(.)	(0.0049)	(.)	(0.0091)	(.)	(0.0094)	(.)	(0.0060)	(.)	(0.0058)	(.)
higher education	-0.0010	0.0000	0.0191*	0.0000	0.0419*	0.0000	0.0414*	0.0000	-0.0315**	0.0000	-0.0065	0.0000
	(0.0127)	(.)	(0.0115)	(.)	(0.0224)	(.)	(0.0218)	(.)	(0.0157)	(.)	(0.0146)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.111	0.213	0.124	0.224	0.126	0.130	0.164	0.166	0.108	0.229	0.122	0.241
Number of observations	108,244	108,244	108,244	108,244	19,593	19,593	19,593	19,593	88,651	88,651	88,651	88,651
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		13,345		13,345		2,895		2,895		11,818		11,818
Panel B: Endemic areas												
post-2004 * base under 5 malaria mortality rate	0.0365	0.0499	-0.0221	0.0585	-0.1915***	-0.0397	-0.0961	-0.0217	0.0472	0.0635	0.0114	0.0959
	(0.0459)	(0.0694)	(0.0667)	(0.1024)	(0.0682)	(0.0721)	(0.1106)	(0.1169)	(0.0497)	(0.0907)	(0.0737)	(0.1334)
primary education	-0.0214***	0.0000	-0.0204***	0.0000	-0.0028	0.0000	-0.0046	0.0000	-0.0270***	0.0000	-0.0266***	0.0000
	(0.0029)	(.)	(0.0029)	(.)	(0.0040)	(.)	(0.0040)	(.)	(0.0037)	(.)	(0.0037)	(.)
secondary education	-0.0336***	0.0000	-0.0328***	0.0000	-0.0118	0.0000	-0.0115	0.0000	-0.0563***	0.0000	-0.0543***	0.0000
	(0.0052)	(.)	(0.0052)	(.)	(0.0077)	(.)	(0.0076)	(.)	(0.0066)	(.)	(0.0067)	(.)
higher education	-0.0277**	0.0000	-0.0283**	0.0000	-0.0255	0.0000	-0.0236	0.0000	-0.0713***	0.0000	-0.0661***	0.0000
	(0.0118)	(.)	(0.0122)	(.)	(0.0206)	(.)	(0.0208)	(.)	(0.0176)	(.)	(0.0180)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.118	0.204	0.128	0.213	0.128	0.137	0.155	0.163	0.113	0.226	0.125	0.236
Number of observations	145,380	145,380	145,380	145,380	36,897	36,897	36,897	36,897	108,483	108,483	108,483	108,483
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		16,414		16,414		4,717		4,717		14,214		14,214

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 26 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth in non-endemic areas was 0.18, 0.02 for women who were likely to give birth to their first child, and 0.23 for women who were likely to have higher order births. In endemic areas, the average probability of birth was 0.15, 0.01 for women who were likely to give birth to their first child, and 0.23 for women who were likely to have higher order births.

TABLE 3.21: Labour force participation as a function of exposure to the malaria intervention: results for women aged 15–25 in non-endemic areas

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-25 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0457***	-0.0322*	-0.0476***	-0.0199
	(0.0080)	(0.0185)	(0.0078)	(0.0187)
primary education	-0.0894***	-0.0801***	-0.0949***	-0.0834***
	(0.0153)	(0.0136)	(0.0145)	(0.0127)
secondary education	-0.2954***	-0.2693***	-0.3156***	-0.2870***
	(0.0192)	(0.0174)	(0.0193)	(0.0172)
higher education	-0.3553***	-0.3153***	-0.3949***	-0.3519***
	(0.0687)	(0.0690)	(0.0701)	(0.0693)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.281	0.337	0.304	0.357
Number of observations	11,055	11,055	11,055	11,055
Panel B: 15-25 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0326***	-0.0314	-0.0319***	-0.0193
	(0.0087)	(0.0238)	(0.0090)	(0.0239)
primary education	-0.1405***	-0.1300***	-0.1608***	-0.1461***
	(0.0257)	(0.0241)	(0.0245)	(0.0225)
secondary education	-0.3881***	-0.3716***	-0.4248***	-0.4036***
	(0.0291)	(0.0275)	(0.0288)	(0.0267)
higher education	-0.4657***	-0.4371***	-0.5523***	-0.5198***
	(0.0773)	(0.0805)	(0.0828)	(0.0853)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.283	0.336	0.304	0.355
Number of observations	6,950	6,950	6,950	6,950
Panel C: 15-25 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0791***	-0.0336	-0.0839***	-0.0137
	(0.0130)	(0.0340)	(0.0117)	(0.0321)
primary education	-0.0465**	-0.0367**	-0.0389**	-0.0315*
	(0.0199)	(0.0183)	(0.0186)	(0.0173)
secondary education	-0.0912***	-0.0515*	-0.0974***	-0.0576*
	(0.0305)	(0.0302)	(0.0297)	(0.0300)
higher education	-0.0599	-0.0535	-0.0231	-0.0274
	(0.2130)	(0.1900)	(0.1998)	(0.1786)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.306	0.411	0.310	0.410
Number of observations	4,105	4,105	4,105	4,105

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in non-endemic areas were 0.44 and 0.52 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.40 and 0.48 respectively for women without children, and 0.53 and 0.59 respectively for women with children.

TABLE 3.22: Labour force participation as a function of exposure to the malaria intervention: results for women aged 15–25 in endemic areas

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-25 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0006	0.0040	0.0048	0.0150*
	(0.0067)	(0.0089)	(0.0067)	(0.0089)
primary education	-0.0714***	-0.0516***	-0.0843***	-0.0655***
	(0.0121)	(0.0113)	(0.0111)	(0.0102)
secondary education	-0.3654***	-0.3030***	-0.3929***	-0.3340***
	(0.0165)	(0.0157)	(0.0161)	(0.0152)
higher education	-0.4807***	-0.3997***	-0.5344***	-0.4555***
	(0.0690)	(0.0664)	(0.0687)	(0.0663)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.275	0.327	0.300	0.352
Number of observations	14,223	14,223	14,223	14,223
Panel B: 15-25 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0014	0.0065	0.0021	0.0152
	(0.0082)	(0.0121)	(0.0083)	(0.0120)
primary education	-0.1409***	-0.1167***	-0.1662***	-0.1389***
	(0.0220)	(0.0223)	(0.0199)	(0.0199)
secondary education	-0.4745***	-0.4233***	-0.5191***	-0.4665***
	(0.0263)	(0.0265)	(0.0251)	(0.0250)
higher education	-0.6403***	-0.5916***	-0.7077***	-0.6594***
	(0.0786)	(0.0806)	(0.0816)	(0.0817)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.309	0.359	0.326	0.376
Number of observations	7,646	7,646	7,646	7,646
Panel C: 15-25 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	0.0033	0.0058	0.0096	0.0178
	(0.0099)	(0.0128)	(0.0091)	(0.0119)
primary education	-0.0097	0.0037	-0.0140	-0.0014
	(0.0135)	(0.0127)	(0.0119)	(0.0110)
secondary education	-0.1294***	-0.0599**	-0.1346***	-0.0716***
	(0.0244)	(0.0241)	(0.0235)	(0.0229)
higher education	-0.0595	0.0275	-0.1100	-0.0166
	(0.1780)	(0.1276)	(0.1663)	(0.1195)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.210	0.300	0.219	0.311
Number of observations	6,577	6,577	6,577	6,577

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in endemic areas were 0.78 and 0.83 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.71 and 0.75 respectively for women without children, and 0.83 and 0.90 respectively for women with children.

TABLE 3.23: Labour force participation as a function of exposure to the malaria intervention: results for women aged 26–40 in non-endemic areas

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 26-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0609***	-0.0556***	-0.0619***	-0.0630***
	(0.0100)	(0.0149)	(0.0093)	(0.0141)
primary education	0.0205*	0.0125	0.0194**	0.0101
	(0.0105)	(0.0102)	(0.0094)	(0.0090)
secondary education	0.0305*	0.0502***	0.0256*	0.0451***
	(0.0163)	(0.0164)	(0.0147)	(0.0144)
higher education	0.1405***	0.1755***	0.1117***	0.1449***
	(0.0257)	(0.0281)	(0.0234)	(0.0262)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.156	0.211	0.160	0.216
Number of observations	10,705	10,705	10,705	10,705
Panel B: 26-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.1544**	-0.1211	-0.1393**	-0.0934
	(0.0743)	(0.1085)	(0.0650)	(0.0984)
primary education	0.1271	0.1651	0.1326	0.1585
	(0.1000)	(0.1143)	(0.0923)	(0.1139)
secondary education	0.1351	0.1656	0.1180	0.1535
	(0.1121)	(0.1270)	(0.0983)	(0.1158)
higher education	0.2412*	0.3389**	0.2075*	0.3138*
	(0.1328)	(0.1695)	(0.1193)	(0.1610)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.588	0.680	0.586	0.673
Number of observations	841	841	841	841
Panel C: 26-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0552***	-0.0478***	-0.0575***	-0.0550***
	(0.0105)	(0.0166)	(0.0098)	(0.0156)
primary education	0.0164	0.0093	0.0139	0.0054
	(0.0105)	(0.0100)	(0.0092)	(0.0087)
secondary education	0.0281*	0.0494***	0.0215	0.0424***
	(0.0169)	(0.0170)	(0.0151)	(0.0150)
higher education	0.1340***	0.1655***	0.1113***	0.1385***
	(0.0292)	(0.0303)	(0.0265)	(0.0276)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.159	0.218	0.162	0.222
Number of observations	9,864	9,864	9,864	9,864

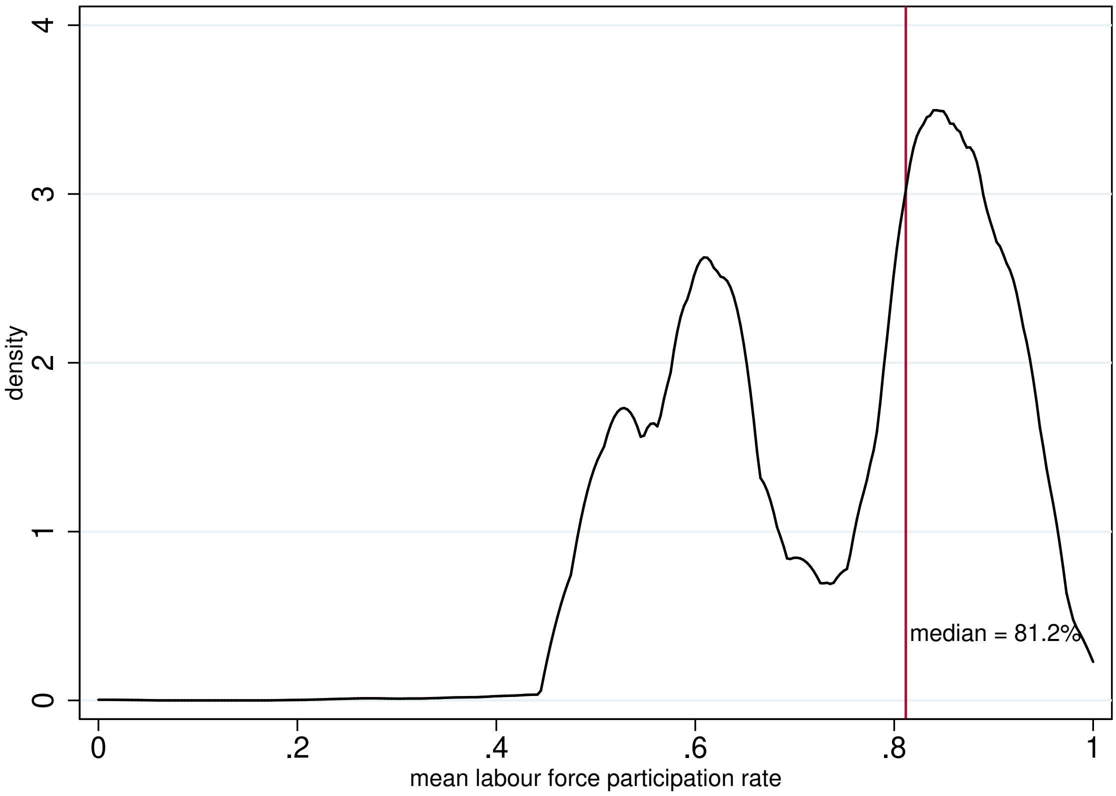
Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in non-endemic areas were 0.72 and 0.79 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.76 and 0.83 respectively for women without children, and 0.71 and 0.78 respectively for women with children.

TABLE 3.24: Labour force participation as a function of exposure to the malaria intervention: results for women aged 26–40 in endemic areas

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 26-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0026	-0.0184*	-0.0007	-0.0097
	(0.0090)	(0.0103)	(0.0082)	(0.0095)
primary education	0.0152*	0.0202**	0.0162**	0.0186***
	(0.0092)	(0.0079)	(0.0081)	(0.0069)
secondary education	-0.0062	0.0477***	-0.0062	0.0415***
	(0.0159)	(0.0151)	(0.0141)	(0.0135)
higher education	0.0832**	0.1393***	0.0834***	0.1335***
	(0.0336)	(0.0317)	(0.0293)	(0.0289)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.111	0.181	0.119	0.188
Number of observations	14,247	14,247	14,247	14,247
Panel B: 26-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0130	0.0839	0.0169	0.0920
	(0.0559)	(0.1061)	(0.0511)	(0.0985)
primary education	0.0010	-0.0502	0.0586	0.0275
	(0.0704)	(0.0889)	(0.0616)	(0.0755)
secondary education	0.0090	0.0897	0.0790	0.1620
	(0.1023)	(0.1209)	(0.0908)	(0.1035)
higher education	0.0751	0.1442	0.1493	0.2155*
	(0.1468)	(0.1555)	(0.1255)	(0.1274)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.543	0.689	0.569	0.703
Number of observations	821	821	821	821
Panel C: 26-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0019	-0.0228**	-0.0001	-0.0138
	(0.0094)	(0.0106)	(0.0087)	(0.0099)
primary education	0.0133	0.0183**	0.0139*	0.0165**
	(0.0095)	(0.0081)	(0.0084)	(0.0071)
secondary education	-0.0117	0.0418***	-0.0145	0.0328**
	(0.0165)	(0.0156)	(0.0147)	(0.0140)
higher education	0.0845**	0.1275***	0.0750**	0.1145***
	(0.0371)	(0.0348)	(0.0363)	(0.0341)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.116	0.188	0.123	0.196
Number of observations	13,426	13,426	13,426	13,426

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in endemic areas were 0.96 and 0.99 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.8 and almost 1 (for sample<10) respectively for women without children, and 0.97 and 0.98 respectively for women with children.

FIGURE 3.14: Distribution of female labour force participation rates in the 1999 DHS survey clusters



Notes: The map shows the distribution of the proportion of women aged 15-49 in the DHS clusters who were working at the time of survey interview in 1999.

TABLE 3.25: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation by local baseline labour force participation rates

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Controlling for high LFP clusters												
post-2004 * base under 5 malaria mortality rate	0.0702***	0.2368***	-0.0510	0.0319	-0.0297	-0.0321	0.0215	0.1023	0.1190***	0.2791***	-0.0886	0.0172
	(0.0254)	(0.0423)	(0.0408)	(0.0682)	(0.0270)	(0.0423)	(0.0473)	(0.0802)	(0.0373)	(0.0604)	(0.0583)	(0.0995)
post2004 * high LFP cluster	0.0109***	0.0290***	-0.2411**	0.3218***	0.0295***	0.0455***	0.0181	0.1430	-0.0013	0.0238***	-0.1254	0.0697
	(0.0030)	(0.0048)	(0.0961)	(0.0363)	(0.0033)	(0.0047)	(0.0199)	(14.5369)	(0.0041)	(0.0065)	(52.7145)	(.)
primary education	-0.0262***	0.0000	-0.0219***	0.0000	-0.0167***	0.0000	-0.0158***	0.0000	-0.0315***	0.0000	-0.0252***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0021)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0726***	0.0000	-0.0688***	0.0000	-0.0841***	0.0000	-0.0829***	0.0000	-0.0623***	0.0000	-0.0560***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0026)	(.)	(0.0025)	(.)	(0.0038)	(.)	(0.0037)	(.)
higher education	-0.0944***	0.0000	-0.0839***	0.0000	-0.1024***	0.0000	-0.1014***	0.0000	-0.0961***	0.0000	-0.0745***	0.0000
	(0.0040)	(.)	(0.0043)	(.)	(0.0044)	(.)	(0.0045)	(.)	(0.0102)	(.)	(0.0101)	(.)
R-squared	0.103	0.142	0.110	0.151	0.059	0.145	0.065	0.154	0.118	0.215	0.130	0.222
Number of observations	593,749	593,749	593,749	593,749	283,442	283,442	283,442	283,442	310,307	310,307	310,307	310,307
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,141		55,141		45,570		45,570		35,404		35,404
Panel B: Triple difference: high LFP clusters												
post-2004 * base under 5 malaria mortality rate	0.0955***	0.3034***	0.0149	0.1266	-0.0535*	-0.0529	0.0121	0.1147	0.2004***	0.3972***	0.0018	0.0965
	(0.0288)	(0.0480)	(0.0492)	(0.0833)	(0.0297)	(0.0470)	(0.0528)	(0.0906)	(0.0440)	(0.0665)	(0.0713)	(0.1230)
post2004 * high LFP cluster	0.0194***	0.0519***	-0.2260**	0.3365***	0.0205***	0.0374***	0.0173	0.1455	0.0236***	0.0631***	-0.0870	0.0906
	(0.0057)	(0.0091)	(0.0948)	(0.0367)	(0.0060)	(0.0089)	(0.0199)	(.)	(0.0082)	(0.0125)	(24.9069)	(61.7976)
post2004 * u5mort * high LFP cluster	-0.1164*	-0.3171***	-0.2433***	-0.3589**	0.1249*	0.1142	0.0397	-0.0563	-0.3388***	-0.5356***	-0.3014**	-0.2770
	(0.0646)	(0.1046)	(0.0919)	(0.1499)	(0.0667)	(0.1049)	(0.1156)	(0.2020)	(0.0899)	(0.1530)	(0.1313)	(0.2194)
primary education	-0.0262***	0.0000	-0.0219***	0.0000	-0.0168***	0.0000	-0.0158***	0.0000	-0.0316***	0.0000	-0.0253***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0021)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0728***	0.0000	-0.0688***	0.0000	-0.0840***	0.0000	-0.0829***	0.0000	-0.0630***	0.0000	-0.0561***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0026)	(.)	(0.0025)	(.)	(0.0038)	(.)	(0.0037)	(.)
higher education	-0.0944***	0.0000	-0.0839***	0.0000	-0.1024***	0.0000	-0.1014***	0.0000	-0.0963***	0.0000	-0.0745***	0.0000
	(0.0040)	(.)	(0.0043)	(.)	(0.0044)	(.)	(0.0045)	(.)	(0.0102)	(.)	(0.0101)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
post2004 * base u5 mortality: high LFP clusters	-0.021	-0.014	-0.228***	-0.232*	0.071	0.061	0.052	0.058	-0.138*	-0.138	-0.300***	-0.181
	(0.057)	(0.092)	(0.076)	(0.122)	(0.060)	(0.095)	(0.103)	(0.179)	(0.076)	(0.139)	(0.108)	(0.178)
R-squared	0.103	0.142	0.110	0.151	0.059	0.145	0.065	0.154	0.119	0.215	0.130	0.222
Number of observations	593,749	593,749	593,749	593,749	283,442	283,442	283,442	283,442	310,307	310,307	310,307	310,307
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,141		55,141		45,570		45,570		35,404		35,404

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016, born between 1952 and 2001. High baseline LFP is a variable that takes the value one if the woman lives in a DHS cluster where labour force participation in 1999 was higher than the median for all clusters. Between 1992 and 2003, the average probability of birth in clusters where baseline LFP was higher (lower) than the 1999 median was 0.17 (0.16), 0.09 (0.08) for women who were likely to give birth to their first child, and 0.25 (0.24) for women who were likely to have higher order births.

TABLE 3.26: Labour force participation as a function of exposure to the malaria intervention: results for women controlling for baseline LFP in women aged 15-40

	currently working				worked in the last 12 months			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: 15-40 year old women								
fertile years post-2004 * base u5 malaria mortrate	-0.0031	-0.0129**	-0.0035	-0.0188***	-0.0055	-0.0078	-0.0081*	-0.0142**
	(0.0040)	(0.0051)	(0.0046)	(0.0064)	(0.0039)	(0.0050)	(0.0046)	(0.0063)
fertile years post-2004 * high base FLFP cluster	0.0085***	0.0089***	0.0084***	0.0074***	0.0082***	0.0094***	0.0074***	0.0078***
	(0.0005)	(0.0007)	(0.0008)	(0.0011)	(0.0005)	(0.0007)	(0.0008)	(0.0011)
fertile years post-2004 * base u5mort * high base FLFP cluster			0.0018	0.0184*			0.0106	0.0203*
			(0.0080)	(0.0109)			(0.0079)	(0.0109)
primary education	-0.0131**	-0.0120**	-0.0131**	-0.0118**	-0.0167***	-0.0176***	-0.0168***	-0.0173***
	(0.0060)	(0.0055)	(0.0060)	(0.0055)	(0.0055)	(0.0048)	(0.0055)	(0.0049)
secondary education	-0.1585***	-0.1371***	-0.1584***	-0.1368***	-0.1718***	-0.1523***	-0.1713***	-0.1519***
	(0.0093)	(0.0086)	(0.0093)	(0.0086)	(0.0091)	(0.0081)	(0.0091)	(0.0081)
higher education	-0.0071	0.0130	-0.0072	0.0134	-0.0270	-0.0131	-0.0273	-0.0127
	(0.0219)	(0.0215)	(0.0219)	(0.0215)	(0.0203)	(0.0201)	(0.0204)	(0.0201)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high LFP clusters			-0.002	-0.000			0.003	0.006
			(0.007)	(0.009)			(0.007)	(0.009)
R-squared	0.223	0.266	0.223	0.266	0.240	0.281	0.240	0.281
Number of observations	52,859	52,859	52,859	52,859	52,859	52,859	52,859	52,859
Panel B: 15-40 year old women without children								
fertile years post-2004 * base u5 malaria mortrate	-0.0055	-0.0036	-0.0048	-0.0064	-0.0056	0.0029	-0.0063	0.0014
	(0.0050)	(0.0082)	(0.0057)	(0.0100)	(0.0050)	(0.0082)	(0.0058)	(0.0101)
fertile years post-2004 * high base FLFP cluster	0.0058***	0.0070***	0.0061***	0.0063***	0.0056***	0.0078***	0.0054***	0.0075***
	(0.0006)	(0.0018)	(0.0011)	(0.0022)	(0.0005)	(0.0017)	(0.0011)	(0.0021)
fertile years post-2004 * base u5mort * high base FLFP cluster			-0.0036	0.0087			0.0031	0.0047
			(0.0119)	(0.0182)			(0.0119)	(0.0176)
primary education	-0.0953***	-0.0839***	-0.0953***	-0.0838***	-0.1158***	-0.1047***	-0.1158***	-0.1047***
	(0.0143)	(0.0138)	(0.0143)	(0.0138)	(0.0133)	(0.0125)	(0.0132)	(0.0126)
secondary education	-0.3363***	-0.3132***	-0.3364***	-0.3131***	-0.3696***	-0.3468***	-0.3694***	-0.3467***
	(0.0172)	(0.0166)	(0.0172)	(0.0166)	(0.0166)	(0.0158)	(0.0166)	(0.0158)
higher education	-0.2359***	-0.2181***	-0.2357***	-0.2179***	-0.2782***	-0.2666***	-0.2783***	-0.2665***
	(0.0364)	(0.0357)	(0.0364)	(0.0357)	(0.0363)	(0.0354)	(0.0363)	(0.0354)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high LFP clusters			-0.008	0.002			-0.003	0.006
			(0.010)	(0.015)			(0.010)	(0.014)
R-squared	0.249	0.294	0.249	0.294	0.268	0.313	0.268	0.313
Number of observations	16,649	16,649	16,649	16,649	16,649	16,649	16,649	16,649
Panel C: 15-40 year old women with children								
fertile years post-2004 * base u5 malaria mortrate	-0.0010	-0.0157**	-0.0017	-0.0239***	-0.0043	-0.0110*	-0.0080	-0.0202***
	(0.0050)	(0.0062)	(0.0061)	(0.0082)	(0.0048)	(0.0058)	(0.0060)	(0.0076)
fertile years post-2004 * high base FLFP cluster	0.0095***	0.0102***	0.0093***	0.0084***	0.0089***	0.0099***	0.0079***	0.0078***
	(0.0006)	(0.0008)	(0.0009)	(0.0012)	(0.0005)	(0.0007)	(0.0009)	(0.0012)
fertile years post-2004 * base u5mort * high base FLFP cluster			0.0024	0.0230**			0.0126	0.0260**
			(0.0088)	(0.0115)			(0.0082)	(0.0110)
primary education	0.0083	0.0055	0.0083	0.0058	0.0089	0.0039	0.0087	0.0041
	(0.0060)	(0.0055)	(0.0061)	(0.0055)	(0.0055)	(0.0047)	(0.0055)	(0.0047)
secondary education	-0.0218**	0.0073	-0.0216**	0.0075	-0.0271***	-0.0005	-0.0264***	-0.0003
	(0.0100)	(0.0097)	(0.0100)	(0.0097)	(0.0094)	(0.0087)	(0.0094)	(0.0087)
higher education	0.1062***	0.1273***	0.1061***	0.1279***	0.0891***	0.1047***	0.0887***	0.1054***
	(0.0224)	(0.0224)	(0.0224)	(0.0224)	(0.0214)	(0.0215)	(0.0214)	(0.0215)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high LFP clusters			0.001	-0.001			0.005	0.006
			(0.007)	(0.009)			(0.006)	(0.008)
R-squared	0.133	0.196	0.133	0.196	0.137	0.200	0.138	0.200
Number of observations	36,210	36,210	36,210	36,210	36,210	36,210	36,210	36,210

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. High baseline LFP is a variable that takes the value one if the woman lives in a DHS cluster where labour force participation in 1999 was higher than the median for all clusters. Baseline labour force participation rates in 1999 for women in clusters with high baseline LFP were 0.89 and 0.92 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.56 and 0.65 respectively for women in clusters with LFP rates lower than the median for all clusters in 1999.

TABLE 3.27: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation by women's education level

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: 15-40 year old women with lower than secondary education												
post-2004 * base under 5 malaria mortality rate	0.0451	0.1548***	-0.1287***	-0.1176	-0.0761**	0.0388	-0.0072	0.0595	0.0772*	0.2253***	-0.1620***	-0.0909
	(0.0299)	(0.0468)	(0.0481)	(0.0752)	(0.0353)	(0.0476)	(0.0628)	(0.0955)	(0.0394)	(0.0633)	(0.0622)	(0.1052)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.105	0.153	0.112	0.163	0.066	0.174	0.074	0.181	0.122	0.218	0.134	0.226
Number of observations	493,381	493,381	493,381	493,381	214,327	214,327	214,327	214,327	279,054	279,054	279,054	279,054
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		44,011		44,011		35,178		35,178		31,194		31,194
Panel B: 15-40 year old women with secondary or higher education												
post-2004 * base under 5 malaria mortality rate	0.1247***	0.5925***	0.1809***	0.5578***	-0.0311	0.0328	0.0881	0.2269**	0.5599***	0.7619***	0.3882**	0.7373***
	(0.0301)	(0.0489)	(0.0648)	(0.1049)	(0.0285)	(0.0558)	(0.0621)	(0.1082)	(0.0742)	(0.1112)	(0.1598)	(0.2418)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.089	0.099	0.096	0.109	0.051	0.100	0.063	0.115	0.108	0.201	0.132	0.221
Number of observations	103,675	103,675	103,675	103,675	70,425	70,425	70,425	70,425	33,250	33,250	33,250	33,250
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		11,531		11,531		10,671		10,671		4,432		4,432

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth for more (less) educated women was 0.11 (0.17), 0.05 (0.09) for women who were likely to give birth to their first child, and 0.21 (0.25) for women who were likely to have higher order births.

TABLE 3.28: Labour force participation as a function of exposure to the malaria intervention: results by women's education level

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A1: 15-40 year old women with lower than secondary education				
fertile years post-2004 * base u5 malaria mortrate	-0.0359***	-0.0320***	-0.0379***	-0.0278***
	(0.0049)	(0.0058)	(0.0049)	(0.0056)
R-squared	0.153	0.230	0.161	0.237
Number of observations	42,043	42,043	42,043	42,043
Panel A2: 15-40 year old women with secondary or higher education				
fertile years post-2004 * base u5 malaria mortrate	0.0013	0.0330***	0.0025	0.0400***
	(0.0061)	(0.0091)	(0.0063)	(0.0092)
R-squared	0.312	0.342	0.323	0.357
Number of observations	10,816	10,816	10,816	10,816
Panel B1: 15-40 year old childless women with lower than secondary education				
fertile years post-2004 * base u5 malaria mortrate	-0.0468***	-0.0133	-0.0481***	-0.0102
	(0.0063)	(0.0104)	(0.0063)	(0.0100)
R-squared	0.221	0.293	0.236	0.308
Number of observations	10,392	10,392	10,392	10,392
Panel B2: 15-40 year old childless women with secondary or higher education				
fertile years post-2004 * base u5 malaria mortrate	0.0166**	0.0181	0.0170**	0.0286**
	(0.0071)	(0.0128)	(0.0072)	(0.0130)
R-squared	0.320	0.364	0.331	0.378
Number of observations	6,257	6,257	6,257	6,257
Panel C1: 15-40 year old mothers with lower than secondary education				
fertile years post-2004 * base u5 malaria mortrate	-0.0218***	-0.0261***	-0.0231***	-0.0199***
	(0.0056)	(0.0067)	(0.0054)	(0.0063)
R-squared	0.108	0.203	0.110	0.205
Number of observations	31,651	31,651	31,651	31,651
Panel C2: 15-40 year old mothers with secondary or higher education				
fertile years post-2004 * base u5 malaria mortrate	-0.0485***	0.0018	-0.0489***	-0.0016
	(0.0107)	(0.0160)	(0.0104)	(0.0154)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.221	0.271	0.220	0.275
Number of observations	4,559	4,559	4,559	4,559

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. Baseline labour force participation rates in 1999 for more educated women were 0.61 and 0.68 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.73 and 0.79 respectively for less educated women.

TABLE 3.29: Male labour force participation as a function of exposure to the malaria intervention

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: All men				
post-2004 * base under 5 malaria mortality rate	-0.0359	-0.0437	0.0051	-0.0413
	(0.0663)	(0.1040)	(0.0654)	(0.1046)
primary education	-0.0650***	-0.0617***	-0.0642***	-0.0608***
	(0.0051)	(0.0052)	(0.0044)	(0.0046)
secondary education	-0.2277***	-0.2194***	-0.2249***	-0.2197***
	(0.0088)	(0.0089)	(0.0084)	(0.0086)
higher education	-0.1184***	-0.1020***	-0.1130***	-0.0989***
	(0.0263)	(0.0273)	(0.0255)	(0.0263)
Cluster FE	Yes	Yes	Yes	Yes
Respondent birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.233	0.247	0.238	0.252
Number of observations	33,195	33,195	33,195	33,195
Panel B: Married men				
post-2004 * base under 5 malaria mortality rate	0.0760*	0.0484	0.0701**	0.0468
	(0.0401)	(0.0715)	(0.0352)	(0.0673)
primary education	-0.0017	0.0001	-0.0010	0.0013
	(0.0038)	(0.0038)	(0.0022)	(0.0020)
secondary education	-0.0062	-0.0035	-0.0057*	-0.0029
	(0.0050)	(0.0052)	(0.0031)	(0.0033)
higher education	0.0069	0.0145	0.0030	0.0098
	(0.0310)	(0.0325)	(0.0304)	(0.0321)
Cluster FE	Yes	Yes	Yes	Yes
Respondent birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.064	0.086	0.052	0.075
Number of observations	18,399	18,399	18,399	18,399
Panel C: Unmarried men				
post-2004 * base under 5 malaria mortality rate	-0.1654	-0.1403	-0.0712	-0.1274
	(0.1291)	(0.2116)	(0.1298)	(0.2153)
primary education	-0.1734***	-0.1625***	-0.1754***	-0.1657***
	(0.0135)	(0.0142)	(0.0124)	(0.0131)
secondary education	-0.4471***	-0.4291***	-0.4484***	-0.4363***
	(0.0169)	(0.0181)	(0.0162)	(0.0172)
higher education	-0.3762***	-0.3568***	-0.3562***	-0.3438***
	(0.0502)	(0.0512)	(0.0451)	(0.0456)
Cluster FE	Yes	Yes	Yes	Yes
Respondent birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.222	0.251	0.230	0.259
Number of observations	14,796	14,796	14,796	14,796

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Men aged 15-59 are included in these regressions. Baseline labour force participation rates in 1999 for men in this analysis overall were 0.83 and 0.89 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.93 and 0.98 respectively for married men, and 0.65 and 0.74 respectively for unmarried men.

TABLE 3.30: Labour force participation as a function of exposure to the malaria intervention: results controlling for other malaria interventions

	currently working			worked in the last 12 months		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: 15-40 year old women						
fertile years post-2004 * base u5 malaria mortrate	-0.0237***	-0.0237***	-0.0237***	-0.0192***	-0.0192***	-0.0192***
	(0.0051)	(0.0051)	(0.0051)	(0.0050)	(0.0050)	(0.0050)
ACT coverage	-0.2031		-0.2841	-0.0321		-0.0005
	(0.4433)		(0.8979)	(0.4824)		(0.9368)
IRS coverage		0.5555	-0.4432		0.1747	0.1729
		(2.0822)	(4.0971)		(2.0044)	(3.9358)
primary education	-0.0144***	-0.0144***	-0.0144***	-0.0201***	-0.0201***	-0.0201***
	(0.0055)	(0.0055)	(0.0055)	(0.0049)	(0.0049)	(0.0049)
secondary education	-0.1407***	-0.1407***	-0.1407***	-0.1561***	-0.1561***	-0.1561***
	(0.0086)	(0.0086)	(0.0086)	(0.0081)	(0.0082)	(0.0082)
higher education	0.0148	0.0148	0.0148	-0.0112	-0.0112	-0.0112
	(0.0217)	(0.0217)	(0.0217)	(0.0204)	(0.0204)	(0.0204)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.262	0.262	0.262	0.276	0.276	0.276
Number of observations	52,859	52,859	52,859	52,859	52,859	52,859
Panel B: 15-40 year old women without children						
fertile years post-2004 * base u5 malaria mortrate	-0.0061	-0.0062	-0.0061	0.0000	0.0000	0.0000
	(0.0082)	(0.0082)	(0.0083)	(0.0081)	(0.0081)	(0.0082)
ACT coverage	-0.2377		-1.5202	-0.1011		-0.6664
	(0.6833)		(1.3246)	(0.7352)		(1.4184)
IRS coverage		-1.3944	-6.8030		-0.6274	-2.9983
		(2.3388)	(5.1570)		(2.3359)	(5.1570)
primary education	-0.0848***	-0.0850***	-0.0853***	-0.1058***	-0.1059***	-0.1060***
	(0.0138)	(0.0138)	(0.0138)	(0.0125)	(0.0125)	(0.0125)
secondary education	-0.3130***	-0.3131***	-0.3132***	-0.3465***	-0.3466***	-0.3466***
	(0.0166)	(0.0166)	(0.0166)	(0.0159)	(0.0159)	(0.0159)
higher education	-0.2128***	-0.2129***	-0.2128***	-0.2608***	-0.2608***	-0.2608***
	(0.0360)	(0.0360)	(0.0360)	(0.0359)	(0.0359)	(0.0359)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.293	0.293	0.294	0.312	0.312	0.312
Number of observations	16,649	16,649	16,649	16,649	16,649	16,649
Panel C: 15-40 year old women with children						
fertile years post-2004 * base u5 malaria mortrate	-0.0277***	-0.0276***	-0.0276***	-0.0226***	-0.0225***	-0.0225***
	(0.0061)	(0.0061)	(0.0061)	(0.0057)	(0.0057)	(0.0057)
ACT coverage	-0.2719		0.2545	-0.1162		0.2208
	(0.3437)		(0.7728)	(0.3396)		(0.7513)
IRS coverage		2.0474	2.9346		1.1089	1.8787
		(2.0692)	(4.1076)		(2.0168)	(3.9071)
primary education	0.0036	0.0036	0.0036	0.0020	0.0020	0.0020
	(0.0055)	(0.0055)	(0.0055)	(0.0048)	(0.0047)	(0.0047)
secondary education	0.0054	0.0055	0.0055	-0.0024	-0.0023	-0.0023
	(0.0097)	(0.0097)	(0.0097)	(0.0087)	(0.0087)	(0.0087)
higher education	0.1289***	0.1289***	0.1289***	0.1062***	0.1062***	0.1063***
	(0.0227)	(0.0227)	(0.0227)	(0.0218)	(0.0218)	(0.0218)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.191	0.191	0.191	0.194	0.194	0.194
Number of observations	36,210	36,210	36,210	36,210	36,210	36,210

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.58 and 0.65 respectively for women without children, and 0.78 and 0.83 respectively for women with children.

TABLE 3.31: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation, polygamous versus non-polygamous households

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Non-polygamous households												
post-2004 * base under 5 malaria mortality rate	0.0413*	0.1613***	-0.0421	0.0418	-0.1151***	-0.1626***	0.0342	0.1171	0.1285***	0.2102***	-0.0827	0.0106
	(0.0234)	(0.0397)	(0.0403)	(0.0689)	(0.0252)	(0.0401)	(0.0470)	(0.0805)	(0.0354)	(0.0564)	(0.0593)	(0.1012)
primary education	-0.0272***	0.0000	-0.0223***	0.0000	-0.0167***	0.0000	-0.0153***	0.0000	-0.0326***	0.0000	-0.0256***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0022)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0737***	0.0000	-0.0691***	0.0000	-0.0851***	0.0000	-0.0822***	0.0000	-0.0625***	0.0000	-0.0561***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0026)	(.)	(0.0026)	(.)	(0.0038)	(.)	(0.0037)	(.)
higher education	-0.0957***	0.0000	-0.0843***	0.0000	-0.1037***	0.0000	-0.1004***	0.0000	-0.0974***	0.0000	-0.0751***	0.0000
	(0.0040)	(.)	(0.0042)	(.)	(0.0044)	(.)	(0.0044)	(.)	(0.0102)	(.)	(0.0101)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.103	0.141	0.109	0.150	0.058	0.143	0.065	0.153	0.117	0.214	0.129	0.222
Number of observations	576,717	576,717	576,717	576,717	275,088	275,088	275,088	275,088	301,629	301,629	301,629	301,629
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		53,659		53,659		44,295		44,295		34,288		34,288
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel B: Polygamous households												
post-2004 * base under 5 malaria mortality rate	-0.3494**	-0.4488**	-0.5176**	-0.2093	-0.2754	-0.3833	-0.5291*	-0.4966	-0.1642	-0.1648	-0.2116	0.4496
	(0.1674)	(0.2111)	(0.2310)	(0.2843)	(0.1990)	(0.2511)	(0.3119)	(0.3511)	(0.2158)	(0.3700)	(0.3505)	(0.4852)
primary education	-0.0065	0.0000	-0.0022	0.0000	-0.0289***	0.0000	-0.0236***	0.0000	-0.0038	0.0000	0.0011	0.0000
	(0.0081)	(.)	(0.0084)	(.)	(0.0081)	(.)	(0.0087)	(.)	(0.0123)	(.)	(0.0135)	(.)
secondary education	-0.0424**	0.0000	-0.0300	0.0000	-0.1264***	0.0000	-0.1248***	0.0000	0.0264	0.0000	0.0547	0.0000
	(0.0198)	(.)	(0.0197)	(.)	(0.0191)	(.)	(0.0196)	(.)	(0.0429)	(.)	(0.0430)	(.)
higher education	-0.2332***	0.0000	-0.2261***	0.0000	-0.6880***	0.0000	-0.7210***	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0225)	(.)	(0.0260)	(.)	(0.0290)	(.)	(0.0606)	(.)	(.)	(.)	(.)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.157	0.172	0.186	0.206	0.131	0.180	0.191	0.241	0.204	0.254	0.250	0.309
Number of observations	20,339	20,339	20,339	20,339	9,664	9,664	9,664	9,664	10,675	10,675	10,675	10,675
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		1,883		1,883		1,554		1,554		1,338		1,338

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth for women in polygamous (non-polygamous) households was 0.17 (0.16), 0.09 (0.08) for women who were likely to give birth to their first child, and 0.25 (0.24) for women who were likely to have higher order births.

TABLE 3.32: Labour force participation as a function of exposure to the malaria intervention: polygamous versus non-polygamous households

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A1: Non-polygamous households				
fertile years post-2004 * base u5 malaria mortrate	-0.0259***	-0.0226***	-0.0273***	-0.0185***
	(0.0042)	(0.0051)	(0.0042)	(0.0051)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.204	0.262	0.220	0.276
Number of observations	50,979	50,979	50,979	50,979
Panel A2: 15-40 year childless women in non-polygamous households				
fertile years post-2004 * base u5 malaria mortrate	-0.0201***	-0.0043	-0.0194***	0.0017
	(0.0050)	(0.0083)	(0.0051)	(0.0082)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.238	0.291	0.258	0.311
Number of observations	16,187	16,187	16,187	16,187
Panel A3: 15-40 year old mothers in non-polygamous households				
fertile years post-2004 * base u5 malaria mortrate	-0.0269***	-0.0270***	-0.0287***	-0.0228***
	(0.0052)	(0.0062)	(0.0050)	(0.0058)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.107	0.191	0.109	0.194
Number of observations	34,792	34,792	34,792	34,792
Panel B1: Polygamous households				
fertile years post-2004 * base u5 malaria mortrate	-0.0277	-0.0728*	-0.0283	-0.0568
	(0.0278)	(0.0375)	(0.0258)	(0.0366)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.460	0.529	0.457	0.535
Number of observations	1,880	1,880	1,880	1,880
Panel B2: 15-40 year old childless women in polygamous households				
fertile years post-2004 * base u5 malaria mortrate	0.0035	-0.3477*	0.0229	-0.1715
	(0.0920)	(0.2020)	(0.0844)	(0.2300)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.805	0.874	0.769	0.834
Number of observations	462	462	462	462
Panel B3: 15-40 year old mothers in polygamous households				
fertile years post-2004 * base u5 malaria mortrate	-0.0365	-0.0291	-0.0252	-0.0066
	(0.0353)	(0.0404)	(0.0287)	(0.0396)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.458	0.556	0.444	0.567
Number of observations	1,418	1,418	1,418	1,418

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in non-polygamous households were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.77 and 0.83, respectively, for women in polygamous households.

TABLE 3.33: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation for women with high and low desired fertility

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Women with fertility in 2004 lower than desired												
post-2004 * base under 5 malaria mortality rate	-0.1052***	0.0381	-0.0991*	-0.1054	-0.1502***	-0.4403***	0.0940	0.2615*	-0.0573	0.0522	-0.1909**	-0.1488
	(0.0286)	(0.0600)	(0.0516)	(0.1093)	(0.0317)	(0.0694)	(0.0626)	(0.1427)	(0.0431)	(0.0687)	(0.0745)	(0.1256)
primary education	-0.0290***	0.0000	-0.0263***	0.0000	-0.0248***	0.0000	-0.0221***	0.0000	-0.0286***	0.0000	-0.0248***	0.0000
	(0.0025)	(.)	(0.0024)	(.)	(0.0034)	(.)	(0.0034)	(.)	(0.0032)	(.)	(0.0031)	(.)
secondary education	-0.0892***	0.0000	-0.0821***	0.0000	-0.1107***	0.0000	-0.1036***	0.0000	-0.0633***	0.0000	-0.0555***	0.0000
	(0.0030)	(.)	(0.0029)	(.)	(0.0038)	(.)	(0.0038)	(.)	(0.0048)	(.)	(0.0045)	(.)
higher education	-0.1163***	0.0000	-0.1055***	0.0000	-0.1509***	0.0000	-0.1437***	0.0000	-0.0947***	0.0000	-0.0792***	0.0000
	(0.0055)	(.)	(0.0057)	(.)	(0.0052)	(.)	(0.0055)	(.)	(0.0151)	(.)	(0.0153)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.101	0.140	0.105	0.151	0.075	0.170	0.082	0.184	0.124	0.209	0.133	0.217
Number of observations	327,744	327,744	327,744	327,744	136,792	136,792	136,792	136,792	190,952	190,952	190,952	190,952
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		31,815		31,815		26,790		26,790		20,633		20,633
Panel B: Women with fertility in 2004 higher than or equal to desired												
post-2004 * base under 5 malaria mortality rate	0.1240	0.4050**	0.2749	0.5911	-0.0528	-0.3091	-4.9649*	-10.9861***	0.0981	0.4408***	0.2832	0.6001*
	(0.1211)	(0.1728)	(0.2517)	(0.3664)	(0.7680)	(0.7122)	(2.8370)	(2.9723)	(0.1234)	(0.1675)	(0.2507)	(0.3613)
primary education	-0.0317***	0.0000	-0.0284***	0.0000	-0.0066	0.0000	0.0353	0.0000	-0.0302***	0.0000	-0.0282***	0.0000
	(0.0079)	(.)	(0.0079)	(.)	(0.0588)	(.)	(0.0627)	(.)	(0.0082)	(.)	(0.0083)	(.)
secondary education	-0.0895***	0.0000	-0.0777***	0.0000	-0.1181*	0.0000	-0.0651	0.0000	-0.0895***	0.0000	-0.0776***	0.0000
	(0.0121)	(.)	(0.0128)	(.)	(0.0644)	(.)	(0.0803)	(.)	(0.0130)	(.)	(0.0140)	(.)
higher education	-0.1246***	0.0000	-0.0868***	0.0000	-0.1804	0.0000	-0.1238	0.0000	-0.1221***	0.0000	-0.0911***	0.0000
	(0.0299)	(.)	(0.0242)	(.)	(0.1125)	(.)	(0.1451)	(.)	(0.0296)	(.)	(0.0249)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.152	0.212	0.173	0.235	0.265	0.327	0.412	0.477	0.160	0.226	0.182	0.248
Number of observations	37,414	37,414	37,414	37,414	2,555	2,555	2,555	2,555	34,859	34,859	34,859	34,859
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		2,966		2,966		723		723		2,892		2,892

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016, born between 1952 and 2001. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth for women with high (low) desired fertility was 0.29 (0.18), 0.28 (0.13) for women who were likely to give birth to their first child, and 0.29 (0.23) for women who were likely to have higher order births.

TABLE 3.34: Labour force participation as a function of exposure to the malaria intervention: results for women with high and low desired fertility

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A1: 15-40 year old women with fertility in 2004 lower than desired				
fertile years post-2004 * base u5 malaria mortrate	-0.0247***	-0.0384***	-0.0265***	-0.0383***
	(0.0064)	(0.0072)	(0.0063)	(0.0070)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.219	0.263	0.235	0.284
Number of observations	27,708	27,708	27,708	27,708
Panel A2: 15-40 year childless women with fertility in 2004 lower than desired				
fertile years post-2004 * base u5 malaria mortrate	-0.0343***	-0.0283**	-0.0305***	-0.0199
	(0.0086)	(0.0126)	(0.0086)	(0.0127)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.279	0.320	0.297	0.342
Number of observations	8,947	8,947	8,947	8,947
Panel A3: 15-40 year old mothers with fertility in 2004 lower than desired				
fertile years post-2004 * base u5 malaria mortrate	-0.0136*	-0.0307***	-0.0160**	-0.0310***
	(0.0077)	(0.0083)	(0.0075)	(0.0078)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.150	0.210	0.157	0.224
Number of observations	18,761	18,761	18,761	18,761
Panel B1: 15-40 year old women with fertility in 2004 higher than or equal to desired				
fertile years post-2004 * base u5 malaria mortrate	0.0339	0.0102	0.0371	0.0119
	(0.0404)	(0.0515)	(0.0353)	(0.0471)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.438	0.514	0.480	0.546
Number of observations	1,591	1,591	1,591	1,591
Panel B2: 15-40 year old childless women with fertility in 2004 equal to desired				
fertile years post-2004 * base u5 malaria mortrate	-0.1293	0.3185	-0.1293	0.3185
	(.)	(.)	(.)	(.)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	1.000	1.000	1.000	1.000
Number of observations	44	44	44	44
Panel B3: 15-40 year old mothers with fertility in 2004 higher than or equal to desired				
fertile years post-2004 * base u5 malaria mortrate	0.0197	0.0041	0.0167	-0.0016
	(0.0431)	(0.0547)	(0.0374)	(0.0505)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.421	0.503	0.460	0.533
Number of observations	1,547	1,547	1,547	1,547

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women with low desired fertility were 0.70 and 0.76 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.84 and 0.89, respectively, for women with high desired fertility.

TABLE 3.35: Probability of birth as a function of exposure to the malaria intervention: results controlling for and by levels of domestic violence

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Controlling for high domestic violence region												
post-2004 * base under 5 malaria mortality rate	0.0368	0.1385***	-0.0317	0.0251	-0.0695**	-0.1366***	0.0503	0.1093	0.0995***	0.2112***	-0.0851	0.0027
	(0.0255)	(0.0425)	(0.0420)	(0.0691)	(0.0277)	(0.0410)	(0.0497)	(0.0813)	(0.0381)	(0.0587)	(0.0589)	(0.1003)
post2004 * high DV region	0.0016	-0.0069	-0.0600	0.0043	0.0155***	0.0135***	0.0114	0.0365	-0.0074*	-0.0043	-0.0279	-0.0224
	(0.0030)	(0.0046)	(34.9286)	(0.0189)	(0.0033)	(0.0048)	(.)	(.)	(0.0042)	(0.0061)	(24.3837)	(0.0265)
primary education	-0.0272***	0.0000	-0.0225***	0.0000	-0.0185***	0.0000	-0.0167***	0.0000	-0.0319***	0.0000	-0.0256***	0.0000
	(0.0019)	(.)	(0.0018)	(.)	(0.0024)	(.)	(0.0023)	(.)	(0.0025)	(.)	(0.0024)	(.)
secondary education	-0.0744***	0.0000	-0.0698***	0.0000	-0.0877***	0.0000	-0.0837***	0.0000	-0.0605***	0.0000	-0.0551***	0.0000
	(0.0023)	(.)	(0.0022)	(.)	(0.0027)	(.)	(0.0027)	(.)	(0.0039)	(.)	(0.0038)	(.)
higher education	-0.0988***	0.0000	-0.0864***	0.0000	-0.1096***	0.0000	-0.1034***	0.0000	-0.0969***	0.0000	-0.0762***	0.0000
	(0.0041)	(.)	(0.0043)	(.)	(0.0046)	(.)	(0.0047)	(.)	(0.0102)	(.)	(0.0102)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.101	0.140	0.107	0.149	0.059	0.142	0.064	0.150	0.114	0.213	0.126	0.220
Number of observations	551,556	551,556	551,556	551,556	260,049	260,049	260,049	260,049	291,507	291,507	291,507	291,507
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		51,543		51,543		42,225		42,225		33,035		33,035
Panel B: Triple difference: high domestic violence region												
post-2004 * base under 5 malaria mortality rate	0.0237	0.1497***	0.0058	0.1555*	-0.1234***	-0.2294***	0.0724	0.1727*	0.0960**	0.2750***	-0.0753	0.1464
	(0.0298)	(0.0490)	(0.0561)	(0.0879)	(0.0315)	(0.0461)	(0.0619)	(0.0900)	(0.0443)	(0.0677)	(0.0774)	(0.1253)
post2004 * high DV region	-0.0021	-0.0035	-0.0681	0.0308	-0.0010	-0.0151*	0.0093	0.0477	-0.0083	0.0151	-0.0260	-0.0035
	(0.0054)	(0.0086)	(.)	(0.0218)	(0.0058)	(0.0091)	(.)	(39.4413)	(0.0079)	(0.0114)	(.)	(0.0281)
post2004 * u5mort * high DV region	0.0487	-0.0445	-0.1054	-0.3943**	0.2194***	0.3877***	-0.0657	-0.1939	0.0122	-0.2530**	-0.0261	-0.4449**
	(0.0579)	(0.0935)	(0.0948)	(0.1565)	(0.0596)	(0.1039)	(0.1099)	(0.1866)	(0.0859)	(0.1229)	(0.1348)	(0.2264)
primary education	-0.0272***	0.0000	-0.0225***	0.0000	-0.0185***	0.0000	-0.0167***	0.0000	-0.0319***	0.0000	-0.0256***	0.0000
	(0.0019)	(.)	(0.0018)	(.)	(0.0024)	(.)	(0.0023)	(.)	(0.0025)	(.)	(0.0024)	(.)
secondary education	-0.0742***	0.0000	-0.0698***	0.0000	-0.0872***	0.0000	-0.0837***	0.0000	-0.0605***	0.0000	-0.0551***	0.0000
	(0.0023)	(.)	(0.0022)	(.)	(0.0027)	(.)	(0.0027)	(.)	(0.0039)	(.)	(0.0038)	(.)
higher education	-0.0988***	0.0000	-0.0864***	0.0000	-0.1095***	0.0000	-0.1034***	0.0000	-0.0969***	0.0000	-0.0762***	0.0000
	(0.0041)	(.)	(0.0044)	(.)	(0.0046)	(.)	(0.0047)	(.)	(0.0102)	(.)	(0.0102)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
post2004 * base u5 mortality: high domestic violence region	0.072	0.105	-0.100	-0.239*	0.096*	0.158*	0.007	-0.021	0.108	0.022	-0.101	-0.299
	(0.050)	(0.081)	(0.071)	(0.123)	(0.053)	(0.095)	(0.088)	(0.163)	(0.074)	(0.105)	(0.103)	(0.182)
R-squared	0.101	0.140	0.107	0.149	0.059	0.142	0.064	0.150	0.114	0.213	0.126	0.220
Number of observations	551,556	551,556	551,556	551,556	260,049	260,049	260,049	260,049	291,507	291,507	291,507	291,507
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		51,543		51,543		42,225		42,225		33,035		33,035

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. High domestic violence is a variable that takes the value one in regions where the share of sample women who reported having experienced domestic violence was higher than the median for all regions in the 2010 DHS survey. Between 1992 and 2003, the average probability of birth for women in regions with high (low) domestic violence was 0.16 (0.17), 0.09 (0.08) for women who were likely to give birth to their first child, and 0.23 (0.25) for women who were likely to have higher order births.

TABLE 3.36: Probability of birth as a function of exposure to the malaria intervention: results controlling for and by levels of sexual violence

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Controlling for high sexual violence region												
post-2004 * base under 5 malaria mortality rate	0.0593**	0.2045***	-0.0317	0.0251	-0.0923***	-0.1286***	0.0503	0.1093	0.1428***	0.2524***	-0.0851	0.0027
	(0.0254)	(0.0424)	(0.0420)	(0.0691)	(0.0284)	(0.0414)	(0.0497)	(0.0813)	(0.0383)	(0.0598)	(0.0589)	(0.1003)
post2004 * high sexual violence region	0.0095***	0.0171***	0.0115	-0.0639**	0.0068**	0.0153***	-0.0234	0.0244	0.0101**	0.0113*	-0.0211	0.0995
	(0.0028)	(0.0044)	(12.6137)	(0.0304)	(0.0034)	(0.0049)	(17.4527)	(23.5168)	(0.0040)	(0.0060)	(.)	(2.6081)
primary education	-0.0275***	0.0000	-0.0225***	0.0000	-0.0184***	0.0000	-0.0167***	0.0000	-0.0325***	0.0000	-0.0256***	0.0000
	(0.0019)	(.)	(0.0018)	(.)	(0.0024)	(.)	(0.0023)	(.)	(0.0025)	(.)	(0.0024)	(.)
secondary education	-0.0744***	0.0000	-0.0698***	0.0000	-0.0878***	0.0000	-0.0837***	0.0000	-0.0607***	0.0000	-0.0551***	0.0000
	(0.0023)	(.)	(0.0022)	(.)	(0.0027)	(.)	(0.0027)	(.)	(0.0039)	(.)	(0.0038)	(.)
higher education	-0.0993***	0.0000	-0.0864***	0.0000	-0.1094***	0.0000	-0.1034***	0.0000	-0.0983***	0.0000	-0.0762***	0.0000
	(0.0041)	(.)	(0.0043)	(.)	(0.0046)	(.)	(0.0047)	(.)	(0.0102)	(.)	(0.0102)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.101	0.141	0.107	0.149	0.059	0.142	0.064	0.150	0.114	0.213	0.126	0.220
Number of observations	551,556	551,556	551,556	551,556	260,049	260,049	260,049	260,049	291,507	291,507	291,507	291,507
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		51,543		51,543		42,225		42,225		33,035		33,035
Panel B: Triple difference: high sexual violence region												
post-2004 * base under 5 malaria mortality rate	0.0273	0.1371***	0.0182	0.1464*	-0.1239***	-0.2242***	0.0942	0.1590*	0.0948**	0.2453***	-0.0778	0.1212
	(0.0288)	(0.0476)	(0.0530)	(0.0843)	(0.0318)	(0.0464)	(0.0621)	(0.0902)	(0.0436)	(0.0674)	(0.0723)	(0.1261)
post2004 * high sexual violence region	-0.0001	-0.0052	0.0009	-0.0350	-0.0033	-0.0170*	-0.0198	0.0344	-0.0037	0.0088	-0.0211	0.1312
	(0.0054)	(0.0087)	(16.8926)	(0.0326)	(0.0061)	(0.0096)	(.)	(46.1731)	(0.0080)	(0.0115)	(9.1279)	(.)
post2004 * u5mort * high sexual violence region	0.1290**	0.3018***	-0.1403	-0.3734**	0.1336**	0.4427***	-0.1287	-0.1603	0.1833**	0.0331	-0.0196	-0.3726
	(0.0604)	(0.0978)	(0.0926)	(0.1585)	(0.0656)	(0.1087)	(0.1070)	(0.1924)	(0.0892)	(0.1328)	(0.1318)	(0.2292)
primary education	-0.0275***	0.0000	-0.0225***	0.0000	-0.0184***	0.0000	-0.0167***	0.0000	-0.0325***	0.0000	-0.0256***	0.0000
	(0.0019)	(.)	(0.0018)	(.)	(0.0024)	(.)	(0.0023)	(.)	(0.0025)	(.)	(0.0024)	(.)
secondary education	-0.0741***	0.0000	-0.0698***	0.0000	-0.0875***	0.0000	-0.0837***	0.0000	-0.0601***	0.0000	-0.0551***	0.0000
	(0.0023)	(.)	(0.0023)	(.)	(0.0027)	(.)	(0.0027)	(.)	(0.0039)	(.)	(0.0038)	(.)
higher education	-0.0990***	0.0000	-0.0865***	0.0000	-0.1092***	0.0000	-0.1035***	0.0000	-0.0977***	0.0000	-0.0762***	0.0000
	(0.0041)	(.)	(0.0043)	(.)	(0.0046)	(.)	(0.0047)	(.)	(0.0102)	(.)	(0.0102)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
post2004 * base u5 mortality: high sexual violence region	0.156***	0.439***	-0.122*	-0.227*	0.010	0.218**	-0.034	-0.001	0.278***	0.278**	-0.097	-0.251
	(0.053)	(0.087)	(0.074)	(0.131)	(0.059)	(0.099)	(0.085)	(0.169)	(0.078)	(0.118)	(0.107)	(0.184)
R-squared	0.101	0.141	0.107	0.149	0.059	0.142	0.064	0.150	0.115	0.213	0.126	0.220
Number of observations	551,556	551,556	551,556	551,556	260,049	260,049	260,049	260,049	291,507	291,507	291,507	291,507
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		51,543		51,543		42,225		42,225		33,035		33,035

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. High sexual violence is a variable that takes the value one in regions where the share of sample women who reported having experienced sexual violence was higher than the median for all regions in the 2010 DHS survey. Between 1992 and 2003, the average probability of birth for women in regions with high (low) sexual violence was 0.17 (0.17), 0.09 (0.08) for women who were likely to give birth to their first child, and 0.24 (0.24) for women who were likely to have higher order births.

TABLE 3.37: Labour force participation as a function of exposure to the malaria intervention: results controlling for and by levels of domestic violence

	currently working				worked in the last 12 months			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: 15-40 year old women								
fertile years post-2004 * base u5 malaria mortrate	-0.0169***	-0.0174***	-0.0249***	-0.0228***	-0.0182***	-0.0123**	-0.0260***	-0.0177***
	(0.0044)	(0.0052)	(0.0050)	(0.0063)	(0.0044)	(0.0051)	(0.0052)	(0.0062)
fertile years post-2004 * high DV region	0.0024***	0.0019***	0.0002	0.0006	0.0022***	0.0025***	0.0002	0.0012
	(0.0004)	(0.0007)	(0.0007)	(0.0011)	(0.0004)	(0.0007)	(0.0007)	(0.0011)
fertile years post-2004 * u5mort x high DV region			0.0287***	0.0162			0.0278***	0.0164
			(0.0080)	(0.0107)			(0.0079)	(0.0105)
primary education	-0.0234***	-0.0163***	-0.0235***	-0.0163***	-0.0270***	-0.0219***	-0.0271***	-0.0218***
	(0.0065)	(0.0057)	(0.0066)	(0.0057)	(0.0061)	(0.0051)	(0.0061)	(0.0051)
secondary education	-0.1815***	-0.1411***	-0.1784***	-0.1410***	-0.1946***	-0.1559***	-0.1915***	-0.1558***
	(0.0100)	(0.0088)	(0.0101)	(0.0088)	(0.0098)	(0.0083)	(0.0098)	(0.0083)
higher education	-0.0380	0.0142	-0.0367	0.0141	-0.0563**	-0.0106	-0.0550**	-0.0107
	(0.0233)	(0.0218)	(0.0233)	(0.0218)	(0.0218)	(0.0204)	(0.0218)	(0.0204)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high DV region			0.004	-0.007			0.002	-0.001
			(0.007)	(0.009)			(0.007)	(0.009)
R-squared	0.207	0.262	0.208	0.263	0.225	0.278	0.225	0.278
Number of observations	49,591	49,591	49,591	49,591	49,591	49,591	49,591	49,591
Panel B: 15-40 year old women without children								
fertile years post-2004 * base u5 malaria mortrate	-0.0184***	0.0001	-0.0193***	-0.0031	-0.0171***	0.0064	-0.0180***	0.0054
	(0.0053)	(0.0081)	(0.0062)	(0.0099)	(0.0053)	(0.0080)	(0.0063)	(0.0099)
fertile years post-2004 * high DV region	0.0002	0.0019	-0.0001	0.0011	0.0003	0.0016	0.0000	0.0014
	(0.0006)	(0.0020)	(0.0010)	(0.0024)	(0.0005)	(0.0020)	(0.0010)	(0.0024)
fertile years post-2004 * u5mort x high DV region			0.0038	0.0096			0.0035	0.0030
			(0.0112)	(0.0168)			(0.0112)	(0.0162)
primary education	-0.1078***	-0.0865***	-0.1078***	-0.0865***	-0.1283***	-0.1078***	-0.1282***	-0.1078***
	(0.0149)	(0.0139)	(0.0149)	(0.0139)	(0.0139)	(0.0126)	(0.0139)	(0.0126)
secondary education	-0.3574***	-0.3152***	-0.3570***	-0.3152***	-0.3901***	-0.3485***	-0.3898***	-0.3485***
	(0.0178)	(0.0167)	(0.0178)	(0.0167)	(0.0170)	(0.0158)	(0.0170)	(0.0158)
higher education	-0.2611***	-0.2153***	-0.2610***	-0.2154***	-0.3026***	-0.2622***	-0.3024***	-0.2622***
	(0.0373)	(0.0363)	(0.0373)	(0.0363)	(0.0371)	(0.0361)	(0.0371)	(0.0361)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high DV region			-0.016	0.006			-0.014	0.008
			(0.009)	(0.014)			(0.009)	(0.013)
R-squared	0.240	0.293	0.240	0.293	0.260	0.313	0.260	0.313
Number of observations	15,845	15,845	15,845	15,845	15,845	15,845	15,845	15,845
Panel C: 15-40 year old women with children								
fertile years post-2004 * base u5 malaria mortrate	-0.0150***	-0.0207***	-0.0286***	-0.0300***	-0.0173***	-0.0157***	-0.0302***	-0.0248***
	(0.0054)	(0.0063)	(0.0064)	(0.0081)	(0.0052)	(0.0059)	(0.0064)	(0.0075)
fertile years post-2004 * high DV region	0.0033***	0.0037***	0.0002	0.0017	0.0029***	0.0041***	-0.0001	0.0022*
	(0.0005)	(0.0008)	(0.0009)	(0.0012)	(0.0005)	(0.0007)	(0.0008)	(0.0011)
fertile years post-2004 * u5mort x high DV region			0.0417***	0.0254**			0.0399***	0.0251**
			(0.0095)	(0.0124)			(0.0089)	(0.0116)
primary education	-0.0005	0.0025	-0.0010	0.0025	0.0007	0.0011	0.0002	0.0011
	(0.0065)	(0.0057)	(0.0066)	(0.0057)	(0.0060)	(0.0050)	(0.0060)	(0.0050)
secondary education	-0.0396***	0.0065	-0.0354***	0.0065	-0.0448***	-0.0016	-0.0408***	-0.0016
	(0.0106)	(0.0100)	(0.0106)	(0.0100)	(0.0101)	(0.0091)	(0.0101)	(0.0091)
higher education	0.0858***	0.1337***	0.0870***	0.1336***	0.0716***	0.1126***	0.0728***	0.1125***
	(0.0232)	(0.0224)	(0.0232)	(0.0223)	(0.0222)	(0.0211)	(0.0222)	(0.0211)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high DV region			0.013*	-0.005			0.010	0.000
			(0.008)	(0.010)			(0.007)	(0.009)
R-squared	0.111	0.191	0.112	0.191	0.115	0.195	0.116	0.195
Number of observations	33,746	33,746	33,746	33,746	33,746	33,746	33,746	33,746

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. High domestic violence is a variable that takes the value one in regions where the share of sample women who reported having experienced domestic violence was higher than the median for all regions in the 2010 DHS survey. Baseline labour force participation rates in 1999 for women in regions with low domestic violence in 2010 were 0.72 and 0.78 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.74 and 0.80, respectively, for women in high domestic violence regions.

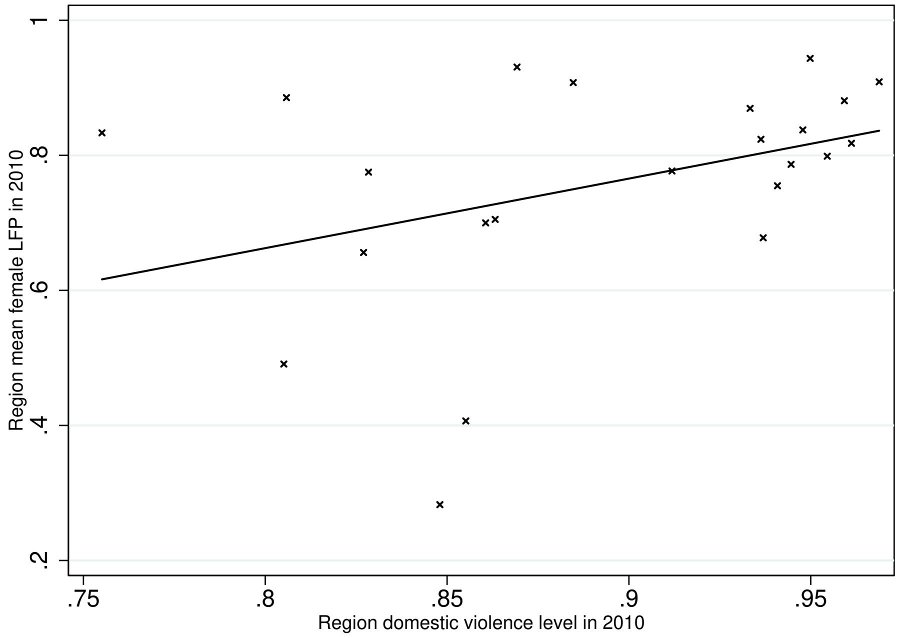
TABLE 3.38: Labour force participation as a function of exposure to the malaria intervention: results controlling for and by levels of sexual violence

	currently working				worked in the last 12 months			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: 15-40 year old women								
fertile years post-2004 * base u5 malaria mortrate	-0.0132***	-0.0152***	-0.0236***	-0.0218***	-0.0144***	-0.0098*	-0.0282***	-0.0165**
	(0.0043)	(0.0052)	(0.0049)	(0.0065)	(0.0043)	(0.0051)	(0.0050)	(0.0064)
fertile years post-2004 * high sexual violence region	0.0035***	0.0038***	0.0005	0.0022*	0.0034***	0.0045***	-0.0005	0.0029***
	(0.0004)	(0.0007)	(0.0008)	(0.0011)	(0.0004)	(0.0007)	(0.0007)	(0.0011)
fertile years post-2004 * u5mort x high sexual violence region			0.0394***	0.0201*			0.0523***	0.0200*
			(0.0087)	(0.0110)			(0.0082)	(0.0105)
primary education	-0.0257***	-0.0158***	-0.0257***	-0.0157***	-0.0293***	-0.0212***	-0.0293***	-0.0212***
	(0.0065)	(0.0057)	(0.0065)	(0.0057)	(0.0061)	(0.0051)	(0.0061)	(0.0051)
secondary education	-0.1828***	-0.1405***	-0.1788***	-0.1404***	-0.1958***	-0.1553***	-0.1904***	-0.1552***
	(0.0100)	(0.0088)	(0.0100)	(0.0088)	(0.0098)	(0.0083)	(0.0098)	(0.0083)
higher education	-0.0409*	0.0149	-0.0380	0.0150	-0.0592***	-0.0099	-0.0553**	-0.0098
	(0.0232)	(0.0217)	(0.0231)	(0.0217)	(0.0216)	(0.0203)	(0.0215)	(0.0203)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high sexual violence region			0.016**	-0.002			0.024***	0.004
			(0.008)	(0.009)			(0.007)	(0.008)
R-squared	0.209	0.263	0.210	0.263	0.227	0.279	0.229	0.279
Number of observations	49,591	49,591	49,591	49,591	49,591	49,591	49,591	49,591
Panel B: 15-40 year old women without children								
fertile years post-2004 * base u5 malaria mortrate	-0.0127**	0.0008	-0.0190***	0.0012	-0.0114**	0.0071	-0.0199***	0.0101
	(0.0052)	(0.0081)	(0.0062)	(0.0102)	(0.0053)	(0.0080)	(0.0064)	(0.0101)
fertile years post-2004 * high sexual violence region	0.0022***	0.0029	0.0002	0.0030	0.0023***	0.0026	-0.0003	0.0033
	(0.0005)	(0.0020)	(0.0010)	(0.0024)	(0.0005)	(0.0019)	(0.0010)	(0.0023)
fertile years post-2004 * u5mort x high sexual violence region			0.0265**	-0.0011			0.0356***	-0.0087
			(0.0114)	(0.0181)			(0.0116)	(0.0171)
primary education	-0.1096***	-0.0863***	-0.1091***	-0.0863***	-0.1301***	-0.1075***	-0.1294***	-0.1075***
	(0.0148)	(0.0139)	(0.0148)	(0.0139)	(0.0138)	(0.0126)	(0.0137)	(0.0126)
secondary education	-0.3570***	-0.3151***	-0.3543***	-0.3151***	-0.3897***	-0.3484***	-0.3862***	-0.3484***
	(0.0177)	(0.0167)	(0.0176)	(0.0167)	(0.0169)	(0.0157)	(0.0168)	(0.0157)
higher education	-0.2626***	-0.2154***	-0.2607***	-0.2154***	-0.3040***	-0.2622***	-0.3014***	-0.2622***
	(0.0373)	(0.0363)	(0.0373)	(0.0363)	(0.0371)	(0.0361)	(0.0370)	(0.0361)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high sexual violence region			0.007	0.000			0.016*	0.001
			(0.010)	(0.014)			(0.009)	(0.014)
R-squared	0.241	0.293	0.242	0.293	0.262	0.313	0.263	0.313
Number of observations	15,845	15,845	15,845	15,845	15,845	15,845	15,845	15,845
Panel C: 15-40 year old women with children								
fertile years post-2004 * base u5 malaria mortrate	-0.0125**	-0.0201***	-0.0268***	-0.0314***	-0.0147***	-0.0146**	-0.0343***	-0.0275***
	(0.0054)	(0.0064)	(0.0063)	(0.0081)	(0.0051)	(0.0059)	(0.0061)	(0.0076)
fertile years post-2004 * high sexual violence region	0.0039***	0.0040***	0.0003	0.0015	0.0035***	0.0049***	-0.0014*	0.0020*
	(0.0005)	(0.0008)	(0.0009)	(0.0012)	(0.0005)	(0.0007)	(0.0008)	(0.0011)
fertile years post-2004 * u5mort x high sexual violence region			0.0480***	0.0317***			0.0658***	0.0365***
			(0.0102)	(0.0120)			(0.0090)	(0.0111)
primary education	-0.0025	0.0025	-0.0029	0.0025	-0.0013	0.0012	-0.0019	0.0012
	(0.0066)	(0.0057)	(0.0066)	(0.0057)	(0.0059)	(0.0050)	(0.0060)	(0.0050)
secondary education	-0.0411***	0.0064	-0.0365***	0.0064	-0.0462***	-0.0016	-0.0398***	-0.0017
	(0.0106)	(0.0100)	(0.0106)	(0.0100)	(0.0101)	(0.0091)	(0.0100)	(0.0091)
higher education	0.0815***	0.1331***	0.0847***	0.1335***	0.0675***	0.1120***	0.0719***	0.1124***
	(0.0230)	(0.0223)	(0.0229)	(0.0223)	(0.0219)	(0.0211)	(0.0219)	(0.0210)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high sexual violence region			0.021**	0.000			0.031***	0.009
			(0.009)	(0.010)			(0.007)	(0.009)
R-squared	0.112	0.191	0.114	0.191	0.116	0.196	0.120	0.196
Number of observations	33,746	33,746	33,746	33,746	33,746	33,746	33,746	33,746

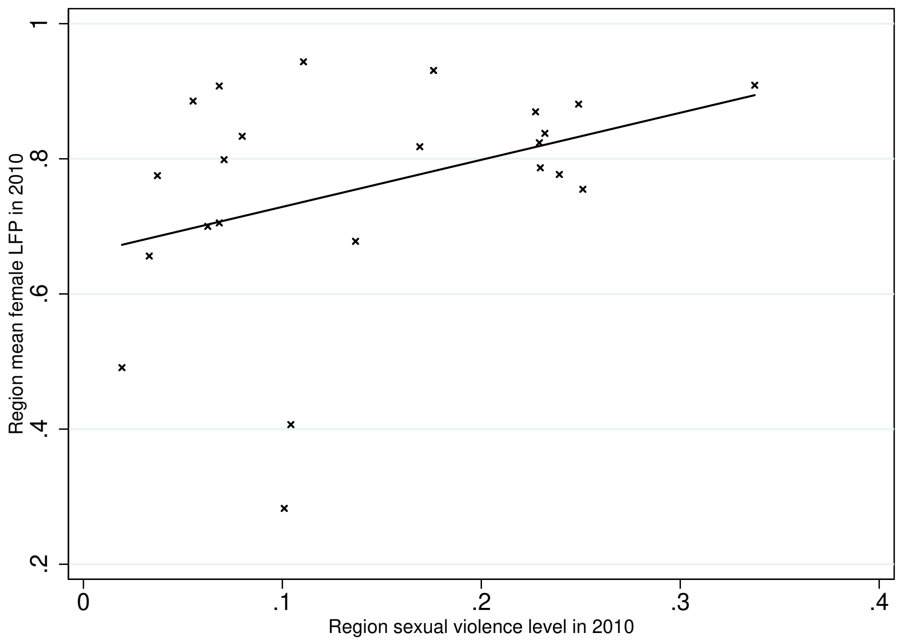
Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. High sexual violence is a variable that takes the value one in regions where the share of sample women who reported having experienced sexual violence was higher than the median for all regions in the 2010 DHS survey. Baseline labour force participation rates in 1999 for women in regions with low sexual violence in 2010 were 0.73 and 0.78 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.74 and 0.80, respectively, for women in high sexual violence regions.

FIGURE 3.15: Correlation between levels of domestic violence and female labour force participation in region in 2010

(a) Domestic violence



(b) Sexual violence



Note: The figures plot the regional levels of domestic and social violence against the average female labour force participation in the 2010 DHS Survey. Lines of best fit showing the correlation between the two sets of measures are also plotted. Domestic violence and sexual violence are measured as the share of surveyed women in the region who report having experienced sexual violence or any type of domestic violence (emotional, physical or sexual violence, as well as controlling behaviour).

Conclusion

The three chapters in this dissertation contribute to the research literature relating to family economics and gender inequality in labour market outcomes.

The first chapter studies the extent to which the changes in the graduate gender wage gap over the life cycle and over time in the UK can be explained by gender differences in sorting into flexible occupations. This chapter documents that graduate women increased their participation in flexible occupations over the life cycle and over time, whereas men were less likely to work in flexible occupations at older ages, with not much change over cohorts. The wage penalty associated with flexibility increased over cohorts and over the life cycle, whereas the graduate gender wage gap increased over the life cycle, with not much change over cohorts. Quantile decomposition analysis of the evolution of the gender wage gap finds that gender differences in sorting into flexible occupations over the life cycle explained between a third of this life cycle increase in the gender wage gap at the 20th percentile to 13% of the increase at the 90th percentile. Similarly, the reduction in the gender wage gap across cohorts would have been larger if not for later cohorts of women being more likely to work in flexible occupations at all ages.

The second chapter uses a model of labour supply and demand to understand the extent to which changes in relative demand and preferences for working in flexible occupations drove the observed changes in sorting into flexible occupations and the gender wage gap. Estimates show that the increase in the gender wage gap over the life cycle was largely explained by increases in relative demand for male labour (versus female labour), and in inflexible occupations. On the other hand, recent cohorts of women having higher preferences for working in flexible occupations drove the large increase in the share of women working in flexible occupations over time, contributing a large proportion of the increase in the flexibility wage penalty and to increases in the gender wage gap over time.

The third chapter uses a difference-in-difference strategy to identify the effect of declines in child mortality on women's fertility along both extensive and intensive margins of fertility and labour force participation in Tanzania. Results show that declines in child mortality led to increases in extensive margin fertility for women aged 15–25 in non-endemic areas with lower levels of acquired immunity, for whom malaria risk during first pregnancy fell. On the other hand, intensive margin fertility fell for women in this age group in endemic areas, suggesting reductions in any precautionary childbearing or child hoarding behaviour. Results also showed that labour force participation fell for women aged 26–40 who had children under age five in the household, suggesting that increased child survival increased the opportunity cost of women's labour market time. The reductions in labour force participation were driven by women in non-polygamous households and in areas with low levels of labour force participation at baseline. This suggests that policy measures to promote access to childcare and improve social norms around women's work may encourage female labour force participation.

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Appendices

A Data Appendix (Chapters 1 & 2): Measuring occupation flexibility

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 O*NET occupation characteristics were therefore mapped onto the UK SOC framework using the International Standard Classificaiton of Occupations, which provides international crosswalks mapping SOC 2000 onto ISCO 08 which can then be mapped onto the US SOC 2010. The flexibility score in each UK SOC occupation in the dataset 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 is fixed for an occupation over time, as the measure corresponds to O*NET characteristics for a fixed 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).[39]

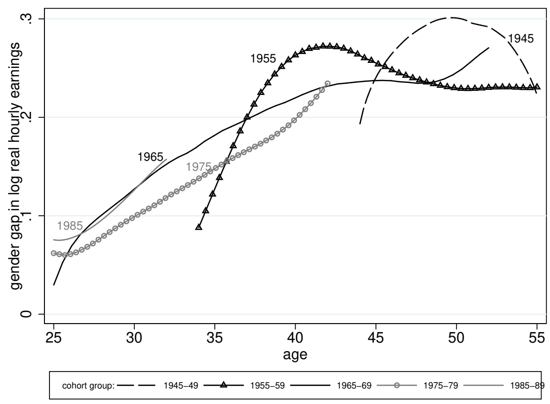
[39]The main descriptive statistics related to flexibility were tested with alternate binary cutoff thresholds, but this did not affect the main patterns observed. However, using cutoffs that were above the 75th percentile of the flexibility score led to very low shares of employment in flexible occupations,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

B Appendix for Ch.1: Decomposition of Trends in Occupation Flexibility and the Gender Wage Gap Across The Distribution in the UK

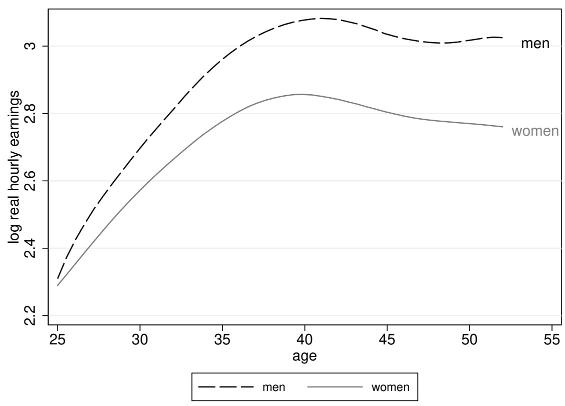
B.1 Additional Tables and Figures

FIGURE B.1: Gender wage gap for full-time graduates by cohort over the life cycle

(a) Gender wage gap by cohort

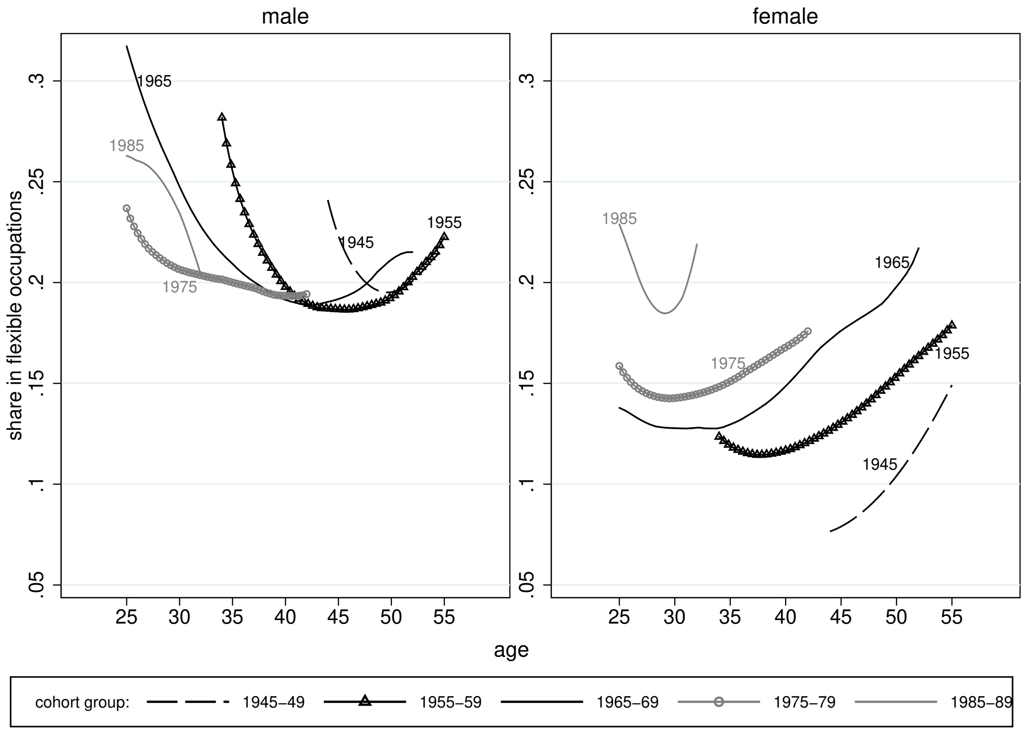


(b) Male and female wages over the life cycle for cohort born 1965-69



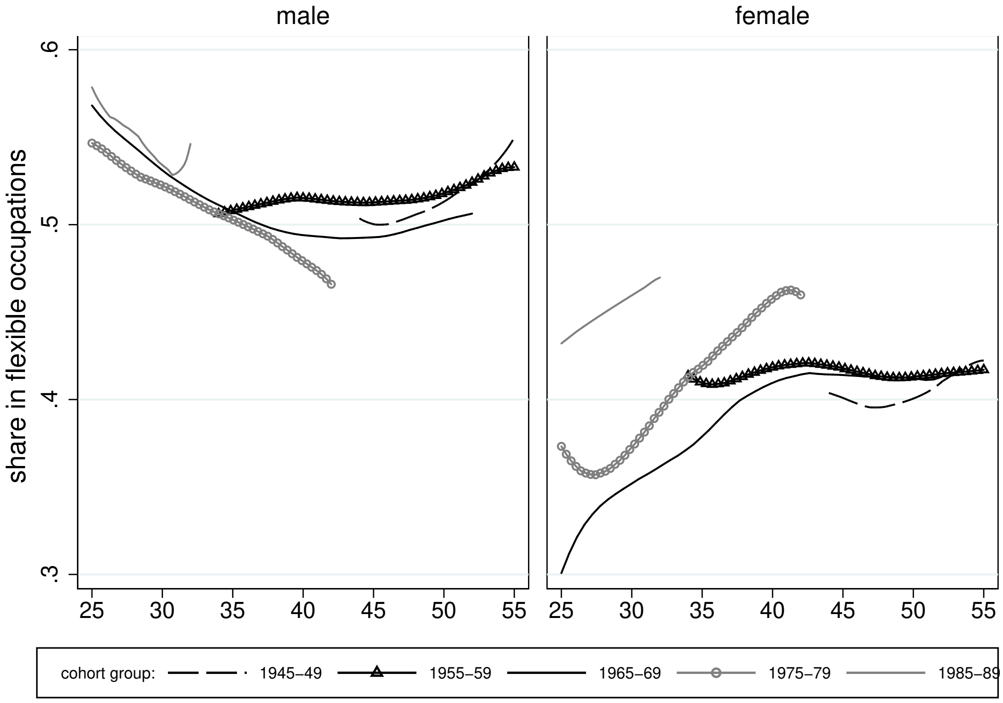
Notes: The graph in panel (a) plots the difference between log male and female real hourly full-time earnings for different cohorts between ages 25 and 55. The graph in panel (b) plots the evolution of log real hourly earnings between ages 25 and 52 for men and women born between 1965 and 1969. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

FIGURE B.2: Share of full-time graduates working in flexible occupations by cohort over the life cycle



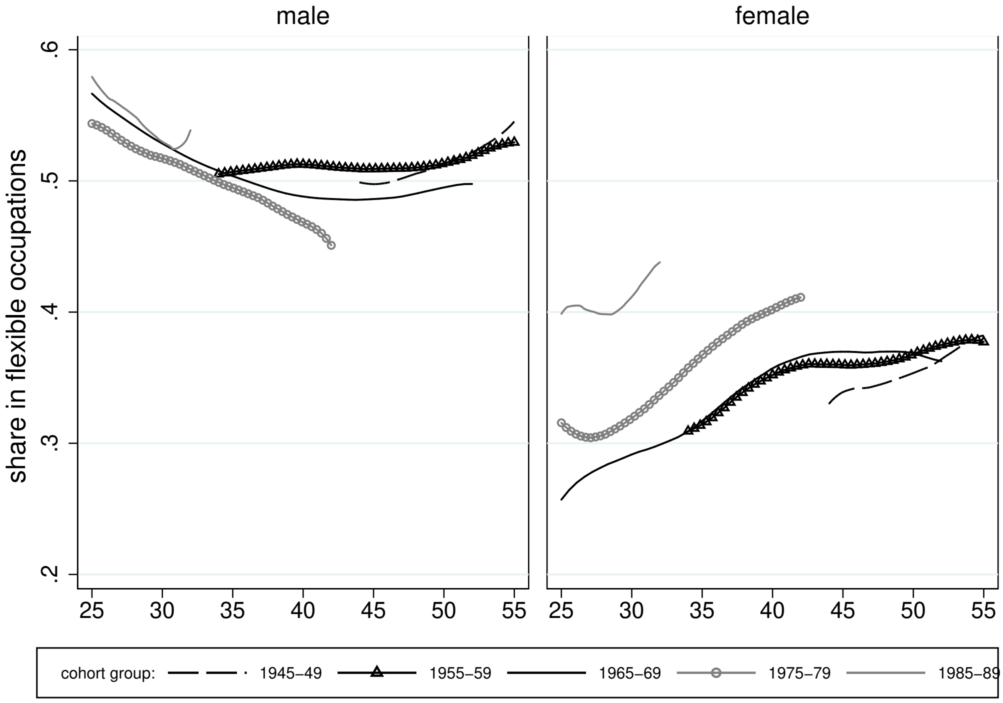
Notes: The graphs plot the share of male and female graduates working full-time in flexible occupations, as defined by a binary indicator, across different cohorts between ages 25 and 55. The binary indicator defines flexible occupations as those that have a flexibility score above the median for all occupations. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

FIGURE B.3: Share of non-graduates working in flexible occupations by cohort over the life cycle



Notes: The graphs plot the share of male and female non-graduates working full-time 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. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

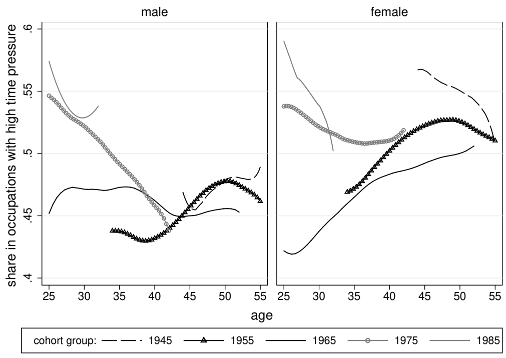
FIGURE B.4: Share of full-time non-graduates working in flexible occupations by cohort over the life cycle



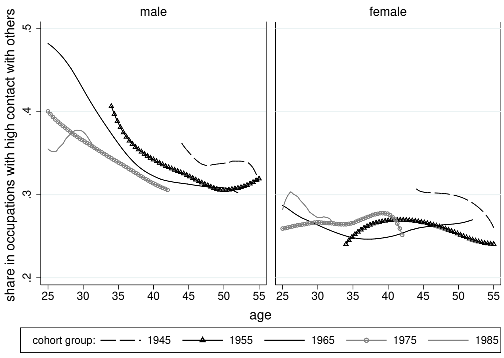
Notes: The graphs plot the share of male and female non-graduates working full-time in flexible occupations, as defined by a binary indicator, across different cohorts between ages 25 and 55. The binary indicator defines flexible occupations as those that have a flexibility score above the median for all occupations. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

FIGURE B.5: Share of graduates working in occupations with high scores on components of the flexibility measure

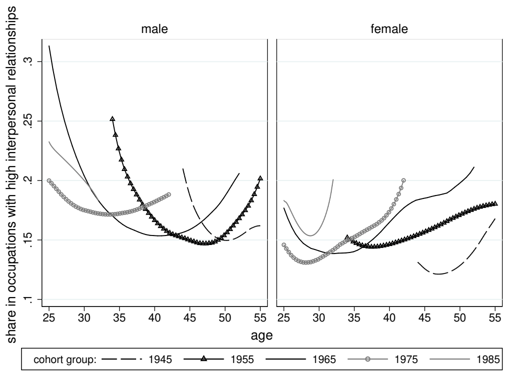
(a) Time pressure



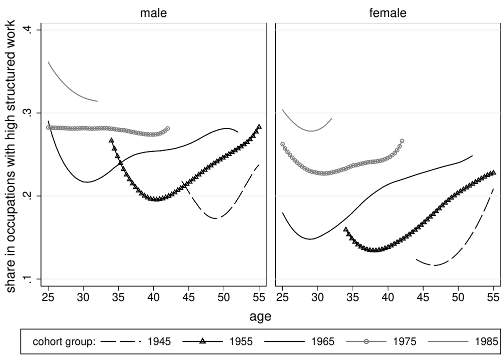
(b) Contact with others



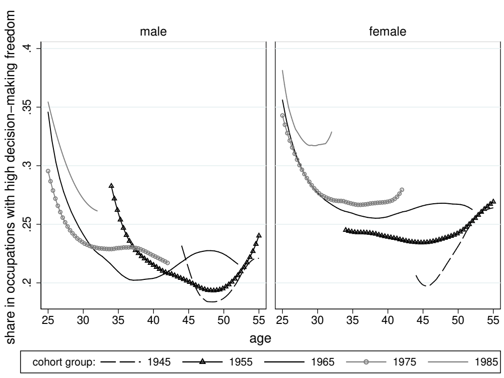
(c) Establishing and maintaining interpersonal relationships



(d) Structured work



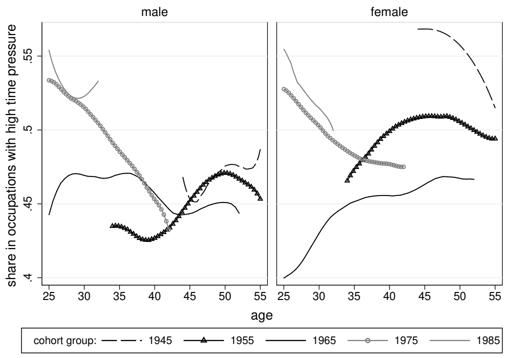
(e) Decision-making freedom



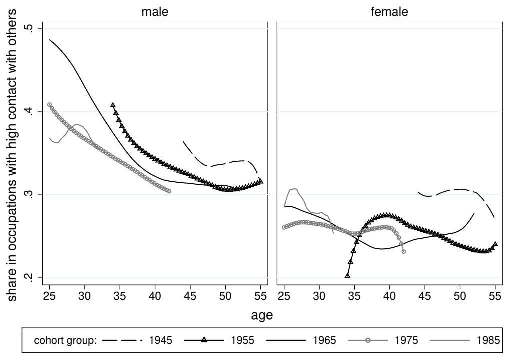
Notes: The graphs plot the share of individuals in each cohort between ages 25 and 55 who work in occupations that score higher than the median across all occupations on each of the individual components of the flexibility score. This is analogous to how the binary indicator for flexible occupations is defined to calculate the share working in flexible occupations.

FIGURE B.6: Share of full-time workers in occupations with high scores on components of the flexibility measure

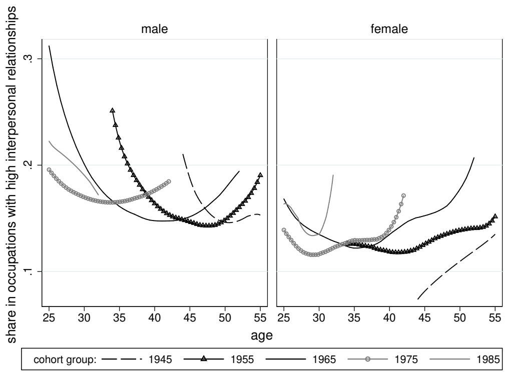
(a) Time pressure



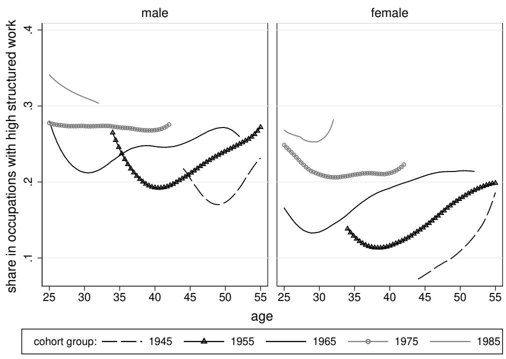
(b) Contact with others



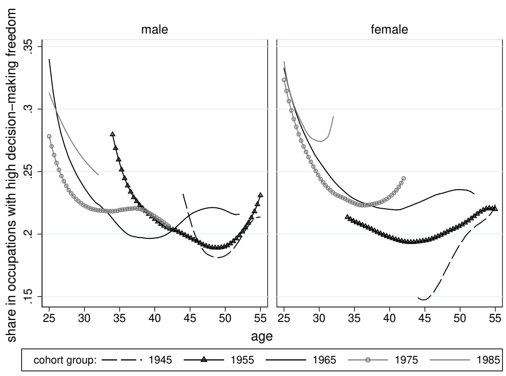
(c) Establishing and maintaining interpersonal relationships



(d) Structured work



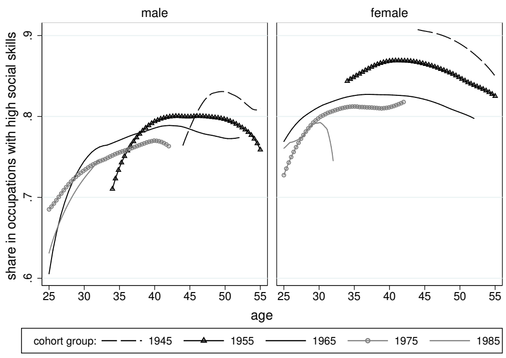
(e) Decision-making freedom



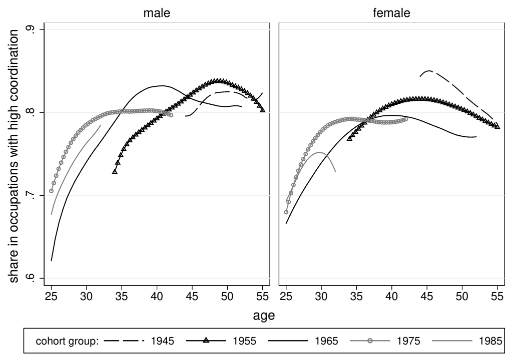
Notes: The graphs plot the share of full-time workers in each cohort between ages 25 and 55 who work in occupations that score higher than the median across all occupations on each of the individual components of the flexibility score. This is analogous to how the binary indicator for flexible occupations is defined.

FIGURE B.7: Share of full-time workers in occupations with high social skills scores

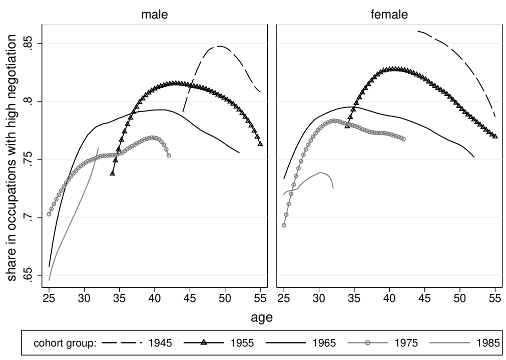
(a) Social skills intensity



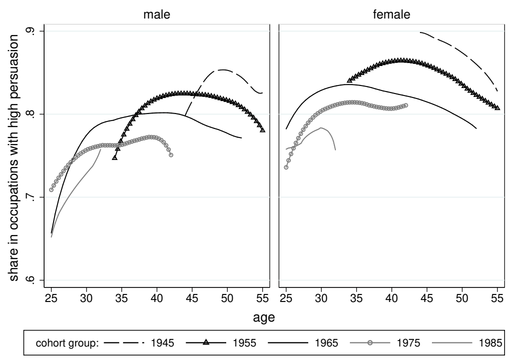
(b) Coordination



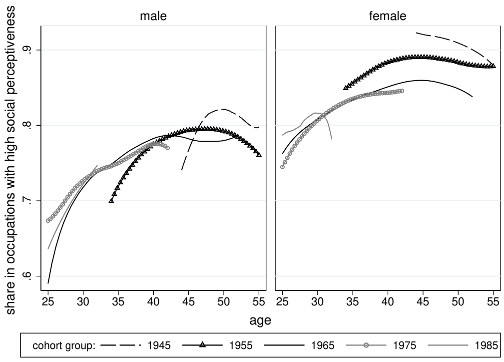
(c) Negotiation



(d) Persuasion



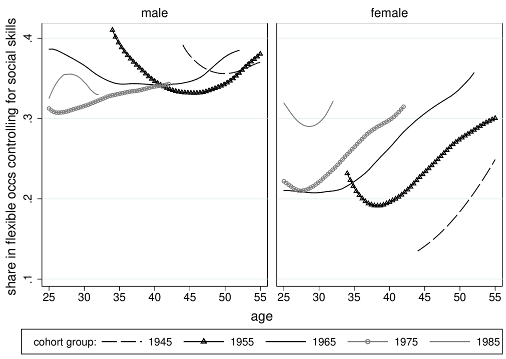
(e) Social perceptiveness



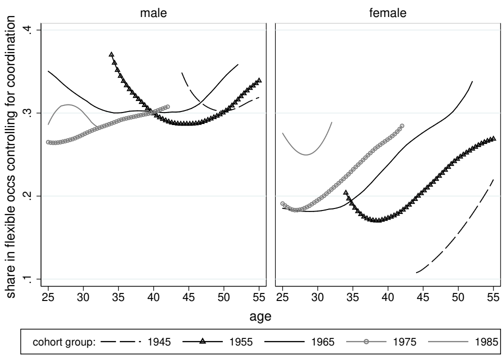
Notes: The graphs plot the share of full-time workers in each cohort between ages 25 and 55 who work in occupations that score higher than the median across all occupations on the social skills intensity score and each of its individual components. This is analogous to how the binary indicator for flexible occupations is defined to calculate the share working in flexible occupations.

FIGURE B.8: Share of full-time workers in flexible occupations controlling for social skills

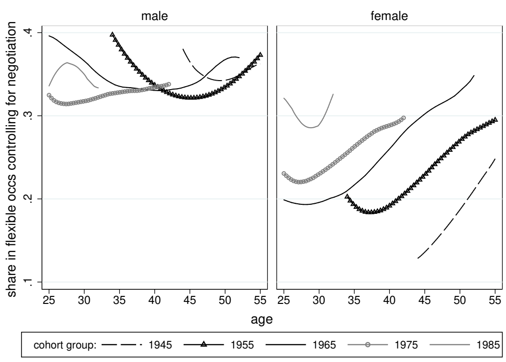
(a) Social skills intensity



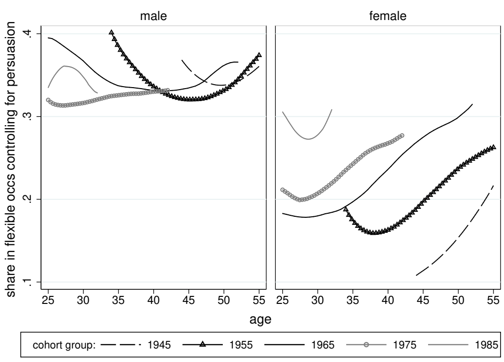
(b) Coordination



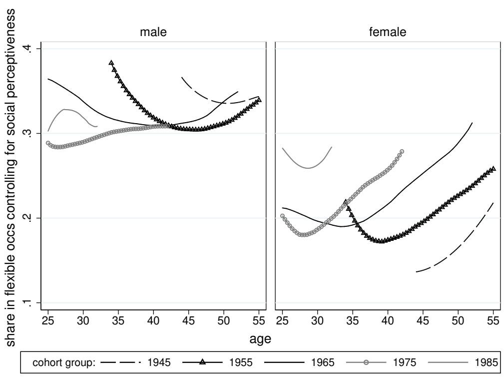
(c) Negotiation



(d) Persuasion



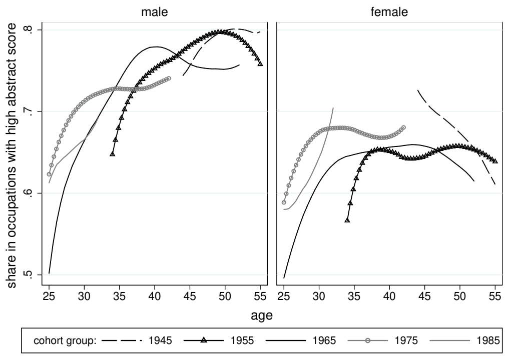
(e) Social perceptiveness



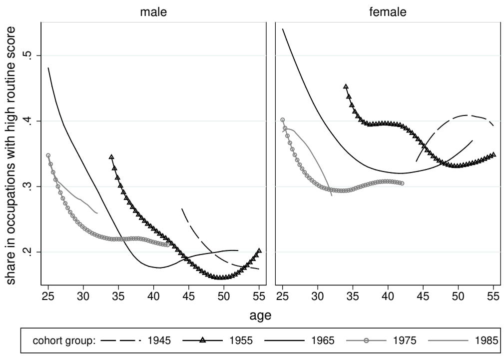
Notes: The graphs plot the share of individuals in each cohort between ages 25 and 55 who work in flexible occupations after having controlled for the social skills intensity score or its individual components in the occupation.

FIGURE B.9: Share working full-time in occupations with high abstract, routine, and manual task intensity

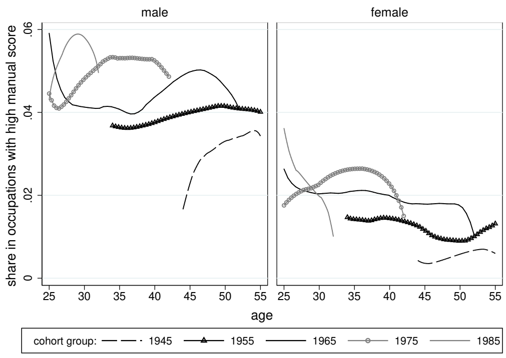
(a) Abstract task intensity



(b) Routine task intensity



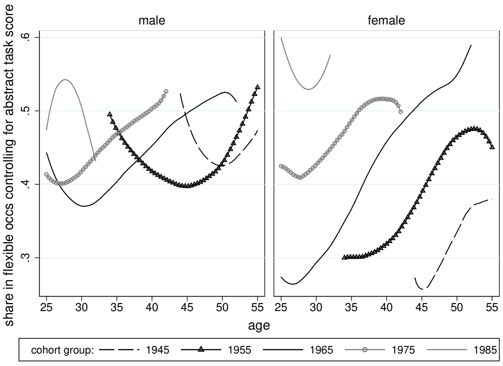
(c) Manual task intensity



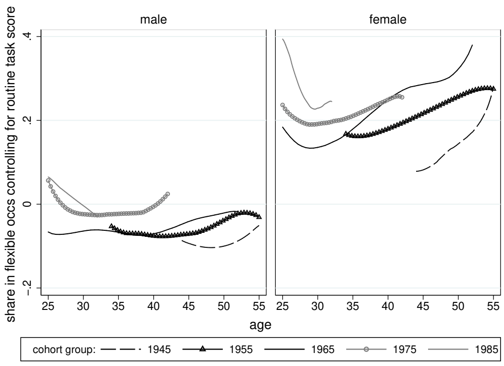
Notes: The graphs plot the share of individuals in each cohort between ages 25 and 55 who worked full-time over the life cycle in occupations that score the highest in abstract task intensity, routine task intensity, and manual task intensity, respectively, when comparing between the three task measures.

FIGURE B.10: Share working full-time in flexible occupations controlling for task intensity measures

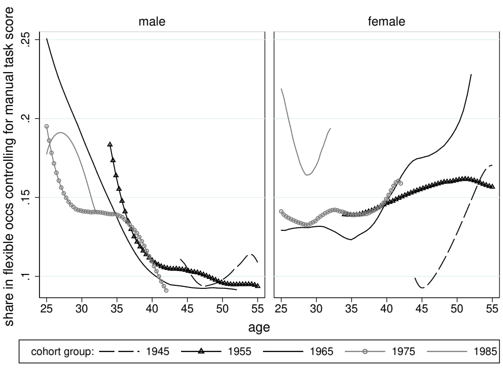
(a) Abstract task intensity



(b) Routine task intensity

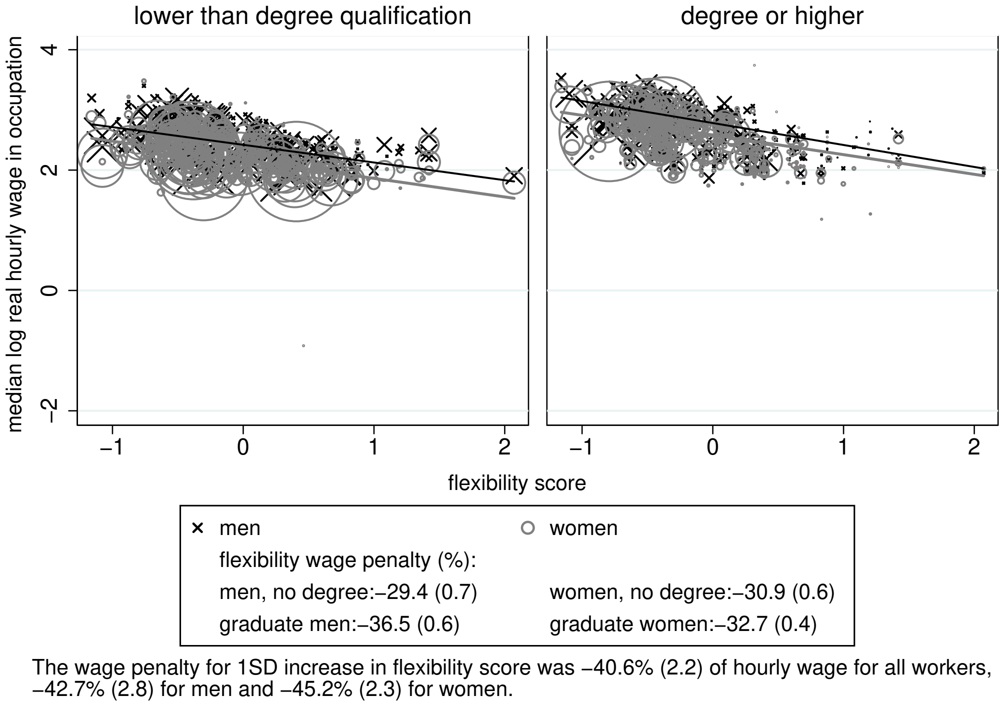


(c) Manual task intensity



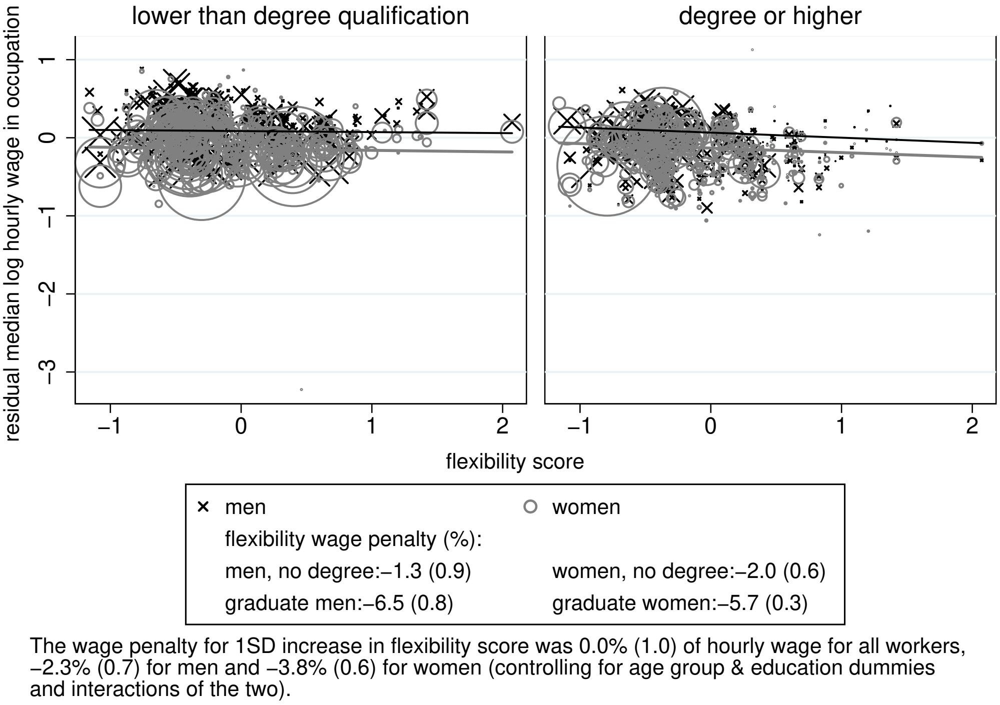
Notes: The graphs plot the share of individuals in each cohort between ages 25 and 55 who work full-time in flexible occupations after having controlled for each of the task intensity measures.

FIGURE B.11: Unconditional wage penalty associated with flexibility in occupations for full-time workers



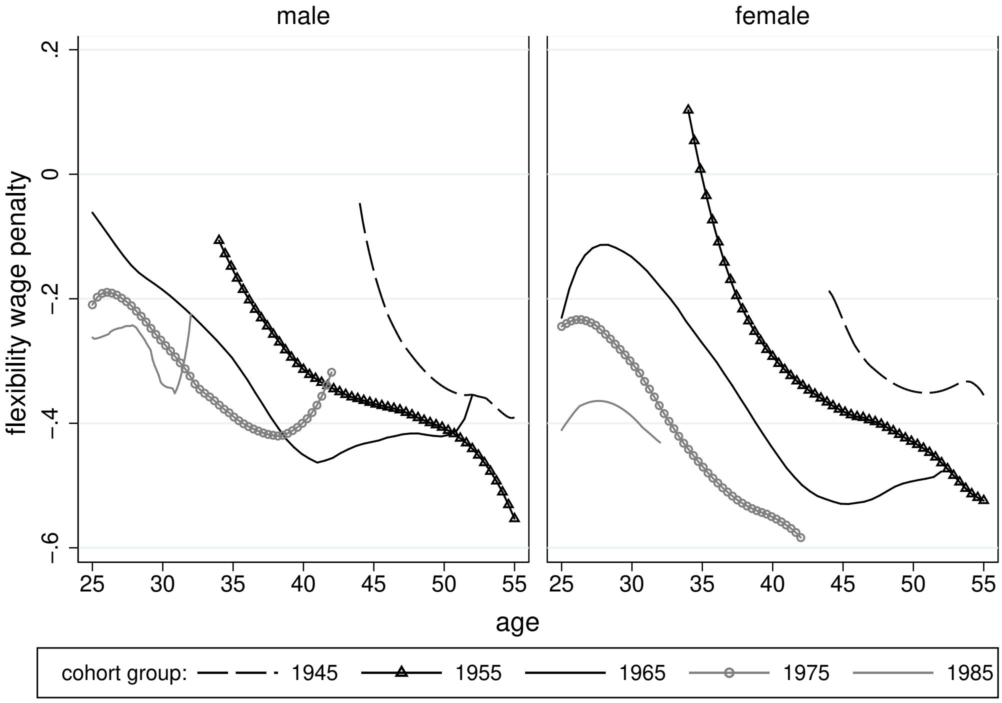
Notes: The graphs plot the median log hourly full-time earnings in occupation against the occupation's standardised flexibility score, for non-graduates and graduates separately. The size of the markers indicate the employment share of women in the occupation. The slope of the regression lines indicate the unconditional wage penalty associated with a 1SD increase in the flexibility score. For the calculated unconditional wage penalties, standard errors clustered by age group, education level and sex are included in parentheses.

FIGURE B.12: Wage penalty associated with flexibility in occupations, conditional on age group and education levels for full-time workers



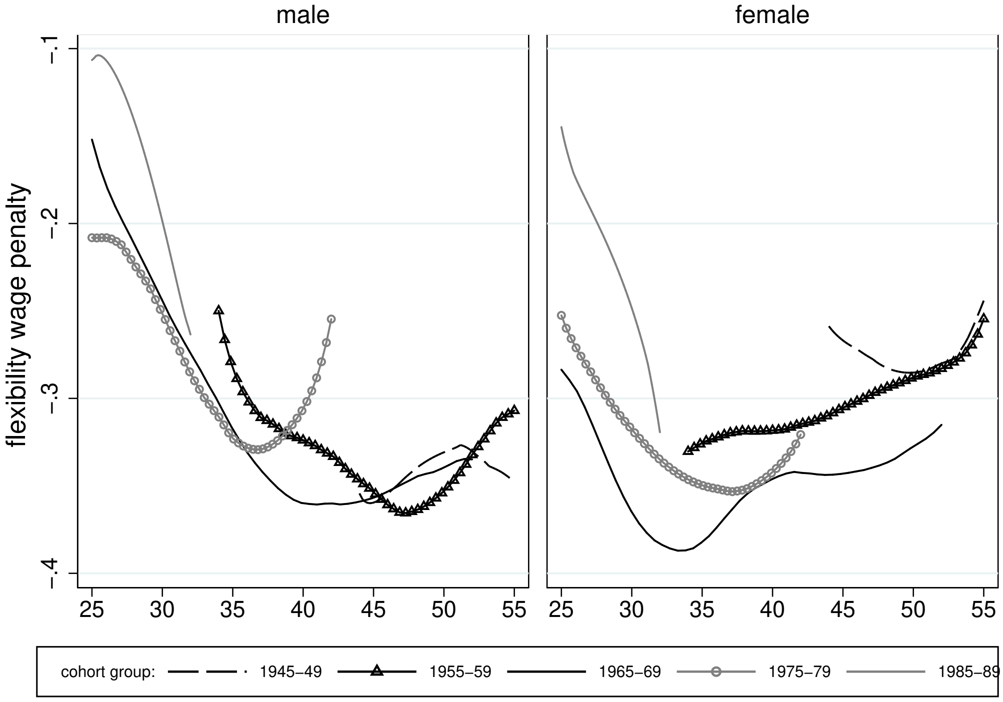
Notes: The graphs plot the median log hourly full-time earnings in occupation against the occupation's standardised flexibility score, controlling for differences in age groups and education levels, for non-graduates and graduates separately. The size of the markers indicate the employment share of women in the occupation. The slope of the regression lines indicate the conditional wage penalty associated with a 1SD increase in the flexibility score. For the calculated conditional wage penalties, standard errors clustered by age group, education level and sex are included in parentheses.

FIGURE B.13: Flexibility wage penalty for full-time graduates by cohort over the life cycle



Notes: The graph plots the evolution of the wage penalty associated with a 1SD increase in occupation flexibility score for full-time employees between ages 25 and 55, separately for male and female graduates in different cohorts. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

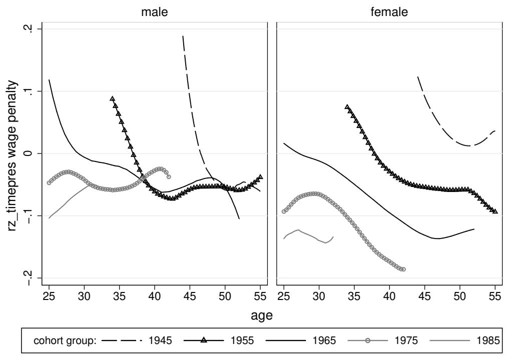
FIGURE B.14: Flexibility wage penalty for non-graduates by cohort over the life cycle



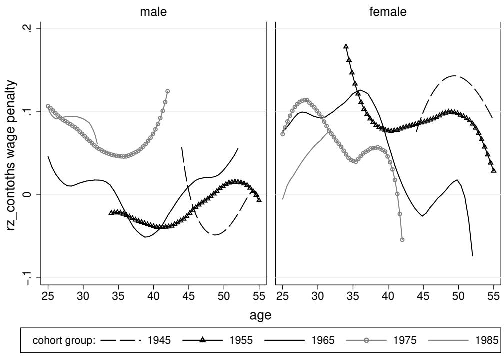
Notes: The graph plots the evolution of the wage penalty associated with a 1SD increase in occupation flexibility score for workers between ages 25 and 55, separately for male and female non-graduates in different cohorts. The plotted lines are smoothed local polynomials of degree 2. Cohort groups comprise of the cohorts of individuals born in the five years starting from the specified year, i.e. cohort group 1945 comprises of all individuals born from 1945-1949.

FIGURE B.15: Wage penalty associated with components of the flexibility measure for full-time workers

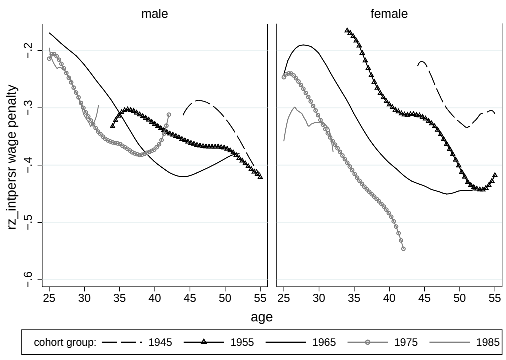
(a) Time pressure



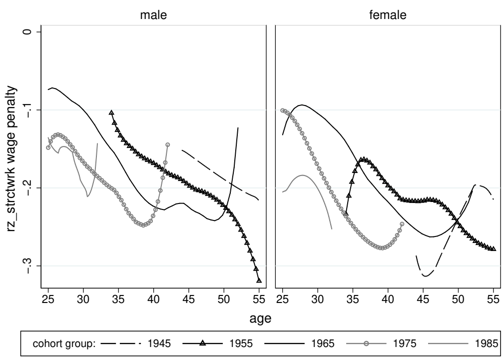
(b) Contact with others



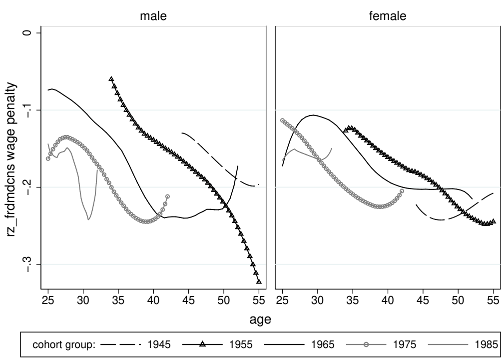
(c) Establishing and maintaining interpersonal relationships



(d) Structured work



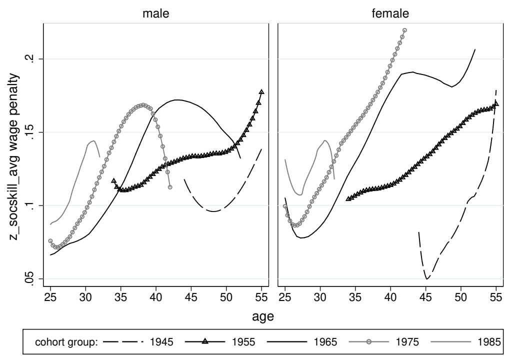
(e) Decision-making freedom



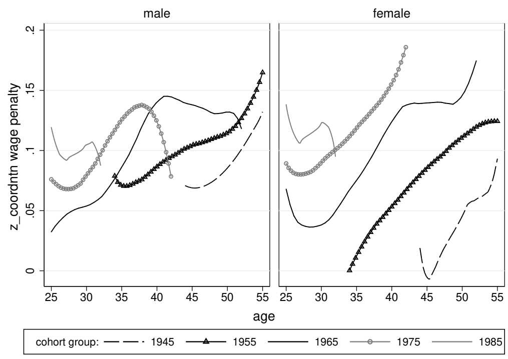
Notes: The graphs plot the evolution of the wage penalty associated with a 1SD increase in the individual components of the flexibility score between ages 25 and 55, separately for male and female graduates in different cohorts, excluding part-time workers. This is analogous to how the flexibility wage penalty is calculated for occupations.

FIGURE B.16: Wage premium associated with social skills in occupations for full-time workers

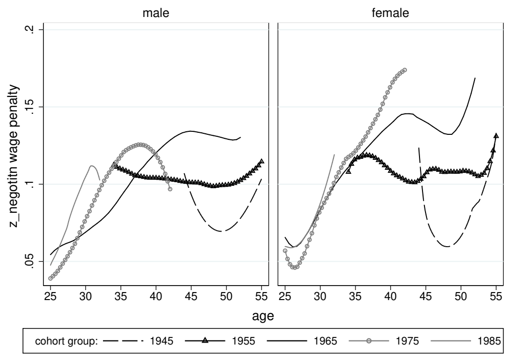
(a) Social skills intensity



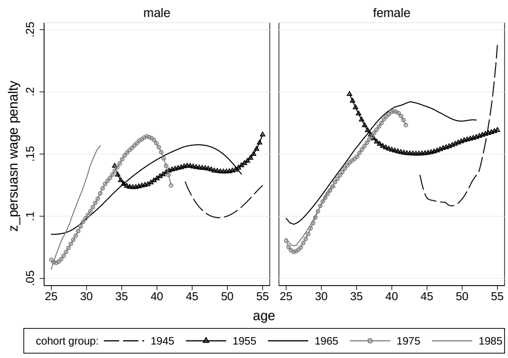
(b) Coordination



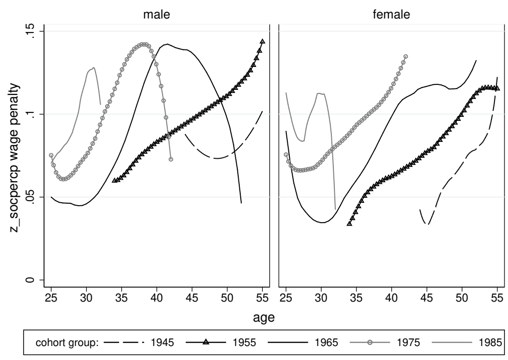
(c) Negotiation



(d) Persuasion



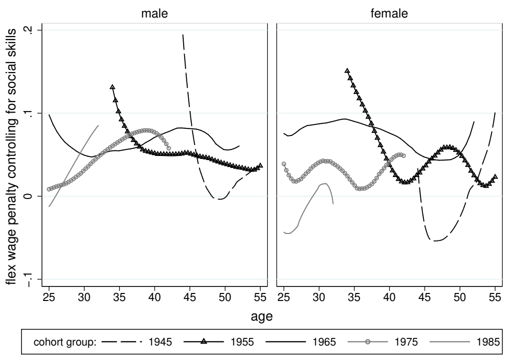
(e) Social perceptiveness



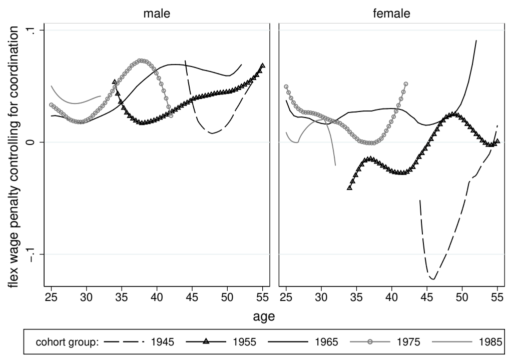
Notes: The graphs plot the evolution of the wage penalty associated with a 1SD increase in the individual components of the social skills score between ages 25 and 55, separately for male and female graduates working full-time in different cohorts. This is analogous to how the flexibility wage penalty is calculated for occupations.

FIGURE B.17: Wage penalty associated with flexibility for full-time workers, controlling for social skills in occupations

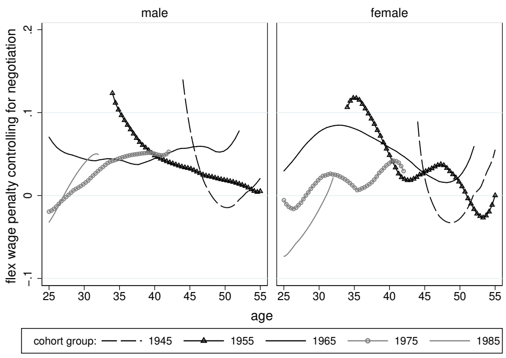
(a) Social skills intensity



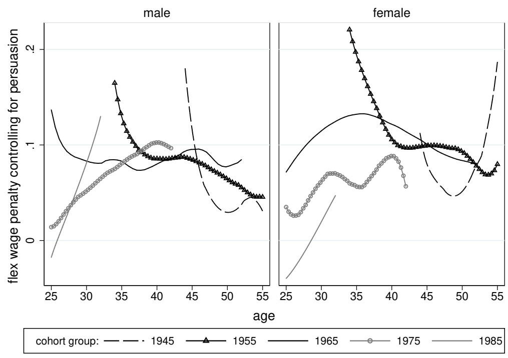
(b) Coordination



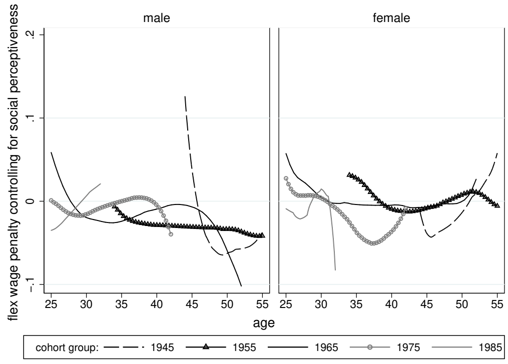
(c) Negotiation



(d) Persuasion



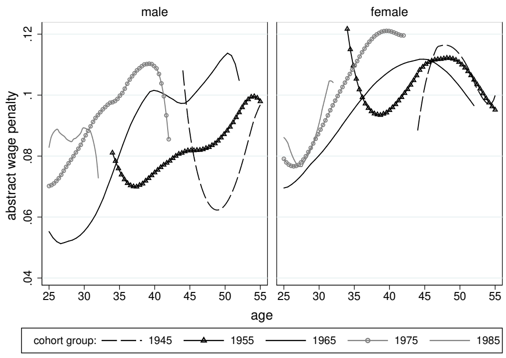
(e) Social perceptiveness



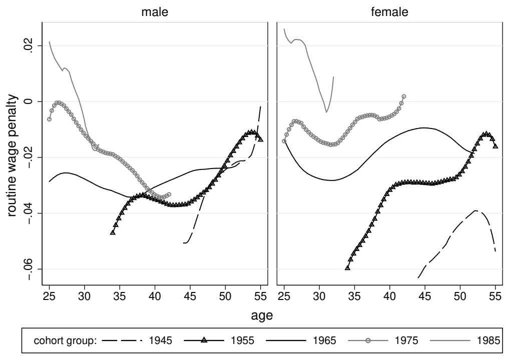
Notes: The graphs plot the evolution of the wage penalty associated with a 1SD increase in the flexibility score, controlling for individual components of the social skills score between ages 25 and 55, separately for male and female graduates in different cohorts. This is analogous to how the flexibility wage penalty is calculated for occupations.

FIGURE B.18: Wage premium (penalty) associated with occupation task intensity measures for full-time workers

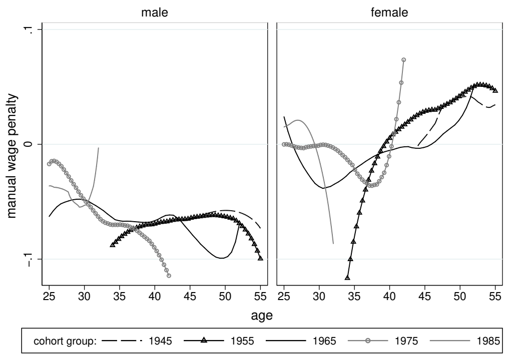
(a) Abstract task intensity



(b) Routine task intensity



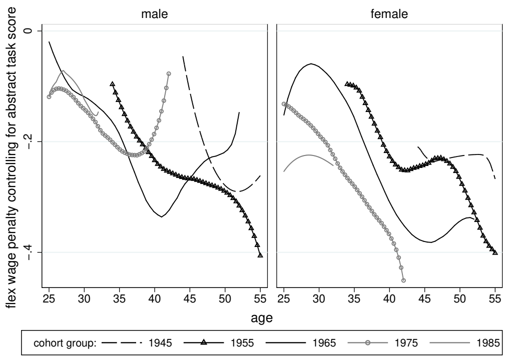
(c) Manual task intensity



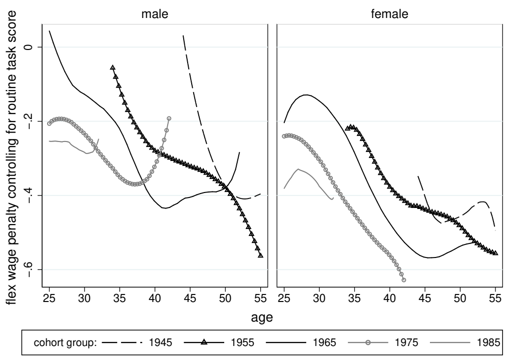
Notes: The graphs plot the evolution of the wage penalty associated with a 1SD increase in the abstract, routine, and manual task intensity scores between ages 25 and 55, separately for male and female graduates working full-time in different cohorts. This is analogous to how the flexibility wage penalty is calculated for occupations.

FIGURE B.19: Wage penalty associated with flexibility, controlling for occupation task intensity measures, for full-time workers

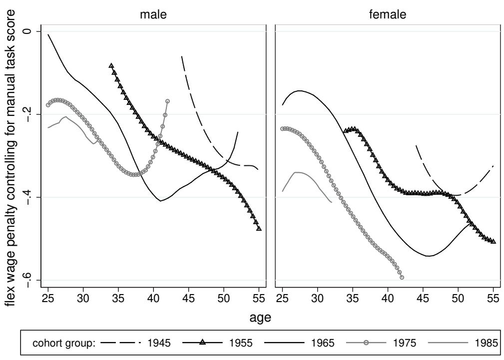
(a) Abstract task intensity



(b) Routine task intensity



(c) Manual task intensity



Notes: The graphs plot the evolution of the wage penalty associated with a 1SD increase in the flexibility score, between ages 25 and 55, controlling for the occupation abstract, routine, and manual task intensity scores, separately for male and female graduates in different cohorts.

TABLE B.1: Decomposition of changes in log real hourly earnings over the life cycle for cohort of full-time workers born in 1965-69, at different percentiles of the earnings distribution

	Men	Women	Difference
10th percentile			
Difference in log real hourly wages (52y-25y)	0.512	0.217	0.294
	(0.075)	(0.083)	(0.112)
Changes in shares in flexible occupations (52y-25y)	0.007	-0.009	0.016
	(0.015)	(0.012)	(0.019)
Changes in returns to flexible occupations (52y-25y)	0.009	-0.027	0.035
	(0.040)	(0.046)	(0.059)
Changes in residuals (52y-25y)	0.496	0.253	0.243
	(0.086)	(0.088)	(0.123)
20th percentile			
Difference in log real hourly wages (52y-25y)	0.537	0.217	0.320
	(0.075)	(0.062)	(0.100)
Changes in shares in flexible occupations (52y-25y)	0.034	-0.030	0.064
	(0.018)	(0.016)	(0.025)
Changes in returns to flexible occupations (52y-25y)	-0.044	-0.067	0.023
	(0.047)	(0.034)	(0.060)
Changes in residuals (52y-25y)	0.547	0.315	0.232
	(0.081)	(0.061)	(0.101)
50th percentile			
Difference in log real hourly wages (52y-25y)	0.608	0.475	0.133
	(0.050)	(0.039)	(0.064)
Changes in shares in flexible occupations (52y-25y)	0.024	-0.022	0.046
	(0.010)	(0.010)	(0.016)
Changes in returns to flexible occupations (52y-25y)	-0.019	-0.035	0.016
	(0.027)	(0.017)	(0.032)
Changes in residuals (52y-25y)	0.603	0.532	0.071
	(0.056)	(0.044)	(0.073)
80th percentile			
Difference in log real hourly wages (52y-25y)	0.844	0.473	0.370
	(0.056)	(0.054)	(0.077)
Changes in shares in flexible occupations (52y-25y)	0.028	-0.021	0.049
	(0.010)	(0.010)	(0.014)
Changes in returns to flexible occupations (52y-25y)	-0.028	-0.013	-0.014
	(0.024)	(0.020)	(0.029)
Changes in residuals (52y-25y)	0.844	0.508	0.336
	(0.066)	(0.064)	(0.089)
90th percentile			
Difference in log real hourly wages (52y-25y)	0.872	0.558	0.314
	(0.064)	(0.069)	(0.090)
Changes in shares in flexible occupations (52y-25y)	0.022	-0.019	0.040
	(0.010)	(0.010)	(0.014)
Changes in returns to flexible occupations (52y-25y)	-0.034	-0.048	0.015
	(0.025)	(0.022)	(0.031)
Changes in residuals (52y-25y)	0.884	0.625	0.260
	(0.077)	(0.087)	(0.110)

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE B.20: Decomposition of changes in the gender wage gap across the distribution over the life cycle for full-time workers

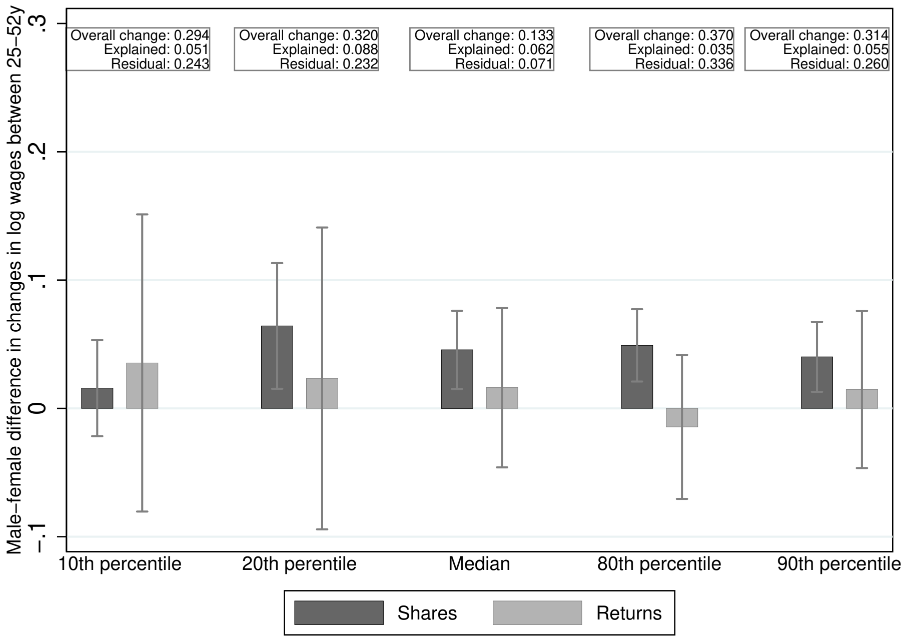


TABLE B.2: Decomposition of changes in log real hourly earnings over the life cycle for cohort of full-time workers born in 1965-69, at different percentiles of the earnings distribution, controlling for other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (52y-25y)	0.518	0.202	0.317	0.573	0.199	0.374	0.622	0.449	0.173	0.842	0.459	0.382	0.879	0.563	0.317
	(0.127)	(0.084)	(0.154)	(0.083)	(0.058)	(0.104)	(0.047)	(0.050)	(0.071)	(0.052)	(0.068)	(0.087)	(0.081)	(0.066)	(0.102)
Changes in shares working in occupations (52y-25y)															
Flexible	-0.002	-0.005	0.002	0.025	-0.031	0.056	0.011	-0.036	0.047	0.020	-0.035	0.056	0.015	-0.023	0.038
	(0.017)	(0.016)	(0.022)	(0.017)	(0.016)	(0.024)	(0.009)	(0.015)	(0.019)	(0.009)	(0.015)	(0.018)	(0.009)	(0.010)	(0.014)
Abstract	0.049	0.029	0.020	0.057	0.019	0.038	0.036	0.018	0.018	0.026	0.020	0.006	0.020	0.016	0.004
	(0.032)	(0.021)	(0.038)	(0.026)	(0.014)	(0.029)	(0.015)	(0.013)	(0.017)	(0.013)	(0.014)	(0.018)	(0.016)	(0.012)	(0.019)
Social	0.007	0.000	0.007	-0.004	0.000	-0.004	0.007	0.000	0.007	-0.005	0.000	-0.005	0.012	0.000	0.012
	(0.030)	(0.003)	(0.032)	(0.026)	(0.003)	(0.026)	(0.016)	(0.002)	(0.016)	(0.015)	(0.005)	(0.017)	(0.015)	(0.002)	(0.016)
Total	*0.053*	*0.025*	*0.029*	*0.078*	*-0.011*	*0.090*	*0.054*	*-0.018*	*0.072*	*0.041*	*-0.015*	*0.056*	*0.047*	*-0.006*	*0.053*
	(0.043)	*(0.027)*	*(0.050)*	*(0.031)*	*(0.020)*	*(0.037)*	*(0.017)*	*(0.019)*	*(0.027)*	*(0.015)*	*(0.019)*	*(0.025)*	*(0.020)*	*(0.014)*	*(0.025)*
Changes in returns to occupations (52y-25y)															
Flexible	0.022	-0.041	0.063	-0.066	-0.059	-0.008	-0.006	-0.072	0.065	-0.017	-0.036	0.019	-0.030	-0.051	0.021
	(0.061)	(0.053)	(0.077)	(0.057)	(0.038)	(0.075)	(0.029)	(0.023)	(0.037)	(0.026)	(0.027)	(0.037)	(0.026)	(0.022)	(0.034)
Abstract	-0.110	-0.114	0.005	0.030	0.007	0.023	0.172	0.057	0.115	0.130	0.072	0.058	0.002	0.181	-0.179
	(0.180)	(0.098)	(0.214)	(0.134)	(0.066)	(0.153)	(0.071)	(0.056)	(0.091)	(0.072)	(0.076)	(0.101)	(0.107)	(0.069)	(0.130)
Social	0.174	-0.025	0.199	-0.115	-0.089	-0.026	-0.121	-0.063	-0.058	-0.089	-0.040	-0.049	0.100	-0.025	0.125
	(0.217)	(0.187)	(0.309)	(0.172)	(0.124)	(0.215)	(0.112)	(0.094)	(0.143)	(0.115)	(0.123)	(0.170)	(0.094)	(0.096)	(0.145)
Residual	0.379	0.357	0.022	0.646	0.351	0.295	0.523	0.544	-0.021	0.776	0.478	0.298	0.760	0.464	0.296
	(0.334)	(0.248)	(0.459)	(0.251)	(0.170)	(0.307)	(0.132)	(0.120)	(0.177)	(0.125)	(0.140)	(0.190)	(0.113)	(0.091)	(0.149)
Total	*0.465*	*0.177*	*0.288*	*0.495*	*0.210*	*0.284*	*0.568*	*0.467*	*0.101*	*0.800*	*0.474*	*0.326*	*0.832*	*0.569*	*0.263*
	(0.135)	*(0.079)*	*(0.157)*	*(0.086)*	*(0.055)*	*(0.101)*	*(0.048)*	*(0.048)*	*(0.071)*	*(0.051)*	*(0.067)*	*(0.086)*	*(0.078)*	*(0.065)*	*(0.100)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE B.21: Decomposition of changes in the gender wage gap for full-time workers across the distribution over the life cycle, controlling for other occupation characteristics

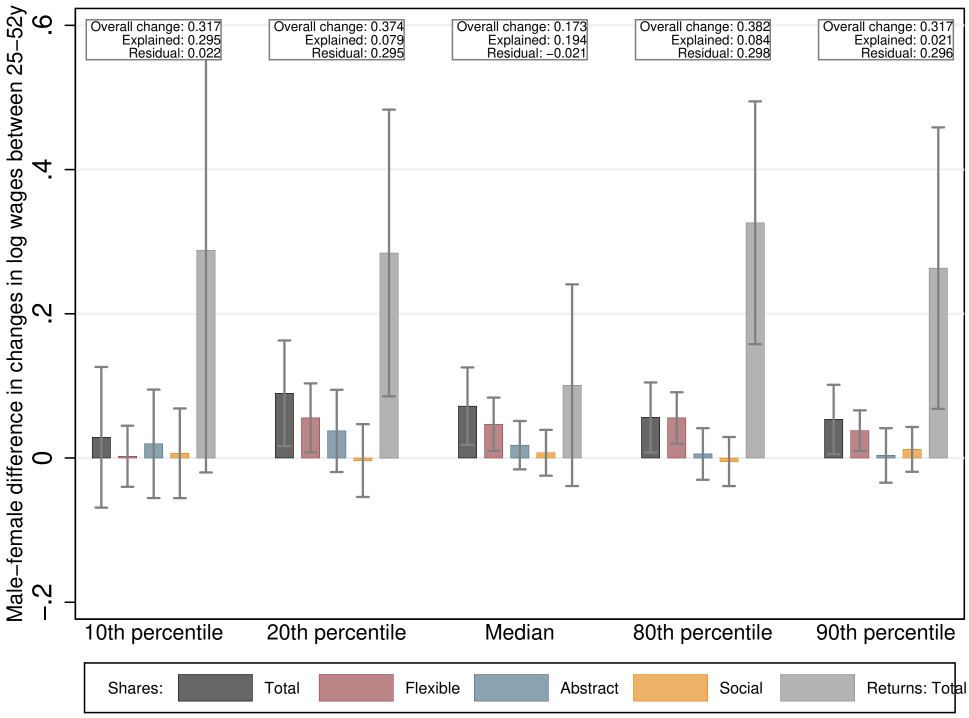


TABLE B.3: Decomposition of changes in log real hourly earnings over the life cycle for cohort of full-time workers born in 1965-69, at different percentiles of the earnings distribution, controlling for and interacting with other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (52y-25y)	0.518	0.202	0.317	0.573	0.199	0.374	0.622	0.449	0.173	0.842	0.459	0.382	0.879	0.563	0.317
	(0.126)	(0.084)	(0.151)	(0.083)	(0.058)	(0.105)	(0.046)	(0.050)	(0.071)	(0.052)	(0.068)	(0.086)	(0.081)	(0.021)	(0.103)
Changes in shares working in occupations (52y-25y)															
Flexible	0.037	0.016	0.022	0.036	0.001	0.035	0.009	0.000	0.009	0.011	-0.007	0.018	-0.002	-0.004	0.002
	(0.037)	(0.036)	(0.049)	(0.029)	(0.019)	(0.035)	(0.014)	(0.012)	(0.019)	(0.010)	(0.015)	(0.018)	(0.011)	(0.002)	(0.014)
Abstract	0.046	0.052	-0.006	0.061	0.025	0.036	0.036	0.029	0.007	0.042	0.027	0.015	0.020	0.016	0.005
	(0.051)	(0.039)	(0.065)	(0.046)	(0.020)	(0.053)	(0.030)	(0.022)	(0.037)	(0.031)	(0.025)	(0.043)	(0.028)	(0.010)	(0.035)
Social	-0.020	0.000	-0.020	-0.006	0.000	-0.006	-0.001	0.000	-0.001	0.005	0.000	0.005	0.014	0.000	0.014
	(0.057)	(0.012)	(0.061)	(0.046)	(0.006)	(0.048)	(0.024)	(0.006)	(0.026)	(0.020)	(0.001)	(0.021)	(0.023)	(0.001)	(0.023)
Flexible*Abstract	-0.001	-0.015	0.014	-0.001	0.013	-0.014	0.001	-0.009	0.010	0.001	-0.016	0.017	0.001	-0.002	0.004
	(0.005)	(0.027)	(0.030)	(0.004)	(0.017)	(0.019)	(0.005)	(0.019)	(0.021)	(0.005)	(0.029)	(0.031)	(0.006)	(0.001)	(0.028)
Flexible*Social	0.002	-0.038	0.040	0.002	-0.029	0.031	-0.001	-0.029	0.028	0.000	-0.010	0.010	0.000	-0.005	0.004
	(0.016)	(0.053)	(0.058)	(0.017)	(0.025)	(0.032)	(0.008)	(0.015)	(0.019)	(0.002)	(0.010)	(0.011)	(0.003)	(0.002)	(0.008)
Abstract*Social	-0.028	-0.018	-0.010	-0.017	-0.004	-0.013	0.008	-0.007	0.014	-0.017	-0.002	-0.015	0.021	0.002	0.019
	(0.078)	(0.023)	(0.081)	(0.065)	(0.009)	(0.069)	(0.041)	(0.010)	(0.042)	(0.042)	(0.012)	(0.047)	(0.044)	(0.002)	(0.047)
Flexible*Abstract*Social	-0.001	0.031	-0.032	-0.006	-0.013	0.007	0.005	-0.001	0.006	0.001	-0.007	0.008	0.001	-0.013	0.013
	(0.005)	(0.046)	(0.054)	(0.017)	(0.022)	(0.033)	(0.013)	(0.013)	(0.018)	(0.003)	(0.019)	(0.021)	(0.002)	(0.006)	(0.020)
Total	*0.035*	*0.028*	*0.007*	*0.070*	*-0.007*	*0.077*	*0.057*	*-0.016*	*0.073*	*0.043*	*-0.015*	*0.058*	*0.056*	*-0.006*	*0.062*
	(0.043)	*(0.028)*	*(0.051)*	*(0.031)*	*(0.023)*	*(0.038)*	*(0.018)*	*(0.021)*	*(0.030)*	*(0.017)*	*(0.021)*	*(0.027)*	*(0.023)*	*(0.014)*	*(0.028)*
Changes in returns to occupations (52y-25y)															
Flexible	-0.049	-0.145	0.096	0.103	-0.033	0.137	0.019	0.000	0.019	-0.006	-0.007	0.001	0.052	0.002	0.051
	(0.178)	(0.117)	(0.224)	(0.115)	(0.077)	(0.147)	(0.052)	(0.047)	(0.073)	(0.046)	(0.053)	(0.071)	(0.047)	(0.002)	(0.047)
Abstract	0.375	-0.282	0.657	0.641	0.197	0.444	-0.129	0.167	-0.296	-0.020	0.184	-0.204	-0.087	0.163	-0.250
	(0.424)	(0.213)	(0.583)	(0.334)	(0.170)	(0.416)	(0.215)	(0.157)	(0.315)	(0.254)	(0.265)	(0.410)	(0.094)	(0.008)	(0.248)
Social	0.483	-0.206	0.689	0.555	0.098	0.457	-0.231	0.218	-0.450	-0.124	0.126	-0.250	0.171	0.070	0.100
	(0.492)	(0.316)	(0.674)	(0.384)	(0.216)	(0.478)	(0.176)	(0.141)	(0.240)	(0.166)	(0.159)	(0.255)	(0.135)	(0.003)	(0.140)
Flexible*Abstract	0.040	0.081	-0.041	-0.033	-0.011	-0.022	0.041	0.024	0.017	0.034	0.021	0.013	-0.003	0.007	-0.010
	(0.094)	(0.063)	(0.124)	(0.064)	(0.045)	(0.087)	(0.047)	(0.043)	(0.074)	(0.052)	(0.063)	(0.091)	(0.026)	(0.002)	(0.071)
Flexible*Social	-0.016	0.211	-0.226	-0.103	0.083	-0.186	-0.001	-0.026	0.025	-0.012	-0.006	-0.006	-0.029	-0.004	-0.025
	(0.024)	(0.130)	(0.142)	(0.038)	(0.052)	(0.075)	(0.031)	(0.024)	(0.054)	(0.037)	(0.026)	(0.054)	(0.014)	(0.001)	(0.025)
Abstract*Social	-0.674	0.183	-0.857	-0.646	-0.173	-0.473	0.381	-0.113	0.494	0.175	-0.116	0.291	0.147	0.050	0.096
	(0.430)	(0.212)	(0.555)	(0.337)	(0.163)	(0.407)	(0.206)	(0.150)	(0.298)	(0.239)	(0.246)	(0.388)	(0.148)	(0.003)	(0.249)
Flexible*Abstract*Social	0.026	-0.199	0.225	0.031	-0.081	0.113	-0.066	-0.037	-0.029	-0.027	-0.023	-0.004	-0.019	-0.037	0.018
	(0.033)	(0.111)	(0.126)	(0.031)	(0.049)	(0.066)	(0.020)	(0.034)	(0.053)	(0.013)	(0.047)	(0.057)	(0.015)	(0.007)	(0.053)
Residual	0.297	0.531	-0.234	-0.046	0.126	-0.172	0.551	0.231	0.319	0.780	0.296	0.484	0.593	0.318	0.275
	(0.579)	(0.373)	(0.818)	(0.445)	(0.257)	(0.571)	(0.208)	(0.156)	(0.282)	(0.195)	(0.178)	(0.294)	(0.062)	(0.000)	(0.067)
Total	*0.483*	*0.174*	*0.310*	*0.503*	*0.206*	*0.297*	*0.565*	*0.465*	*0.100*	*0.799*	*0.474*	*0.325*	*0.824*	*0.569*	*0.255*
	(0.128)	*(0.079)*	*(0.154)*	*(0.085)*	*(0.054)*	*(0.103)*	*(0.048)*	*(0.047)*	*(0.070)*	*(0.051)*	*(0.066)*	*(0.084)*	*(0.075)*	*(0.011)*	*(0.100)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE B.22: Decomposition of changes in the gender wage gap for full-time workers across the distribution over the life cycle, controlling for and interacting with other occupation characteristics

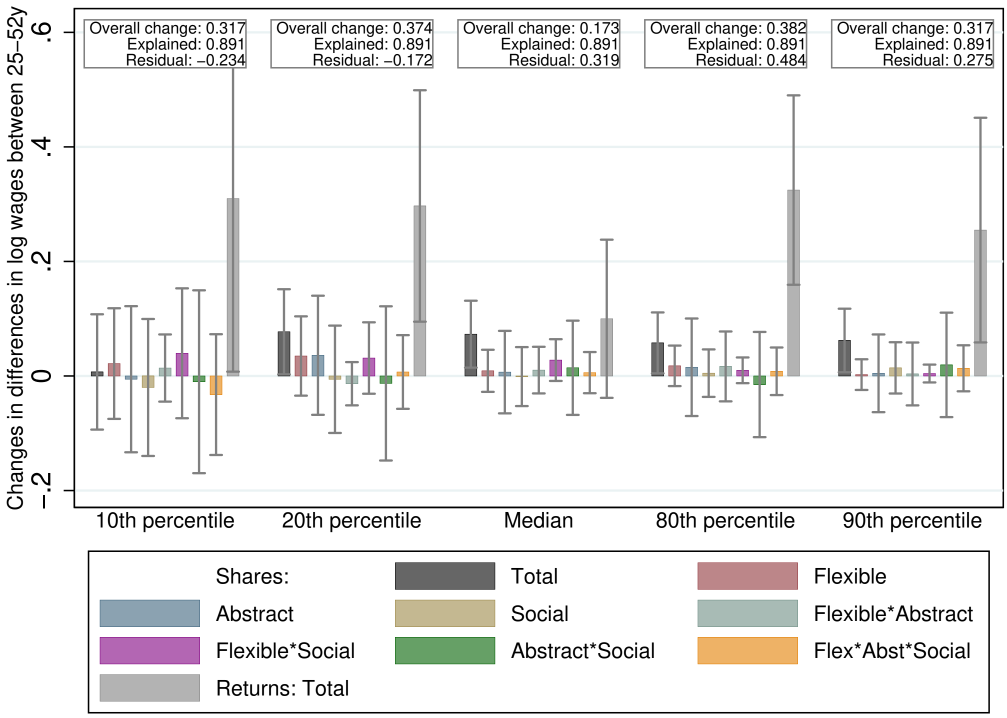


TABLE B.4: Decomposition of changes in log real hourly earnings across the distribution between cohorts of full-time workers born in 1965-69 and 1985-89 in age group 25-34

	Men	Women	Difference
10th percentile			
Difference in log real hourly wages (1985-1965)	-0.104	-0.087	-0.017
	(0.014)	(0.014)	(0.019)
Changes in shares in flexible occupations (1985-1965)	0.001	-0.027	0.028
	(0.002)	(0.003)	(0.003)
Changes in returns to flexible occupations (1985-1965)	-0.018	-0.009	-0.009
	(0.009)	(0.007)	(0.012)
Changes in residuals (1985-1965)	-0.087	-0.051	-0.036
	(0.014)	(0.013)	(0.019)
20th percentile			
Difference in log real hourly wages (1985-1965)	-0.122	-0.081	-0.041
	(0.012)	(0.012)	(0.016)
Changes in shares in flexible occupations (1985-1965)	0.001	-0.030	0.031
	(0.002)	(0.003)	(0.004)
Changes in returns to flexible occupations (1985-1965)	-0.012	-0.037	0.025
	(0.007)	(0.006)	(0.009)
Changes in residuals (1985-1965)	-0.111	-0.015	-0.097
	(0.012)	(0.012)	(0.016)
50th percentile			
Difference in log real hourly wages (1985-1965)	-0.082	-0.051	-0.031
	(0.010)	(0.009)	(0.013)
Changes in shares in flexible occupations (1985-1965)	0.001	-0.020	0.021
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1985-1965)	-0.001	-0.020	0.020
	(0.006)	(0.003)	(0.007)
Changes in residuals (1985-1965)	-0.082	-0.011	-0.071
	(0.012)	(0.010)	(0.014)
80th percentile			
Difference in log real hourly wages (1985-1965)	-0.114	-0.066	-0.048
	(0.012)	(0.010)	(0.016)
Changes in shares in flexible occupations (1985-1965)	0.001	-0.016	0.017
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1985-1965)	0.033	-0.010	0.043
	(0.005)	(0.003)	(0.006)
Changes in residuals (1985-1965)	-0.148	-0.041	-0.108
	(0.015)	(0.011)	(0.019)
90th percentile			
Difference in log real hourly wages (1985-1965)	-0.135	-0.094	-0.041
	(0.019)	(0.014)	(0.023)
Changes in shares in flexible occupations (1985-1965)	0.001	-0.016	0.017
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1985-1965)	0.009	0.007	0.002
	(0.008)	(0.004)	(0.009)
Changes in residuals (1985-1965)	-0.145	-0.086	-0.059
	(0.023)	(0.016)	(0.028)

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE B.5: Decomposition of changes in log real hourly earnings across the distribution between cohorts of full-time workers born in 1955-59 and 1975-79 in age group 35-44

	Men	Women	Difference
10th percentile			
Difference in log real hourly wages (1975-1955)	-0.067	0.007	-0.074
	(0.017)	(0.020)	(0.026)
Changes in shares in flexible occupations (1975-1955)	0.001	-0.026	0.028
	(0.003)	(0.004)	(0.006)
Changes in returns to flexible occupations (1975-1955)	-0.036	-0.017	-0.019
	(0.011)	(0.010)	(0.015)
Changes in residuals (1975-1955)	-0.033	0.050	-0.083
	(0.017)	(0.019)	(0.025)
20th percentile			
Difference in log real hourly wages (1975-1955)	-0.033	0.038	-0.071
	(0.013)	(0.015)	(0.019)
Changes in shares in flexible occupations (1975-1955)	0.001	-0.028	0.029
	(0.003)	(0.004)	(0.005)
Changes in returns to flexible occupations (1975-1955)	-0.019	-0.051	0.032
	(0.007)	(0.007)	(0.010)
Changes in residuals (1975-1955)	-0.015	0.117	-0.132
	(0.013)	(0.014)	(0.019)
50th percentile			
Difference in log real hourly wages (1975-1955)	0.028	0.102	-0.074
	(0.009)	(0.011)	(0.014)
Changes in shares in flexible occupations (1975-1955)	0.001	-0.015	0.016
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1975-1955)	-0.007	-0.020	0.013
	(0.004)	(0.004)	(0.006)
Changes in residuals (1975-1955)	0.034	0.137	-0.103
	(0.010)	(0.012)	(0.015)
80th percentile			
Difference in log real hourly wages (1975-1955)	0.069	0.146	-0.076
	(0.013)	(0.011)	(0.017)
Changes in shares in flexible occupations (1975-1955)	0.001	-0.009	0.009
	(0.002)	(0.001)	(0.003)
Changes in returns to flexible occupations (1975-1955)	-0.026	-0.004	-0.022
	(0.005)	(0.003)	(0.006)
Changes in residuals (1975-1955)	0.094	0.158	-0.064
	(0.016)	(0.012)	(0.019)
90th percentile			
Difference in log real hourly wages (1975-1955)	0.112	0.209	-0.097
	(0.018)	(0.019)	(0.026)
Changes in shares in flexible occupations (1975-1955)	0.001	-0.012	0.013
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1975-1955)	-0.010	-0.009	-0.002
	(0.005)	(0.005)	(0.007)
Changes in residuals (1975-1955)	0.121	0.230	-0.108
	(0.021)	(0.021)	(0.031)

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE B.6: Decomposition of changes in log real hourly earnings across the distribution between cohorts of individuals born in 1945-49 and 1965-69 in age group 45-55

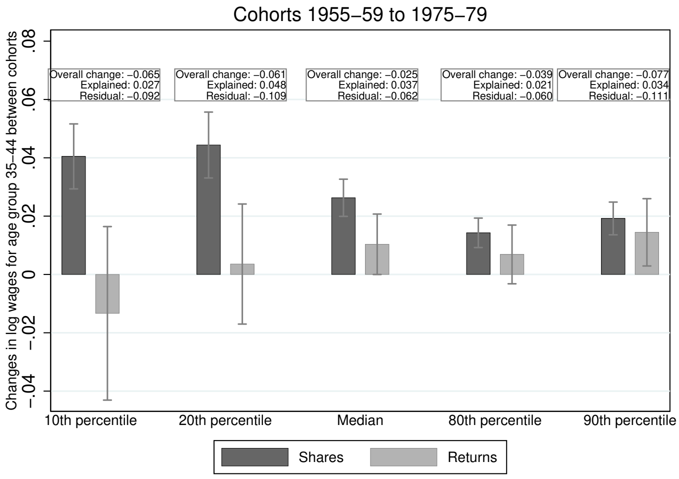
	Men	Women	Difference
10th percentile			
Difference in log real hourly wages (1965-1945)	-0.028	0.037	-0.065
	(0.020)	(0.018)	(0.027)
Changes in shares in flexible_p50 occupations (1965-1945)	0.000	-0.041	0.040
	(0.004)	(0.005)	(0.006)
Changes in returns to flexible_p50 occupations (1965-1945)	-0.023	-0.010	-0.013
	(0.013)	(0.009)	(0.015)
Changes in residuals (1965-1945)	-0.005	0.087	-0.092
	(0.019)	(0.017)	(0.025)
20th percentile			
Difference in log real hourly wages (1965-1945)	-0.005	0.056	-0.061
	(0.015)	(0.015)	(0.023)
Changes in shares in flexible_p50 occupations (1965-1945)	0.000	-0.044	0.044
	(0.003)	(0.005)	(0.006)
Changes in returns to flexible_p50 occupations (1965-1945)	-0.034	-0.037	0.004
	(0.009)	(0.007)	(0.011)
Changes in residuals (1965-1945)	0.029	0.137	-0.109
	(0.015)	(0.015)	(0.022)
50th percentile			
Difference in log real hourly wages (1965-1945)	0.061	0.086	-0.025
	(0.009)	(0.010)	(0.014)
Changes in shares in flexible_p50 occupations (1965-1945)	0.000	-0.026	0.026
	(0.002)	(0.003)	(0.003)
Changes in returns to flexible_p50 occupations (1965-1945)	-0.012	-0.022	0.010
	(0.004)	(0.003)	(0.005)
Changes in residuals (1965-1945)	0.073	0.134	-0.062
	(0.010)	(0.011)	(0.015)
80th percentile			
Difference in log real hourly wages (1965-1945)	0.119	0.158	-0.039
	(0.013)	(0.010)	(0.018)
Changes in shares in flexible_p50 occupations (1965-1945)	0.000	-0.014	0.014
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible_p50 occupations (1965-1945)	-0.008	-0.015	0.007
	(0.005)	(0.003)	(0.005)
Changes in residuals (1965-1945)	0.127	0.187	-0.060
	(0.015)	(0.011)	(0.020)
90th percentile			
Difference in log real hourly wages (1965-1945)	0.153	0.231	-0.077
	(0.014)	(0.017)	(0.023)
Changes in shares in flexible_p50 occupations (1965-1945)	0.000	-0.019	0.019
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible_p50 occupations (1965-1945)	-0.013	-0.028	0.014
	(0.005)	(0.004)	(0.006)
Changes in residuals (1965-1945)	0.166	0.278	-0.111
	(0.017)	(0.020)	(0.027)

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE B.23: Decomposition of changes in the gender wage gap across the distribution across cohorts

(a) Age 25-34

(b) Age 35-44



(c) Age 45-55

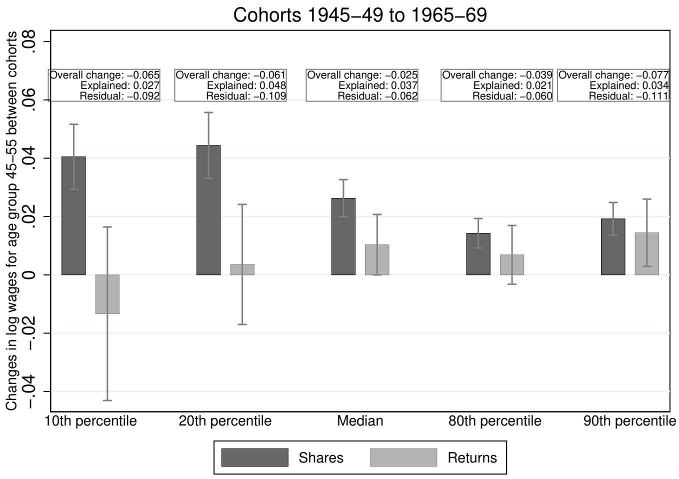


TABLE B.7: Decomposition of changes in log real hourly earnings across the distribution between cohorts of full-time workers born in 1965-69 and 1985-89 in age group 25-34, controlling for other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1985-65)	-0.108	-0.086	-0.021	-0.119	-0.083	-0.036	-0.077	-0.053	-0.024	-0.108	-0.062	-0.046	-0.126	-0.082	-0.045
	(0.015)	(0.014)	(0.020)	(0.013)	(0.012)	(0.017)	(0.011)	(0.010)	(0.015)	(0.013)	(0.011)	(0.016)	(0.021)	(0.015)	(0.026)
Changes in shares working in occupations (1985-65)															
Flexible	-0.002	-0.027	0.025	-0.002	-0.032	0.030	-0.003	-0.022	0.019	-0.005	-0.018	0.013	-0.005	-0.019	0.014
	(0.001)	(0.003)	(0.003)	(0.001)	(0.003)	(0.004)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Abstract	-0.001	0.007	-0.009	-0.001	0.008	-0.009	-0.001	0.008	-0.010	-0.001	0.009	-0.011	-0.001	0.011	-0.012
	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)
Social	0.001	0.000	0.001	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.002	0.000	0.001	0.003	-0.001
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Total	*-0.003*	*-0.020*	*0.017*	*-0.003*	*-0.024*	*0.020*	*-0.003*	*-0.013*	*0.010*	*-0.005*	*-0.007*	*0.002*	*-0.005*	*-0.005*	*0.000*
	(0.004)	*(0.004)*	*(0.006)*	*(0.004)*	*(0.004)*	*(0.006)*	*(0.004)*	*(0.003)*	*(0.005)*	*(0.004)*	*(0.003)*	*(0.005)*	*(0.004)*	*(0.004)*	*(0.005)*
Changes in returns to occupations (1985-65)															
Flexible	-0.004	-0.025	0.021	0.009	-0.049	0.057	0.018	-0.028	0.047	0.042	-0.012	0.054	0.020	0.007	0.013
	(0.010)	(0.009)	(0.013)	(0.008)	(0.007)	(0.011)	(0.007)	(0.004)	(0.008)	(0.007)	(0.004)	(0.008)	(0.011)	(0.005)	(0.012)
Abstract	0.029	-0.045	0.075	0.123	-0.020	0.142	0.082	-0.067	0.149	-0.025	-0.012	-0.013	0.076	-0.091	0.167
	(0.028)	(0.019)	(0.032)	(0.022)	(0.016)	(0.027)	(0.016)	(0.011)	(0.020)	(0.017)	(0.012)	(0.021)	(0.025)	(0.017)	(0.029)
Social	-0.046	-0.170	0.124	-0.041	-0.159	0.118	-0.010	-0.025	0.015	0.004	0.012	-0.007	-0.026	0.048	-0.074
	(0.029)	(0.036)	(0.047)	(0.024)	(0.028)	(0.034)	(0.020)	(0.020)	(0.026)	(0.024)	(0.022)	(0.034)	(0.038)	(0.034)	(0.052)
Residual	-0.084	0.174	-0.258	-0.206	0.168	-0.374	-0.164	0.080	-0.244	-0.124	-0.042	-0.081	-0.192	-0.040	-0.152
	(0.044)	(0.046)	(0.062)	(0.036)	(0.037)	(0.048)	(0.027)	(0.024)	(0.034)	(0.027)	(0.025)	(0.036)	(0.041)	(0.036)	(0.056)
Total	*-0.105*	*-0.067*	*-0.038*	*-0.116*	*-0.060*	*-0.056*	*-0.073*	*-0.040*	*-0.033*	*-0.103*	*-0.055*	*-0.048*	*-0.122*	*-0.076*	*-0.045*
	(0.015)	*(0.014)*	*(0.019)*	*(0.013)*	*(0.012)*	*(0.017)*	*(0.011)*	*(0.009)*	*(0.015)*	*(0.013)*	*(0.011)*	*(0.016)*	*(0.021)*	*(0.015)*	*(0.025)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE B.8: Decomposition of changes in log real hourly earnings across the distribution between cohorts of full-time workers born in 1955-59 and 1975-79 in age group 35-44, controlling for other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1975-55)	-0.065	0.002	-0.068	-0.028	0.037	-0.064	0.037	0.101	-0.064	0.088	0.150	-0.063	0.138	0.237	-0.100
	(0.019)	(0.021)	(0.028)	(0.014)	(0.016)	(0.022)	(0.009)	(0.012)	(0.016)	(0.014)	(0.012)	(0.018)	(0.017)	(0.021)	(0.026)
Changes in shares working in occupations (1975-55)															
Flexible	-0.004	-0.029	0.025	-0.003	-0.036	0.033	-0.002	-0.019	0.017	-0.004	-0.010	0.007	-0.004	-0.018	0.014
	(0.002)	(0.004)	(0.005)	(0.002)	(0.005)	(0.005)	(0.001)	(0.002)	(0.003)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)
Abstract	-0.005	0.013	-0.018	-0.005	0.015	-0.020	-0.003	0.019	-0.022	-0.003	0.016	-0.019	-0.003	0.021	-0.023
	(0.004)	(0.003)	(0.005)	(0.004)	(0.003)	(0.005)	(0.003)	(0.004)	(0.005)	(0.003)	(0.003)	(0.004)	(0.002)	(0.004)	(0.005)
Social	0.000	-0.003	0.003	0.000	0.001	-0.001	0.000	0.003	-0.003	0.000	0.003	-0.004	0.000	0.006	-0.006
	(0.000)	(0.002)	(0.002)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Total	*-0.009*	*-0.019*	*0.010*	*-0.008*	*-0.020*	*0.012*	*-0.005*	*0.002*	*-0.008*	*-0.007*	*0.008*	*-0.016*	*-0.007*	*0.009*	*-0.015*
	(0.005)	*(0.006)*	*(0.008)*	*(0.005)*	*(0.006)*	*(0.008)*	*(0.003)*	*(0.005)*	*(0.006)*	*(0.003)*	*(0.003)*	*(0.005)*	*(0.003)*	*(0.005)*	*(0.006)*
Changes in returns to occupations (1975-55)															
Flexible	-0.010	-0.021	0.012	-0.002	-0.066	0.064	0.005	-0.025	0.029	-0.014	-0.003	-0.011	-0.004	-0.015	0.011
	(0.011)	(0.012)	(0.016)	(0.008)	(0.008)	(0.012)	(0.005)	(0.005)	(0.007)	(0.006)	(0.004)	(0.007)	(0.006)	(0.005)	(0.008)
Abstract	0.064	-0.023	0.088	0.075	0.047	0.028	0.084	0.047	0.037	0.111	-0.010	0.121	0.032	0.073	-0.041
	(0.042)	(0.028)	(0.051)	(0.029)	(0.022)	(0.033)	(0.017)	(0.015)	(0.023)	(0.020)	(0.013)	(0.025)	(0.023)	(0.022)	(0.033)
Social	0.039	-0.246	0.285	0.036	-0.179	0.215	0.013	-0.115	0.128	-0.001	-0.008	0.008	-0.023	-0.059	0.036
	(0.050)	(0.068)	(0.086)	(0.035)	(0.045)	(0.059)	(0.022)	(0.029)	(0.036)	(0.031)	(0.026)	(0.042)	(0.038)	(0.047)	(0.064)
Residual	-0.150	0.312	-0.461	-0.129	0.254	-0.383	-0.059	0.191	-0.251	-0.002	0.163	-0.165	0.140	0.230	-0.091
	(0.066)	(0.081)	(0.106)	(0.046)	(0.055)	(0.074)	(0.025)	(0.034)	(0.042)	(0.031)	(0.028)	(0.044)	(0.036)	(0.048)	(0.062)
Total	*-0.056*	*0.021*	*-0.077*	*-0.020*	*0.057*	*-0.077*	*0.042*	*0.099*	*-0.057*	*0.095*	*0.142*	*-0.047*	*0.144*	*0.229*	*-0.084*
	(0.018)	*(0.020)*	*(0.027)*	*(0.013)*	*(0.015)*	*(0.021)*	*(0.009)*	*(0.011)*	*(0.015)*	*(0.014)*	*(0.011)*	*(0.018)*	*(0.017)*	*(0.021)*	*(0.026)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

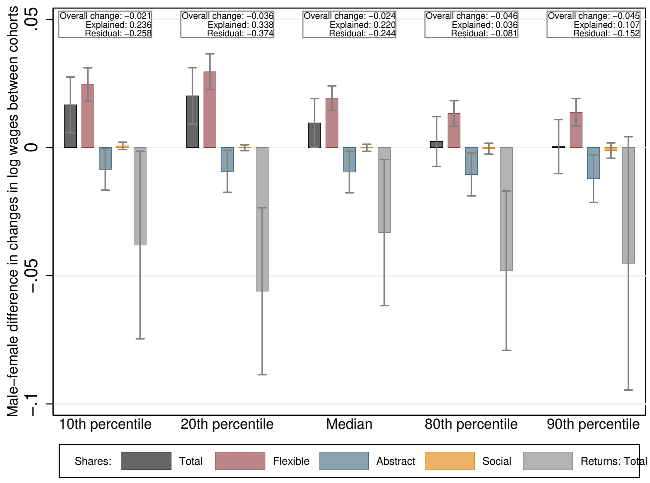
TABLE B.9: Decomposition of changes in log real hourly earnings across the distribution between cohorts of full-time workers born in 1945-49 and 1965-69 in age group 45-55, controlling for other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1965-45)	-0.029	0.035	-0.064	0.006	0.055	-0.050	0.065	0.085	-0.020	0.134	0.173	-0.040	0.171	0.249	-0.078
	(0.021)	(0.019)	(0.028)	(0.016)	(0.017)	(0.025)	(0.010)	(0.011)	(0.015)	(0.014)	(0.011)	(0.019)	(0.016)	(0.017)	(0.025)
Changes in shares working in occupations (1965-45)															
Flexible	-0.003	-0.037	0.034	-0.003	-0.046	0.043	-0.001	-0.030	0.028	-0.002	-0.018	0.016	-0.002	-0.021	0.020
	(0.002)	(0.005)	(0.005)	(0.002)	(0.005)	(0.005)	(0.001)	(0.003)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)
Abstract	-0.014	0.003	-0.017	-0.015	0.004	-0.019	-0.009	0.005	-0.014	-0.009	0.005	-0.014	-0.006	0.005	-0.011
	(0.004)	(0.002)	(0.004)	(0.004)	(0.003)	(0.005)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)	(0.004)	(0.002)	(0.004)	(0.004)
Social	-0.002	-0.007	0.005	-0.001	-0.004	0.003	0.000	0.001	-0.001	0.001	0.003	-0.002	0.000	0.004	-0.004
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Total	*-0.019*	*-0.040*	*0.022*	*-0.018*	*-0.046*	*0.028*	*-0.010*	*-0.023*	*0.013*	*-0.010*	*-0.010*	*0.000*	*-0.008*	*-0.012*	*0.005*
	(0.006)	*(0.006)*	*(0.008)*	*(0.005)*	*(0.006)*	*(0.008)*	*(0.003)*	*(0.004)*	*(0.005)*	*(0.003)*	*(0.004)*	*(0.005)*	*(0.002)*	*(0.004)*	*(0.005)*
Changes in returns to occupations (1965-45)															
Flexible	-0.021	-0.037	0.017	-0.018	-0.068	0.050	0.001	-0.039	0.040	-0.003	-0.024	0.021	-0.005	-0.031	0.026
	(0.014)	(0.011)	(0.018)	(0.011)	(0.008)	(0.013)	(0.006)	(0.004)	(0.007)	(0.007)	(0.003)	(0.008)	(0.007)	(0.004)	(0.008)
Abstract	-0.166	-0.077	-0.089	0.046	-0.057	0.103	0.107	-0.002	0.109	0.107	0.064	0.043	0.086	0.128	-0.042
	(0.054)	(0.025)	(0.058)	(0.039)	(0.022)	(0.045)	(0.020)	(0.014)	(0.024)	(0.024)	(0.012)	(0.028)	(0.025)	(0.018)	(0.031)
Social	0.039	-0.291	0.329	0.053	-0.292	0.345	-0.008	-0.108	0.100	-0.042	-0.046	0.004	0.013	-0.053	0.066
	(0.067)	(0.071)	(0.098)	(0.049)	(0.053)	(0.072)	(0.026)	(0.029)	(0.038)	(0.034)	(0.024)	(0.043)	(0.035)	(0.035)	(0.049)
Residual	0.138	0.481	-0.343	-0.057	0.518	-0.575	-0.025	0.257	-0.282	0.082	0.189	-0.107	0.084	0.217	-0.133
	(0.080)	(0.082)	(0.114)	(0.059)	(0.061)	(0.086)	(0.029)	(0.032)	(0.042)	(0.034)	(0.025)	(0.040)	(0.034)	(0.036)	(0.051)
Total	*-0.010*	*0.075*	*-0.085*	*0.024*	*0.101*	*-0.077*	*0.075*	*0.108*	*-0.033*	*0.144*	*0.183*	*-0.040*	*0.179*	*0.261*	*-0.082*
	(0.020)	*(0.018)*	*(0.027)*	*(0.015)*	*(0.016)*	*(0.024)*	*(0.009)*	*(0.011)*	*(0.014)*	*(0.014)*	*(0.011)*	*(0.018)*	*(0.016)*	*(0.017)*	*(0.025)*

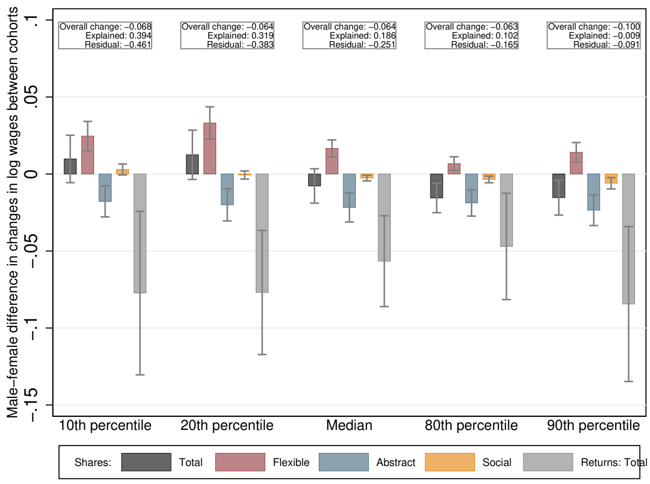
Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE B.24: Decomposition of changes in the gender wage gap for full-time workers across the distribution across cohorts, controlling for other occupation characteristics

(a) Age 25-34



(b) Age 35-44



(c) Age 45-55

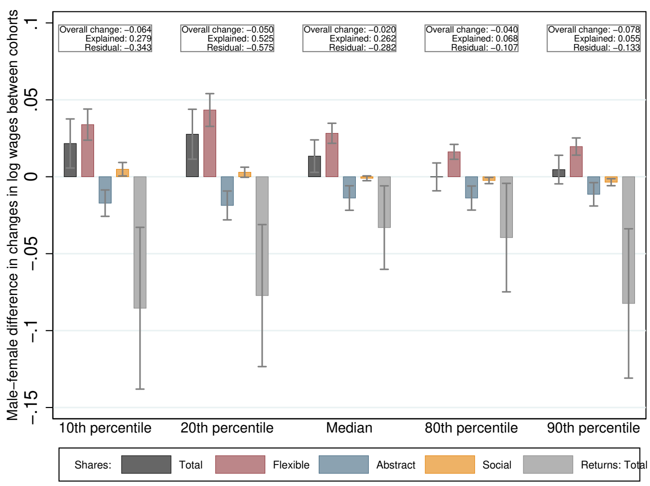


TABLE B.10: Decomposition of changes in log real hourly earnings across the distribution between cohorts of full-time workers born in 1965-69 and 1985-89 in age group 25-34, controlling for and interacting with other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1985-65)	-0.108	-0.086	-0.021	-0.119	-0.083	-0.036	-0.077	-0.053	-0.024	-0.108	-0.062	-0.046	-0.126	-0.082	-0.045
	(0.015)	(0.014)	(0.020)	(0.013)	(0.012)	(0.017)	(0.011)	(0.010)	(0.015)	(0.013)	(0.011)	(0.016)	(0.021)	(0.015)	(0.026)
Changes in shares working in occupations (1985-65)															
Flexible	-0.001	0.001	-0.003	-0.002	-0.001	-0.001	-0.002	-0.003	0.001	0.000	-0.004	0.004	0.000	0.002	-0.002
	(0.001)	(0.006)	(0.006)	(0.001)	(0.004)	(0.005)	(0.001)	(0.003)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Abstract	-0.002	0.015	-0.017	-0.002	0.016	-0.018	-0.002	0.014	-0.015	-0.002	0.013	-0.015	-0.002	0.019	-0.021
	(0.004)	(0.005)	(0.007)	(0.004)	(0.005)	(0.007)	(0.004)	(0.004)	(0.006)	(0.005)	(0.004)	(0.006)	(0.005)	(0.006)	(0.008)
Social	-0.001	-0.005	0.004	-0.001	-0.005	0.003	0.000	-0.002	0.002	-0.001	0.000	-0.001	-0.001	0.000	0.000
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)
Flexible*Abstract	0.000	-0.009	0.009	0.000	-0.014	0.014	0.000	-0.012	0.012	0.000	-0.010	0.010	0.000	-0.022	0.022
	(0.000)	(0.004)	(0.005)	(0.001)	(0.004)	(0.004)	(0.001)	(0.003)	(0.003)	(0.001)	(0.004)	(0.004)	(0.001)	(0.005)	(0.005)
Flexible*Social	-0.007	-0.027	0.019	-0.005	-0.024	0.019	-0.002	-0.009	0.007	-0.001	0.000	-0.001	-0.002	-0.001	0.000
	(0.004)	(0.006)	(0.007)	(0.002)	(0.005)	(0.005)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Abstract*Social	0.008	0.003	0.005	0.008	0.003	0.005	0.006	0.002	0.004	0.007	0.001	0.006	0.005	0.002	0.002
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)
Flexible*Abstract*Social	0.003	0.012	-0.009	0.002	0.012	-0.010	0.001	0.005	-0.004	0.000	-0.002	0.002	0.000	0.006	-0.006
	(0.003)	(0.005)	(0.006)	(0.002)	(0.004)	(0.005)	(0.001)	(0.003)	(0.003)	(0.000)	(0.003)	(0.003)	(0.001)	(0.004)	(0.004)
Total	*-0.001*	*-0.009*	*0.008*	*0.000*	*-0.013*	*0.013*	*0.001*	*-0.006*	*0.007*	*0.003*	*-0.002*	*0.005*	*0.000*	*0.005*	*-0.005*
	(0.005)	*(0.005)*	*(0.007)*	*(0.004)*	*(0.005)*	*(0.007)*	*(0.004)*	*(0.004)*	*(0.005)*	*(0.004)*	*(0.004)*	*(0.006)*	*(0.005)*	*(0.004)*	*(0.007)*
Changes in returns to occupations (1985-65)															
Flexible	0.055	-0.042	0.097	0.050	-0.063	0.113	0.011	-0.044	0.055	0.006	-0.011	0.017	-0.005	-0.001	-0.004
	(0.032)	(0.020)	(0.039)	(0.025)	(0.016)	(0.031)	(0.015)	(0.011)	(0.019)	(0.010)	(0.009)	(0.013)	(0.014)	(0.008)	(0.015)
Abstract	0.118	-0.178	0.296	0.202	-0.112	0.313	0.013	-0.111	0.123	-0.107	-0.024	-0.083	0.017	-0.152	0.169
	(0.075)	(0.054)	(0.092)	(0.060)	(0.047)	(0.077)	(0.043)	(0.037)	(0.055)	(0.049)	(0.042)	(0.063)	(0.072)	(0.065)	(0.094)
Social	0.073	-0.213	0.286	0.082	-0.166	0.248	-0.029	-0.037	0.009	-0.048	0.026	-0.074	-0.063	0.047	-0.110
	(0.087)	(0.070)	(0.113)	(0.068)	(0.061)	(0.091)	(0.042)	(0.042)	(0.057)	(0.029)	(0.034)	(0.042)	(0.039)	(0.026)	(0.045)
Flexible*Abstract	-0.030	0.013	-0.043	-0.012	0.032	-0.044	0.015	0.020	-0.005	0.033	0.010	0.023	0.032	0.022	0.010
	(0.018)	(0.012)	(0.022)	(0.015)	(0.012)	(0.020)	(0.012)	(0.008)	(0.015)	(0.014)	(0.008)	(0.015)	(0.024)	(0.011)	(0.025)
Flexible*Social	-0.009	0.025	-0.034	-0.025	0.028	-0.052	-0.010	0.019	-0.029	0.010	0.005	0.005	0.005	0.006	-0.001
	(0.027)	(0.016)	(0.032)	(0.018)	(0.012)	(0.022)	(0.011)	(0.007)	(0.013)	(0.007)	(0.005)	(0.009)	(0.008)	(0.005)	(0.009)
Abstract*Social	-0.070	0.146	-0.215	-0.087	0.106	-0.193	0.062	0.050	0.011	0.068	0.028	0.040	0.055	0.073	-0.018
	(0.071)	(0.051)	(0.088)	(0.057)	(0.045)	(0.073)	(0.041)	(0.035)	(0.053)	(0.047)	(0.039)	(0.059)	(0.069)	(0.061)	(0.090)
Flexible*Abstract*Social	0.006	-0.023	0.028	0.016	-0.043	0.059	0.003	-0.022	0.025	-0.014	-0.012	-0.002	-0.016	-0.015	-0.001
	(0.025)	(0.015)	(0.029)	(0.018)	(0.013)	(0.022)	(0.013)	(0.008)	(0.015)	(0.013)	(0.008)	(0.015)	(0.021)	(0.010)	(0.022)
Residual	-0.250	0.195	-0.445	-0.346	0.147	-0.494	-0.142	0.078	-0.220	-0.058	-0.082	0.024	-0.151	-0.065	-0.086
	(0.107)	(0.082)	(0.135)	(0.084)	(0.071)	(0.110)	(0.050)	(0.049)	(0.069)	(0.033)	(0.040)	(0.048)	(0.047)	(0.029)	(0.052)
Total	*-0.106*	*-0.077*	*-0.029*	*-0.120*	*-0.070*	*-0.049*	*-0.078*	*-0.047*	*-0.031*	*-0.111*	*-0.060*	*-0.051*	*-0.126*	*-0.087*	*-0.040*
	(0.015)	*(0.014)*	*(0.019)*	*(0.013)*	*(0.012)*	*(0.017)*	*(0.011)*	*(0.009)*	*(0.015)*	*(0.013)*	*(0.011)*	*(0.016)*	*(0.021)*	*(0.015)*	*(0.026)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE B.11: Decomposition of changes in log real hourly earnings across the distribution between cohorts of full-time workers born in 1955-59 and 1975-79 in age group 35-44, controlling for and interacting with other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1975-55)	-0.065	0.002	-0.068	-0.028	0.037	-0.064	0.037	0.101	-0.064	0.088	0.150	-0.063	0.138	0.237	-0.100
	(0.019)	(0.021)	(0.028)	(0.014)	(0.016)	(0.022)	(0.009)	(0.012)	(0.016)	(0.014)	(0.012)	(0.018)	(0.017)	(0.021)	(0.026)
Changes in shares working in occupations (1975-55)															
Flexible	-0.008	-0.009	0.002	-0.005	-0.014	0.009	-0.001	-0.005	0.004	-0.001	0.001	-0.002	-0.001	0.001	-0.001
	(0.004)	(0.006)	(0.007)	(0.002)	(0.005)	(0.005)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.000)	(0.002)	(0.003)
Abstract	-0.004	0.031	-0.035	-0.005	0.030	-0.035	-0.004	0.020	-0.024	-0.004	0.018	-0.022	-0.004	0.026	-0.030
	(0.004)	(0.007)	(0.008)	(0.004)	(0.007)	(0.008)	(0.003)	(0.005)	(0.006)	(0.004)	(0.004)	(0.006)	(0.004)	(0.007)	(0.008)
Social	0.000	-0.016	0.016	0.000	-0.012	0.012	0.000	-0.002	0.002	0.000	0.000	0.000	0.000	0.001	-0.001
	(0.000)	(0.004)	(0.004)	(0.001)	(0.003)	(0.003)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Flexible*Abstract	0.003	-0.001	0.004	0.001	-0.001	0.002	-0.001	-0.001	0.001	-0.001	-0.004	0.003	-0.002	-0.010	0.008
	(0.003)	(0.005)	(0.006)	(0.001)	(0.004)	(0.004)	(0.001)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.005)	(0.006)
Flexible*Social	-0.013	-0.013	0.000	-0.009	-0.016	0.007	-0.002	-0.005	0.002	-0.001	-0.002	0.001	-0.001	-0.002	0.001
	(0.005)	(0.005)	(0.007)	(0.003)	(0.004)	(0.006)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Abstract*Social	0.003	0.002	0.001	0.005	0.001	0.004	0.002	0.000	0.002	0.002	0.000	0.002	0.004	0.000	0.004
	(0.002)	(0.004)	(0.005)	(0.002)	(0.003)	(0.004)	(0.001)	(0.000)	(0.001)	(0.002)	(0.000)	(0.002)	(0.002)	(0.001)	(0.003)
Flexible*Abstract*Social	0.004	0.002	0.002	0.003	0.002	0.001	0.001	-0.004	0.005	0.001	-0.004	0.004	0.001	-0.004	0.005
	(0.003)	(0.005)	(0.006)	(0.003)	(0.003)	(0.004)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.003)	(0.004)
Total	*-0.015*	*-0.004*	*-0.011*	*-0.009*	*-0.009*	*0.000*	*-0.005*	*0.004*	*-0.008*	*-0.005*	*0.010*	*-0.015*	*-0.002*	*0.012*	*-0.014*
	(0.006)	*(0.006)*	*(0.009)*	*(0.005)*	*(0.007)*	*(0.009)*	*(0.003)*	*(0.005)*	*(0.006)*	*(0.004)*	*(0.004)*	*(0.005)*	*(0.003)*	*(0.006)*	*(0.007)*
Changes in returns to occupations (1975-55)															
Flexible	0.029	0.001	0.028	0.024	-0.058	0.081	0.004	-0.027	0.030	0.017	0.002	0.015	0.011	0.008	0.004
	(0.034)	(0.029)	(0.044)	(0.023)	(0.020)	(0.032)	(0.010)	(0.011)	(0.015)	(0.008)	(0.007)	(0.011)	(0.008)	(0.010)	(0.013)
Abstract	0.090	-0.221	0.310	0.038	-0.060	0.098	-0.050	-0.079	0.029	0.075	-0.107	0.182	0.038	-0.007	0.046
	(0.112)	(0.091)	(0.142)	(0.081)	(0.073)	(0.109)	(0.046)	(0.058)	(0.075)	(0.064)	(0.064)	(0.098)	(0.086)	(0.111)	(0.145)
Social	0.211	-0.153	0.364	0.127	-0.074	0.201	-0.058	-0.158	0.100	0.030	-0.014	0.045	0.022	-0.018	0.040
	(0.123)	(0.123)	(0.179)	(0.088)	(0.092)	(0.134)	(0.040)	(0.054)	(0.067)	(0.030)	(0.031)	(0.045)	(0.033)	(0.044)	(0.058)
Flexible*Abstract	0.000	-0.002	0.002	0.008	0.021	-0.013	0.006	0.009	-0.003	-0.003	0.004	-0.008	0.002	0.000	0.002
	(0.018)	(0.017)	(0.024)	(0.014)	(0.013)	(0.019)	(0.009)	(0.010)	(0.014)	(0.011)	(0.010)	(0.016)	(0.014)	(0.017)	(0.022)
Flexible*Social	-0.102	-0.014	-0.088	-0.046	-0.006	-0.040	-0.002	0.002	-0.005	-0.006	-0.005	-0.001	-0.002	-0.005	0.003
	(0.032)	(0.023)	(0.041)	(0.018)	(0.015)	(0.024)	(0.007)	(0.007)	(0.011)	(0.005)	(0.005)	(0.007)	(0.004)	(0.006)	(0.007)
Abstract*Social	-0.099	0.201	-0.300	0.008	0.104	-0.096	0.163	0.148	0.015	0.084	0.115	-0.031	0.010	0.120	-0.110
	(0.113)	(0.087)	(0.143)	(0.081)	(0.071)	(0.110)	(0.046)	(0.057)	(0.073)	(0.063)	(0.062)	(0.094)	(0.083)	(0.108)	(0.138)
Flexible*Abstract*Social	0.085	0.001	0.084	0.028	-0.017	0.044	-0.003	-0.011	0.008	-0.012	-0.002	-0.009	-0.008	-0.011	0.002
	(0.030)	(0.020)	(0.037)	(0.018)	(0.014)	(0.023)	(0.009)	(0.009)	(0.013)	(0.010)	(0.009)	(0.014)	(0.011)	(0.014)	(0.018)
Residual	-0.263	0.193	-0.456	-0.204	0.136	-0.340	-0.017	0.212	-0.229	-0.093	0.148	-0.240	0.068	0.139	-0.071
	(0.138)	(0.140)	(0.200)	(0.099)	(0.103)	(0.149)	(0.043)	(0.060)	(0.073)	(0.029)	(0.034)	(0.047)	(0.034)	(0.049)	(0.061)
Total	*-0.050*	*0.006*	*-0.057*	*-0.018*	*0.046*	*-0.064*	*0.042*	*0.098*	*-0.056*	*0.092*	*0.140*	*-0.048*	*0.140*	*0.225*	*-0.085*
	(0.018)	*(0.020)*	*(0.027)*	*(0.013)*	*(0.015)*	*(0.021)*	*(0.009)*	*(0.011)*	*(0.015)*	*(0.014)*	*(0.011)*	*(0.018)*	*(0.017)*	*(0.021)*	*(0.026)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

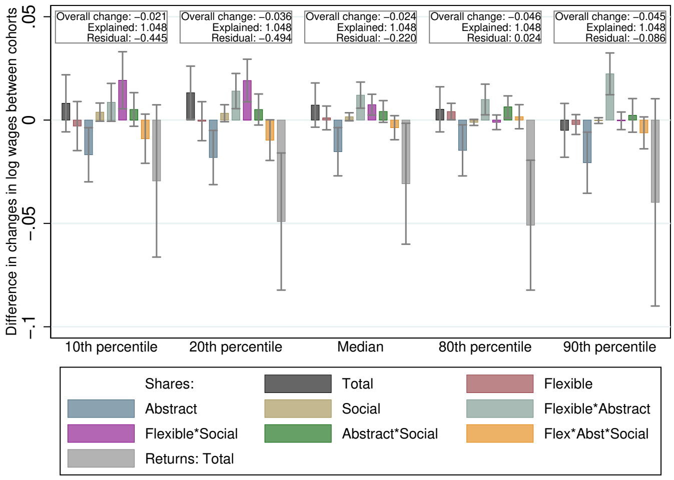
TABLE B.12: Decomposition of changes in log real hourly earnings across the distribution between cohorts of full-time workers born in 1945-49 and 1965-69 in age group 45-55, controlling for and interacting with other occupational characteristics

	10th percentile			*20th percentile*			*50th percentile*			*80th percentile*			*90th percentile*		
	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference	Men	Women	Difference
Difference in log real hourly wages (1965-45)	-0.029	0.035	-0.064	0.006	0.055	-0.050	0.065	0.085	-0.020	0.134	0.173	-0.040	0.171	0.249	-0.078
	(0.021)	(0.019)	(0.028)	(0.016)	(0.017)	(0.025)	(0.010)	(0.011)	(0.015)	(0.014)	(0.011)	(0.019)	(0.016)	(0.017)	(0.025)
Changes in shares working in occupations (1965-45)															
Flexible	-0.006	-0.022	0.016	-0.004	-0.017	0.013	-0.001	-0.004	0.003	-0.001	0.001	-0.002	0.000	0.001	-0.001
	(0.004)	(0.008)	(0.009)	(0.003)	(0.006)	(0.007)	(0.001)	(0.003)	(0.003)	(0.001)	(0.002)	(0.002)	(0.000)	(0.003)	(0.003)
Abstract	-0.012	0.007	-0.019	-0.014	0.010	-0.024	-0.010	0.007	-0.017	-0.010	0.006	-0.015	-0.006	0.005	-0.011
	(0.004)	(0.005)	(0.007)	(0.004)	(0.006)	(0.008)	(0.003)	(0.005)	(0.005)	(0.003)	(0.004)	(0.005)	(0.002)	(0.003)	(0.004)
Social	-0.002	-0.015	0.014	-0.002	-0.015	0.013	-0.001	-0.005	0.005	-0.001	-0.001	0.000	-0.001	0.001	-0.001
	(0.002)	(0.004)	(0.004)	(0.002)	(0.004)	(0.004)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Flexible*Abstract	-0.001	0.018	-0.019	-0.001	0.002	-0.002	0.000	-0.003	0.003	0.000	-0.004	0.004	0.000	-0.009	0.009
	(0.003)	(0.008)	(0.009)	(0.002)	(0.007)	(0.007)	(0.000)	(0.005)	(0.005)	(0.000)	(0.005)	(0.005)	(0.001)	(0.007)	(0.007)
Flexible*Social	-0.001	-0.004	0.003	-0.001	-0.008	0.007	0.000	-0.007	0.007	0.000	-0.004	0.004	0.000	-0.003	0.003
	(0.002)	(0.007)	(0.008)	(0.002)	(0.006)	(0.006)	(0.001)	(0.003)	(0.003)	(0.000)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
Abstract*Social	0.005	0.007	-0.003	0.005	0.009	-0.005	0.003	0.002	0.000	0.001	0.000	0.001	-0.003	-0.003	0.000
	(0.005)	(0.004)	(0.007)	(0.004)	(0.004)	(0.006)	(0.002)	(0.002)	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)
Flexible*Abstract*Social	-0.001	-0.027	0.025	-0.001	-0.022	0.022	0.000	-0.017	0.017	0.001	-0.013	0.014	0.000	-0.013	0.013
	(0.002)	(0.009)	(0.010)	(0.001)	(0.008)	(0.008)	(0.000)	(0.005)	(0.005)	(0.001)	(0.004)	(0.004)	(0.000)	(0.006)	(0.006)
Total	*-0.018*	*-0.035*	*0.017*	*-0.018*	*-0.041*	*0.024*	*-0.009*	*-0.026*	*0.017*	*-0.010*	*-0.014*	*0.005*	*-0.010*	*-0.021*	*0.011*
	(0.006)	*(0.007)*	*(0.010)*	*(0.006)*	*(0.007)*	*(0.010)*	*(0.003)*	*(0.005)*	*(0.006)*	*(0.003)*	*(0.004)*	*(0.005)*	*(0.003)*	*(0.005)*	*(0.006)*
Changes in returns to occupations (1965-45)															
Flexible	0.048	-0.051	0.099	0.038	-0.070	0.109	0.004	-0.007	0.011	0.005	0.009	-0.003	0.018	0.006	0.012
	(0.040)	(0.025)	(0.046)	(0.029)	(0.019)	(0.036)	(0.012)	(0.009)	(0.015)	(0.011)	(0.005)	(0.012)	(0.007)	(0.008)	(0.011)
Abstract	0.137	0.003	0.134	0.275	-0.054	0.330	0.078	0.160	-0.081	0.101	0.162	-0.061	0.103	0.181	-0.078
	(0.152)	(0.177)	(0.236)	(0.118)	(0.116)	(0.162)	(0.059)	(0.067)	(0.091)	(0.077)	(0.061)	(0.096)	(0.072)	(0.082)	(0.110)
Social	0.309	-0.268	0.578	0.321	-0.202	0.523	-0.015	0.047	-0.062	-0.031	0.050	-0.081	0.042	0.012	0.029
	(0.152)	(0.107)	(0.180)	(0.116)	(0.088)	(0.144)	(0.049)	(0.045)	(0.067)	(0.048)	(0.021)	(0.056)	(0.034)	(0.030)	(0.046)
Flexible*Abstract	-0.045	-0.007	-0.037	-0.015	0.005	-0.021	0.005	-0.016	0.022	0.004	-0.023	0.027	-0.010	-0.021	0.011
	(0.024)	(0.019)	(0.031)	(0.018)	(0.014)	(0.023)	(0.010)	(0.008)	(0.013)	(0.013)	(0.008)	(0.016)	(0.012)	(0.011)	(0.016)
Flexible*Social	-0.011	0.035	-0.045	-0.047	0.017	-0.064	0.012	-0.010	0.022	0.007	-0.009	0.016	-0.005	-0.003	-0.002
	(0.048)	(0.018)	(0.054)	(0.027)	(0.014)	(0.031)	(0.009)	(0.007)	(0.012)	(0.006)	(0.004)	(0.007)	(0.004)	(0.005)	(0.006)
Abstract*Social	-0.318	-0.073	-0.245	-0.268	0.000	-0.268	0.043	-0.139	0.182	0.027	-0.065	0.091	0.018	0.001	0.017
	(0.153)	(0.172)	(0.232)	(0.119)	(0.113)	(0.160)	(0.059)	(0.066)	(0.092)	(0.076)	(0.061)	(0.097)	(0.073)	(0.082)	(0.110)
Flexible*Abstract*Social	0.017	-0.013	0.030	0.034	-0.009	0.042	-0.019	0.009	-0.027	-0.017	0.010	-0.027	0.000	-0.001	0.000
	(0.047)	(0.018)	(0.053)	(0.028)	(0.014)	(0.031)	(0.011)	(0.008)	(0.014)	(0.011)	(0.006)	(0.013)	(0.010)	(0.009)	(0.013)
Residual	-0.149	0.444	-0.593	-0.314	0.410	-0.724	-0.035	0.068	-0.104	0.048	0.053	-0.006	0.017	0.095	-0.078
	(0.168)	(0.119)	(0.196)	(0.129)	(0.096)	(0.161)	(0.053)	(0.048)	(0.072)	(0.050)	(0.021)	(0.055)	(0.026)	(0.031)	(0.043)
Total	*-0.011*	*0.070*	*-0.081*	*0.023*	*0.097*	*-0.073*	*0.074*	*0.111*	*-0.037*	*0.144*	*0.188*	*-0.044*	*0.181*	*0.270*	*-0.089*
	(0.020)	*(0.018)*	*(0.027)*	*(0.015)*	*(0.016)*	*(0.024)*	*(0.009)*	*(0.011)*	*(0.014)*	*(0.014)*	*(0.011)*	*(0.018)*	*(0.016)*	*(0.017)*	*(0.025)*

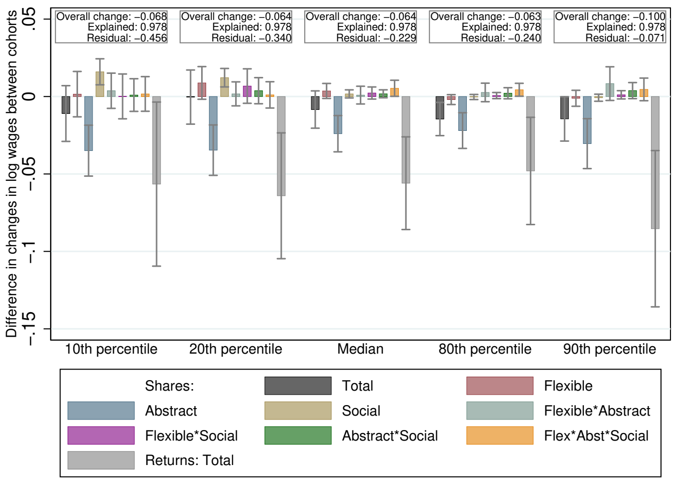
Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE B.25: Decomposition of changes in the gender wage gap for full-time workers across the distribution across cohorts, controlling for and interacting with other occupation characteristics

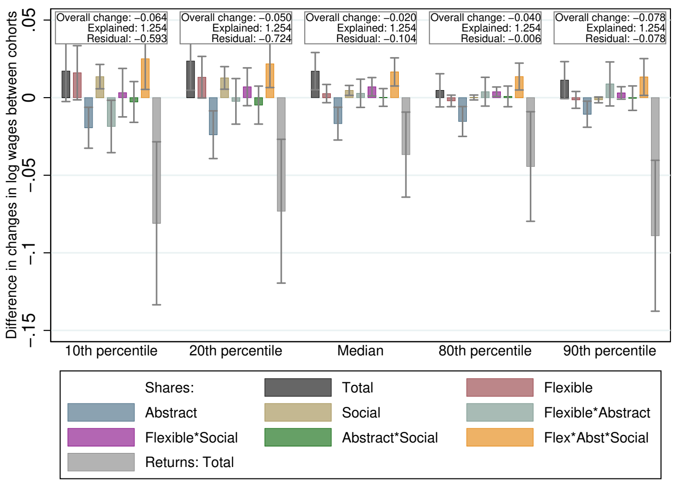
(a) Age 25-34



(b) Age 35-44



(c) Age 45-55



B.2 Decomposition results at the mean

Decomposition of the change in the gender wage gap over the life cycle

The decomposition of changes in the gender wage gap over the life cycle at the distributional mean is also considered to see how the changes in sorting behaviour and returns varied on average. Appendix Table B.13 and Appendix Figure B.26 show the results from the decomposition of the changes in the gender wage gap over the life cycle. The first line reports the difference in the log hourly wages between ages 25 and 52 for both men and women, and the difference between the two. Men's wage increased faster over the whole period compared to women's, which meant that the gender wage gap at age 52 was 58.7 log points higher than at age 25. The decomposition analysis allocates this difference in log hourly wages between ages 25 and 52 to changes in the proportion of individuals working in flexible occupations between these ages, changes in the returns to flexible occupations between these ages, and any other residual changes.

Men moving out of flexible occupations as they got older meant that their earnings increased over the life cycle by about 3.1 log points in total, while women's earnings fell over the life cycle by about 3.2 log points as a result of their increasing participation in flexible occupations at older ages. Both of these are consistent with there being a wage penalty associated with flexibility and it increasing at older ages. The net effect of these relative movements means that of the 20.4 log point increase in the gender wage gap between age 25 and 52, 6.2 log points (or more than a quarter of the total gap) is explained by gender differences in changes in shares working in flexible occupations between ages 25 and 52.

The decomposition results indicate that a significant proportion of the explained changes in wages (sum of the decomposition components attributed to shares and returns) were due to changes in how men and women sorted into flexible occupations over ages, with more than a quarter of the increase in the gender wage gap over the life cycle explained by this differential sorting over the life cycle.Wages over the life cycle did not change significantly due to changes in returns to working in flexible occupations. The observed increase in the flexibility wage penalty over ages (as seen in Figure 1.15) would imply a reduction in wages, but the resulting magnitudes are small and insignificant.

Given that the decomposition model used is simple and only tries to pinpoint the contribution of differential sorting into flexible occupations towards changes in the wage gap, it does explain a significant proportion (more than a quarter) of the total observed change in the gender wage gap between ages 25 and 52. The remaining 70% is attributed to unobserved characteristics that are not controlled for, such as changes in returns to non-flexible occupations, and other unobserved characteristics.

Appendix Table B.14 and Appendix Figure B.27 show the results from the Oaxaca-Blinder decomposition of the changes in the gender wage gap over the life cycle at the mean, controlling for sorting by occupation characteristics in addition to flexibility. The average gender age gap increased by 22.4 log points for the cohort of men and women born in 1955-69, more than a quarter (28.1%) of which was because of gender differences in patterns of sorting into flexible occupations by age. Sorting into occupations with high abstract and social skills explained much smaller proportions (8.5% and 0.9%) of the average increase in the gender wage gap over the life cycle. Changes in returns to occupations and other characteristics led to men's wages increasing by more than women's over the life cycle, increasing the gender wage gap.

Appendix Table B.15 and Appendix Figure B.28 include additional controls for the interactions between occupation characteristics. These results indicate that sorting is not mainly driven by occupation flexibility alone, though it remains important, as changes in the shares of women and men working in occupations that are flexible (in combination with other characteristics) explain more than a third of the mean increase in the gender wage gap over the life cycle, though this is not statistically significant due to small cell sizes. Therefore, sorting by occupation flexibility explains a larger proportion of the gender wage gap when considering that occupations that are more flexible may also be characterised by lower social and abstract skills.

Decomposition of the change in the gender wage gap for a given age group across cohorts

Results from the Oaxaca-Blinder decomposition of the average gender wage gap across cohorts are shown in Appendix Tables B.16, B.17, and B.18, and Appendix Figure B.29.

Both men and women aged 25-34 had lower wages on average in the 1985 cohort than in the 1965 cohort as seen in Appendix Table B.16 – this is likely due to the Great Recession and the fall in earnings that the 1985 cohort was exposed to soon after labour market entry – however, the net effect was that the gender wage gap reduced over these two cohorts, as the fall in men's wages was greater than for women. Increased sorting into flexible occupations reduced the wages of women in the 1985 cohort relative to the 1965 cohort (and had no effect on men's wages), with a net effect of an fall in the gender wage gap mostly driven by women in later cohorts increasingly sorting into flexible occupations. Changes in returns to flexible occupations reduced women's wages in the later cohort, as the younger cohort of women faced larger wage penalties associated with flexibility. This again led to the gender wage gap increasing between the cohorts. However, changes in residual factors reduced the gender wage gap between these cohorts more than the changes in flexibility increased them, so that if changes in sorting did not happen, the gender wage gap at ages 25-34 would have been reduced by double the current reduction, whereas the higher wage penalty in later cohorts meant that the gender wage gap in 1985 was two thirds what it would have been without it. Together, differences in occupation flexibility between the two cohorts countered the reductions in the gender wage gap from other factors more than fully, meaning that the gender wage gap did not in fact increase for the age group 25-34 between 1965 and 1985.

Appendix Table B.17 shows that for the two cohorts in the age group 35-44, both men's and women's wages were higher in the later cohort, but the increase in women's wages was high enough that the gender wage gap fell across these two cohorts. Increased sorting into flexible occupations in the later years reduced women's wages and therefore contributed towards increasing the gender wage gap across cohorts. Changes in returns to flexible occupations meant that especially male wages in the later cohort were negatively affected, so that the gender wage gap fell as a result of this. In the absence of differences between cohorts in flexibility, the gender wage gap would have reduced by an additional 30% for graduates aged 35-44 the 1975 cohort in comparison to the 1955 cohort.

Finally, individuals from the 1945 and 1965 cohorts in the age group 45-55 are compared in Appendix Table B.18 - for these cohorts too, both men and women in later cohorts had higher wages, but women's wages increased by a larger amount across cohorts and so the gender wage gap decreased. However, the decrease in the gender wage gap would have been 52% larger if not for the differences in sorting into flexible occupations across these two cohorts, which was mostly dominated by women in the latter cohort who were more likely to work in flexible occupations than the earlier cohort. On the other hand, the increase in the flexibility wage penalty across cohorts led to more of a decline in men's wages compared to women's, so that this led to a reduction in the gender wage gap across cohorts, though this was not statistically significant.

This above decomposition exercise considered for any given age group, the relative importance of differences in occupational sorting across cohorts versus differences in returns to occupations across cohorts in explaining the changes in the wage gap over cohorts. The gender wage gap fell across cohorts as the increase in later cohorts' women's wages outstripped the increase in men's wages for all age groups. This is despite the fact that women's wages were pushed down by their increasing participation in flexible occupations in more recent cohorts for all age groups, whereas men's wages were not affected likewise. The patterns observed here are consistent with trends showing an increase in likelihood of working in flexible occupations in more recent cohorts, as well as an increase in the wage penalty associated with flexibility in more recent cohorts.

Appendix Tables B.19, B.20, and B.21, and Appendix Figure B.30 include controls for occupations characterised by high levels of abstract and social skills, in addition to flexibility, in the decomposition analysis. For all three age groups considered, sorting into flexible occupations substantially increased the average gender wage gap, whereas sorting into occupations with high abstract and social skills reduced the gender wage gap at the mean (though by proportionately smaller amounts than the increases generated by sorting into flexible occupations) for later-born cohorts in all three age groups considered.

Appendix Tables B.22, B.23, and B.24, as well as Appendix Figure B.31 include controls for occupations characterised by high levels of multiple traits. While sorting into occupations with high flexibility increased the average gender wage gap for all age groups considered, in contrast to the above results, sorting into occupations with high abstract skills increased the average gender wage gap for later cohorts of the oldest age group of 45-55 year olds, and sorting into occupations with high social skills increased the average gender wage gap for later cohorts of all age groups.

TABLE B.13: Decomposition of changes in log real hourly earnings over the life cycle for cohort of individuals born in 1965-69

	Men	Women	Difference
Difference in log real hourly wages (52y-25y)	0.587	0.383	0.204
	(0.062)	(0.038)	(0.076)
Changes in shares in flexible occupations (52y-25y)	0.031	-0.032	0.062
	(0.012)	(0.012)	(0.018)
Changes in returns to flexible occupations (52y-25y)	-0.038	-0.027	-0.011
	(0.031)	(0.018)	(0.034)
Changes in residuals (52y-25y)	0.594	0.442	0.152
	(0.073)	(0.043)	(0.089)
Number of observations	418	532	950

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE B.26: Decomposition of average changes in the gender wage gap over the life cycle

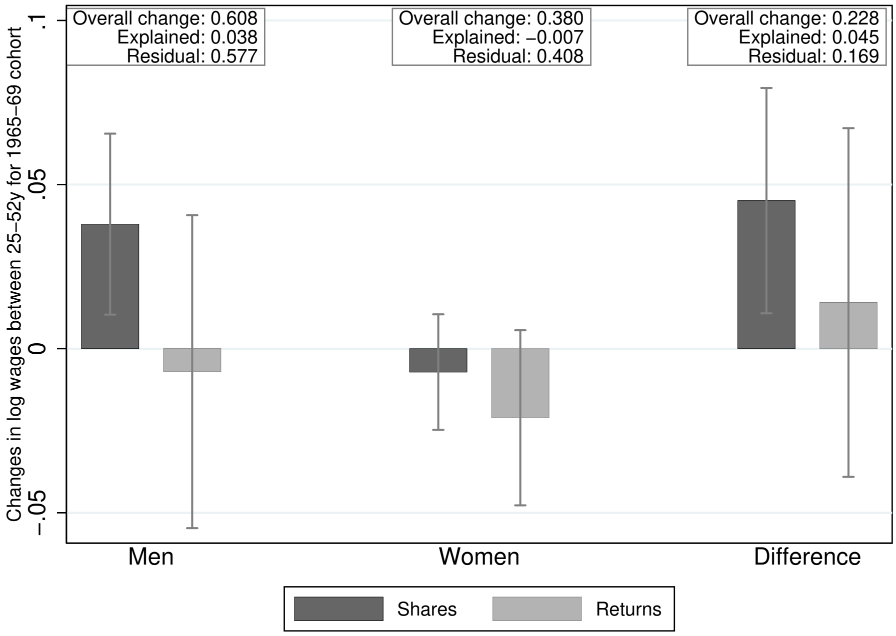


TABLE B.14: Decomposition of changes in log real hourly earnings over the life cycle for cohort of individuals born in 1965-69, controlling for other occupational characteristics

	Men	Women	Difference
Difference in log real hourly wages (52y-25y)	0.590	0.366	0.224
	(0.069)	(0.040)	(0.079)
Changes in shares working in occupations (52y-25y)			
Flexible	0.020	-0.043	0.063
	(0.010)	(0.014)	(0.017)
Abstract	0.045	0.026	0.019
	(0.016)	(0.013)	(0.020)
Social	-0.001	-0.002	0.002
	(0.013)	(0.004)	(0.014)
Total	*0.064*	*-0.020*	*0.084*
	(0.021)	*(0.018)*	*(0.027)*
Changes in returns to occupations (52y-25y)			
Flexible	-0.033	-0.055	0.022
	(0.032)	(0.021)	(0.042)
Abstract	0.104	-0.002	0.106
	(0.078)	(0.040)	(0.088)
Social	-0.056	-0.154	0.098
	(0.093)	(0.076)	(0.121)
Residual	0.511	0.596	-0.085
	(0.118)	(0.102)	(0.166)
Total	*0.526*	*0.386*	*0.140*
	(0.065)	*(0.038)*	*(0.075)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE B.27: Decomposition of average changes in the gender wage gap over the life cycle, controlling for other occupation characteristics

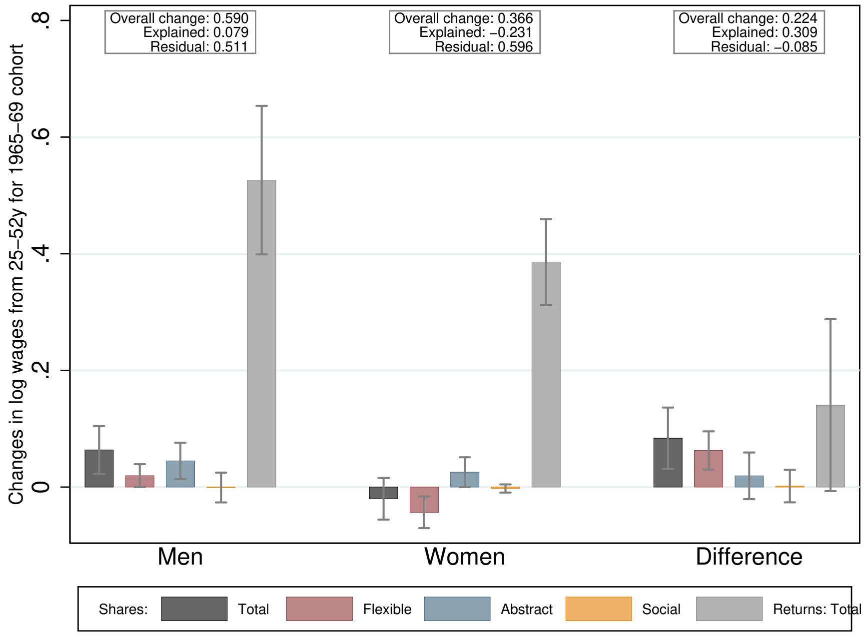


TABLE B.15: Decomposition of changes in log real hourly earnings over the life cycle for cohort of individuals born in 1965-69, controlling for and interacting with other occupational characteristics

	Men	Women	Difference
Difference in log real hourly wages (52y-25y)	0.590	0.366	0.224
	(0.069)	(0.040)	(0.079)
Changes in shares working in occupations (52y-25y)			
Flexible	0.018	0.001	0.017
	(0.014)	(0.013)	(0.019)
Abstract	0.054	0.038	0.016
	(0.024)	(0.021)	(0.032)
Social	0.007	0.003	0.004
	(0.021)	(0.005)	(0.021)
Flexible*Abstract	0.001	-0.010	0.011
	(0.004)	(0.017)	(0.018)
Flexible*Social	-0.004	-0.031	0.027
	(0.014)	(0.015)	(0.022)
Abstract*Social	-0.023	-0.007	-0.016
	(0.034)	(0.009)	(0.035)
Flexible*Abstract*Social	0.007	-0.015	0.022
	(0.019)	(0.016)	(0.026)
Total	*0.060*	*-0.020*	*0.080*
	(0.023)	*(0.021)*	*(0.031)*
Changes in returns to occupations (52y-25y)			
Flexible	0.030	0.047	-0.017
	(0.057)	(0.051)	(0.078)
Abstract	0.187	0.144	0.043
	(0.164)	(0.120)	(0.225)
Social	0.142	0.118	0.024
	(0.152)	(0.128)	(0.206)
Flexible*Abstract	0.008	-0.017	0.025
	(0.039)	(0.036)	(0.059)
Flexible*Social	-0.081	-0.002	-0.078
	(0.028)	(0.031)	(0.058)
Abstract*Social	-0.110	-0.102	-0.008
	(0.171)	(0.116)	(0.228)
Flexible*Abstract*Social	0.029	-0.041	0.070
	(0.033)	(0.032)	(0.058)
Residual	0.323	0.238	0.084
	(0.174)	(0.151)	(0.242)
Total	*0.530*	*0.386*	*0.144*
	(0.063)	*(0.036)*	*(0.075)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE B.28: Decomposition of average changes in the gender wage gap over the life cycle, controlling for and interacting with other occupation characteristics

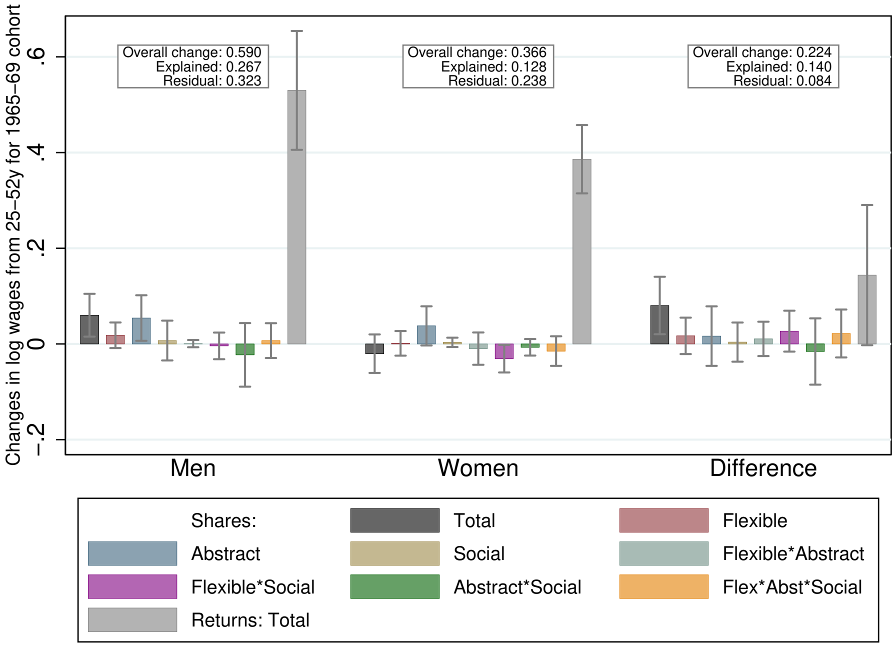


TABLE B.16: Decomposition of changes in log real hourly earnings between cohorts of individuals born in 1965-69 and 1985-89 in age group 25-34

	Men	Women	Difference
Difference in log real hourly wages (1985-65)	-0.118	-0.092	-0.026
	(0.009)	(0.008)	(0.012)
Changes in shares in flexible occupations (1985-65)	-0.001	-0.029	0.029
	(0.002)	(0.002)	(0.003)
Changes in returns to flexible occupations (1985-65)	0.001	-0.012	0.013
	(0.005)	(0.003)	(0.006)
Changes in residuals (1985-65)	-0.119	-0.051	-0.068
	(0.011)	(0.008)	(0.013)
Number of observations	14238	16117	30355

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE B.17: Decomposition of changes in log real hourly earnings between cohorts of individuals born in 1955-59 and 1975-79 in age group 35-44

	Men	Women	Difference
Difference in log real hourly wages (1975-55)	0.010	0.084	-0.075
	(0.009)	(0.009)	(0.012)
Changes in shares in flexible occupations (1975-55)	-0.001	-0.024	0.023
	(0.002)	(0.003)	(0.003)
Changes in returns to flexible occupations (1975-55)	-0.014	-0.003	-0.011
	(0.004)	(0.004)	(0.005)
Changes in residuals (1975-55)	0.024	0.111	-0.087
	(0.010)	(0.009)	(0.013)
Number of observations	15271	16407	31678

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE B.18: Decomposition of changes in log real hourly earnings between cohorts of individuals born in 1945-49 and 1965-69 in age group 45-55

	Men	Women	Difference
Difference in log real hourly wages (1965-45)	0.043	0.077	-0.034
	(0.010)	(0.009)	(0.013)
Changes in shares in flexible occupations (1965-45)	-0.003	-0.040	0.037
	(0.002)	(0.003)	(0.004)
Changes in returns to flexible occupations (1965-45)	-0.016	-0.010	-0.005
	(0.005)	(0.004)	(0.006)
Changes in residuals (1965-45)	0.061	0.127	-0.066
	(0.011)	(0.009)	(0.014)
Number of observations	14130	14829	28959

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE B.29: Decomposition of changes in the gender wage gap across cohorts

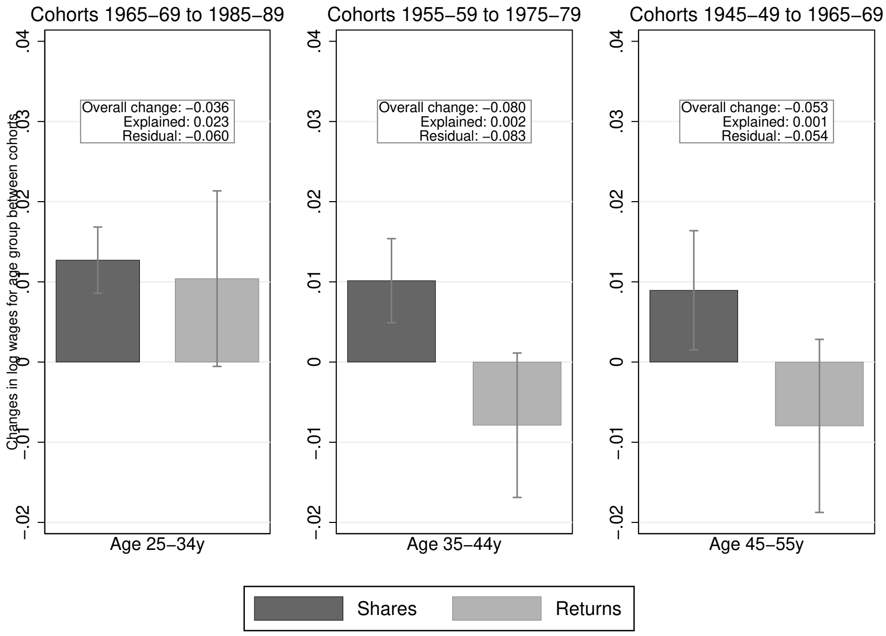


TABLE B.19: Decomposition of changes in log real hourly earnings between cohorts of individuals born in 1965-69 and 1985-89 in age group 25-34, controlling for other occupational characteristics

	Men	Women	Difference
Difference in log real hourly wages (1985-65)	-0.117	-0.093	-0.024
	(0.010)	(0.008)	(0.014)
Changes in shares working in occupations (1985-65)			
Flexible	-0.005	-0.032	0.027
	(0.001)	(0.002)	(0.003)
Abstract	-0.007	0.006	-0.013
	(0.003)	(0.002)	(0.004)
Social	0.001	0.002	-0.001
	(0.001)	(0.001)	(0.001)
Total	*-0.010*	*-0.023*	*0.013*
	(0.004)	*(0.003)*	*(0.005)*
Changes in returns to occupations (1985-65)			
Flexible	0.015	-0.017	0.033
	(0.005)	(0.004)	(0.007)
Abstract	0.064	-0.027	0.091
	(0.013)	(0.009)	(0.015)
Social	-0.035	-0.060	0.025
	(0.016)	(0.018)	(0.023)
Residual	-0.152	0.034	-0.186
	(0.021)	(0.021)	(0.029)
Total	*-0.108*	*-0.070*	*-0.038*
	(0.009)	*(0.008)*	*(0.012)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE B.20: Decomposition of changes in log real hourly earnings between cohorts of individuals born in 1955-59 and 1975-79 in age group 35-44, controlling for and interacting with other occupational characteristics

	Men	Women	Difference
Difference in log real hourly wages (1975-55)	0.018	0.086	-0.067
	(0.010)	(0.009)	(0.014)
Changes in shares working in occupations (1985-65)			
Flexible	-0.005	-0.031	0.026
	(0.001)	(0.003)	(0.003)
Abstract	-0.007	0.013	-0.020
	(0.003)	(0.003)	(0.004)
Social	0.000	0.003	-0.003
	(0.000)	(0.001)	(0.001)
Total	*-0.011*	*-0.015*	*0.003*
	(0.004)	*(0.004)*	*(0.006)*
Changes in returns to occupations (1975-55)			
Flexible	0.000	-0.004	0.004
	(0.005)	(0.004)	(0.007)
Abstract	0.078	-0.007	0.086
	(0.017)	(0.010)	(0.020)
Social	0.024	-0.084	0.109
	(0.023)	(0.023)	(0.030)
Residual	-0.132	0.071	-0.204
	(0.021)	(0.023)	(0.030)
Total	*-0.093*	*-0.047*	*-0.046*
	(0.009)	*(0.008)*	*(0.012)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE B.21: Decomposition of changes in log real hourly earnings between cohorts of individuals born in 1945-49 and 1965-69 in age group 45-55, controlling for other occupational characteristics

	Men	Women	Difference
Difference in log real hourly wages (1985-65)	0.051	0.081	-0.030
	(0.011)	(0.010)	(0.014)
Changes in shares working in occupations (1985-65)			
Flexible	-0.004	-0.047	0.043
	(0.001)	(0.003)	(0.004)
Abstract	-0.011	0.001	-0.012
	(0.003)	(0.003)	(0.004)
Social	0.000	0.001	-0.001
	(0.000)	(0.001)	(0.001)
Total	*-0.014*	*-0.045*	*0.030*
	(0.004)	*(0.004)*	*(0.005)*
Changes in returns to occupations (1985-65)			
Flexible	-0.006	-0.028	0.022
	(0.006)	(0.004)	(0.007)
Abstract	0.054	-0.053	0.107
	(0.021)	(0.011)	(0.025)
Social	0.005	-0.124	0.130
	(0.027)	(0.025)	(0.039)
Residual	0.011	0.330	-0.319
	(0.029)	(0.028)	(0.041)
Total	*0.065*	*0.125*	*-0.060*
	(0.010)	*(0.009)*	*(0.014)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

FIGURE B.30: Decomposition of changes in the gender wage gap across cohorts, controlling for other occupation characteristics

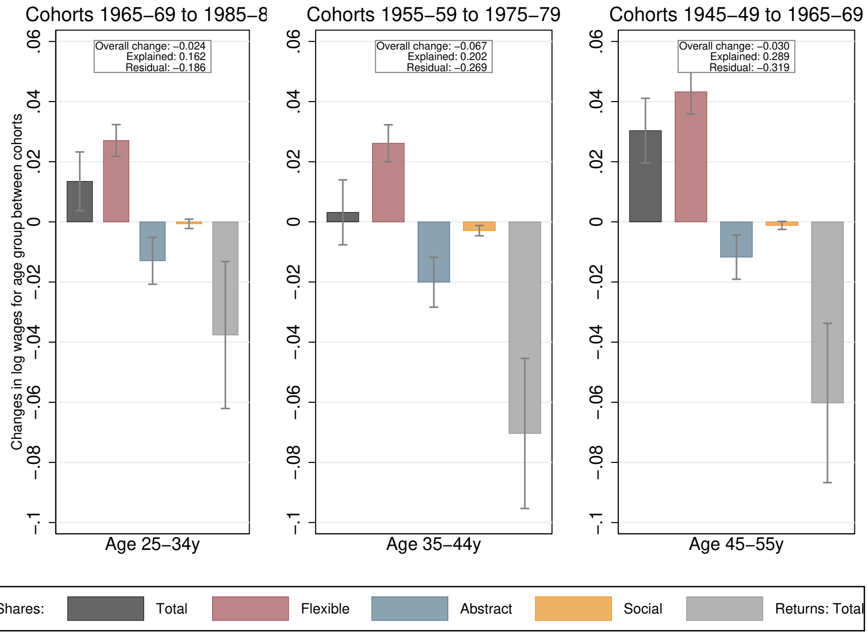


TABLE B.22: Decomposition of changes in log real hourly earnings between cohorts of individuals born in 1965-69 and 1985-89 in age group 25-34, controlling for and interacting with other occupational characteristics

	Men	Women	Difference
Difference in log real hourly wages (1985-65)	-0.117	-0.093	-0.024
	(0.010)	(0.008)	(0.014)
Changes in shares working in occupations (1985-65)			
Flexible	-0.002	-0.007	0.005
	(0.001)	(0.003)	(0.003)
Abstract	-0.008	0.010	-0.019
	(0.004)	(0.004)	(0.006)
Social	0.000	-0.003	0.002
	(0.000)	(0.001)	(0.001)
Flexible*Abstract	0.000	-0.012	0.012
	(0.001)	(0.003)	(0.003)
Flexible*Social	-0.004	-0.015	0.010
	(0.002)	(0.003)	(0.003)
Abstract*Social	0.007	0.003	0.003
	(0.002)	(0.002)	(0.003)
Flexible*Abstract*Social	0.001	0.005	-0.004
	(0.001)	(0.002)	(0.003)
Total	*-0.007*	*-0.017*	*0.010*
	(0.004)	*(0.004)*	*(0.005)*
Changes in returns to occupations (1985-65)			
Flexible	0.028	-0.030	0.058
	(0.012)	(0.010)	(0.016)
Abstract	0.049	-0.072	0.121
	(0.034)	(0.030)	(0.044)
Social	-0.006	-0.068	0.062
	(0.033)	(0.032)	(0.045)
Flexible*Abstract	0.007	0.014	-0.008
	(0.010)	(0.007)	(0.012)
Flexible*Social	-0.010	0.023	-0.032
	(0.009)	(0.007)	(0.012)
Abstract*Social	0.017	0.058	-0.042
	(0.033)	(0.029)	(0.041)
Flexible*Abstract*Social	-0.001	-0.022	0.021
	(0.010)	(0.007)	(0.012)
Residual	-0.194	0.021	-0.214
	(0.040)	(0.038)	(0.055)
Total	*-0.111*	*-0.077*	*-0.034*
	(0.009)	*(0.008)*	*(0.013)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE B.23: Decomposition of changes in log real hourly earnings between cohorts of individuals born in 1955-59 and 1975-79 in age group 35-44, controlling for and interacting with other occupational characteristics

	Men	Women	Difference
Difference in log real hourly wages (1975-55)	0.018	0.086	-0.067
	(0.010)	(0.009)	(0.014)
Changes in shares working in occupations (1975-55)			
Flexible	-0.004	-0.007	0.003
	(0.001)	(0.002)	(0.003)
Abstract	-0.008	0.020	-0.028
	(0.004)	(0.004)	(0.006)
Social	0.000	-0.007	0.007
	(0.000)	(0.001)	(0.001)
Flexible*Abstract	0.000	-0.004	0.003
	(0.000)	(0.002)	(0.002)
Flexible*Social	-0.005	-0.005	0.001
	(0.002)	(0.001)	(0.002)
Abstract*Social	0.004	0.002	0.002
	(0.002)	(0.001)	(0.002)
Flexible*Abstract*Social	0.002	-0.006	0.009
	(0.001)	(0.002)	(0.003)
Total	*-0.011*	*-0.007*	*-0.004*
	(0.004)	*(0.004)*	*(0.006)*
Changes in returns to occupations (1975-55)			
Flexible	0.025	-0.009	0.034
	(0.011)	(0.010)	(0.015)
Abstract	0.067	-0.111	0.178
	(0.051)	(0.044)	(0.068)
Social	0.078	-0.063	0.142
	(0.043)	(0.036)	(0.056)
Flexible*Abstract	-0.005	0.011	-0.016
	(0.009)	(0.009)	(0.012)
Flexible*Social	-0.022	0.001	-0.023
	(0.011)	(0.008)	(0.014)
Abstract*Social	0.020	0.115	-0.095
	(0.050)	(0.043)	(0.068)
Flexible*Abstract*Social	0.012	-0.006	0.018
	(0.011)	(0.009)	(0.015)
Residual	-0.147	0.155	-0.302
	(0.047)	(0.041)	(0.062)
Total	*0.029*	*0.092*	*-0.063*
	(0.010)	*(0.008)*	*(0.013)*

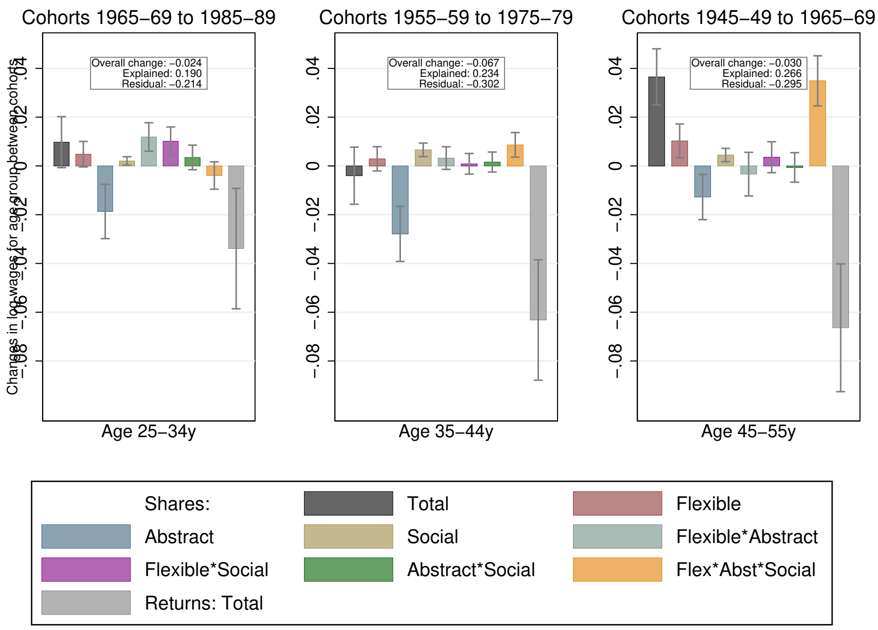
Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

TABLE B.24: Decomposition of changes in log real hourly earnings between cohorts of individuals born in 1945-49 and 1965-69 in age group 45-55, controlling for and interacting with other occupational characteristics

	Men	Women	Difference
Difference in log real hourly wages (1965-45)	0.051	0.081	-0.030
	(0.011)	(0.010)	(0.014)
Changes in shares working in occupations (1965-45)			
Flexible	-0.003	-0.014	0.010
	(0.001)	(0.003)	(0.004)
Abstract	-0.011	0.002	-0.013
	(0.003)	(0.004)	(0.005)
Social	-0.001	-0.006	0.004
	(0.001)	(0.001)	(0.001)
Flexible*Abstract	0.000	0.004	-0.003
	(0.000)	(0.005)	(0.005)
Flexible*Social	-0.001	-0.005	0.004
	(0.001)	(0.003)	(0.003)
Abstract*Social	0.003	0.003	-0.001
	(0.002)	(0.002)	(0.003)
Flexible*Abstract*Social	0.000	-0.035	0.035
	(0.000)	(0.005)	(0.005)
Total	*-0.014*	*-0.050*	*0.037*
	(0.004)	*(0.005)*	*(0.006)*
Changes in returns to occupations (1965-45)			
Flexible	0.021	-0.006	0.027
	(0.012)	(0.010)	(0.016)
Abstract	0.157	0.036	0.122
	(0.058)	(0.062)	(0.087)
Social	0.105	-0.019	0.124
	(0.049)	(0.032)	(0.061)
Flexible*Abstract	-0.014	-0.016	0.002
	(0.010)	(0.009)	(0.014)
Flexible*Social	-0.010	-0.005	-0.004
	(0.011)	(0.008)	(0.014)
Abstract*Social	-0.103	-0.065	-0.037
	(0.060)	(0.061)	(0.088)
Flexible*Abstract*Social	0.009	0.012	-0.004
	(0.013)	(0.009)	(0.015)
Residual	-0.101	0.195	-0.295
	(0.051)	(0.035)	(0.063)
Total	*0.065*	*0.131*	*-0.066*
	(0.010)	*(0.009)*	*(0.013)*

Notes: Standard errors are in parentheses. The standard errors for the difference in changes between men and women are obtained via bootstrap with 500 replications.

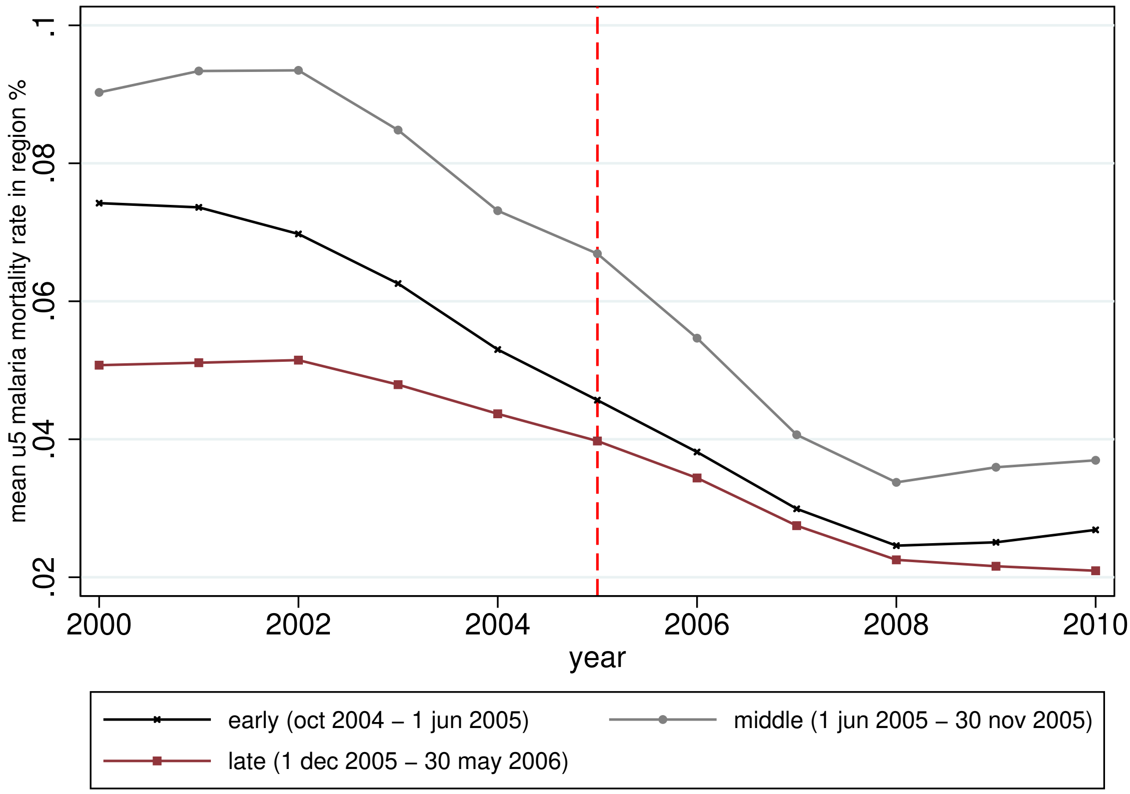
FIGURE B.31: Decomposition of changes in the gender wage gap across cohorts, controlling for and interacting with other occupation characteristics



C Appendix for Ch.3: Child malaria mortality decline, fertility, and female labour force participation in Tanzania

C.1 Additional Tables and Figures

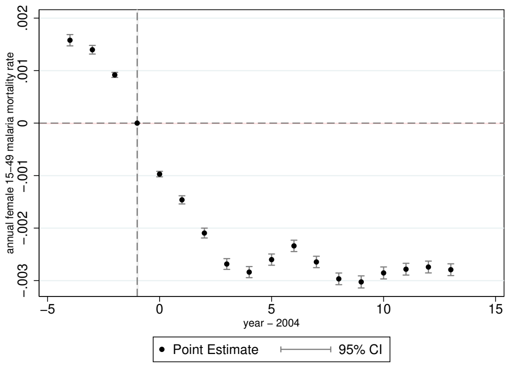
FIGURE C.1: Mean under five malaria mortality rates in regions grouped by implementation phase



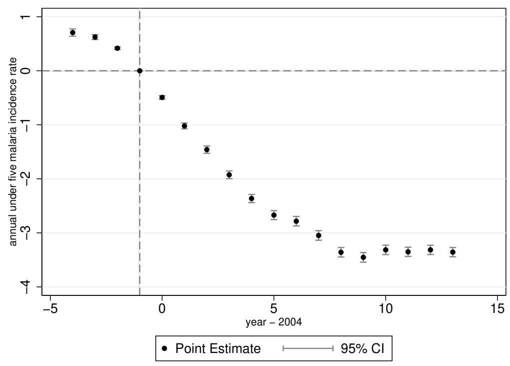
Notes: Data on locality specific under five malaria mortality rates estimated using GBD country-year level age- and cause-specific estimates of probabilities of death combined with Malaria Atlas Project modelled estimates on malaria mortality rates between 2000 and 2017 at a 5km × 5km resolution (Weiss et al., 2019).

FIGURE C.2: Event study of mortality and incidence rates

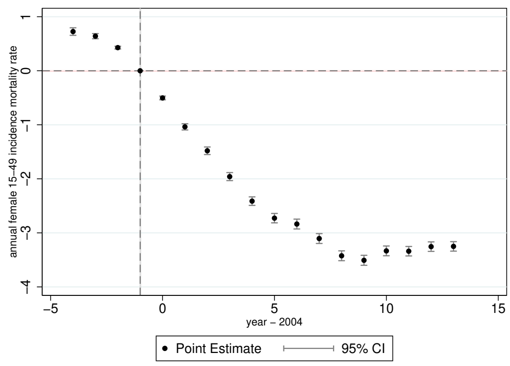
(a) Mortality, women aged 15-49



(b) Incidence, under five

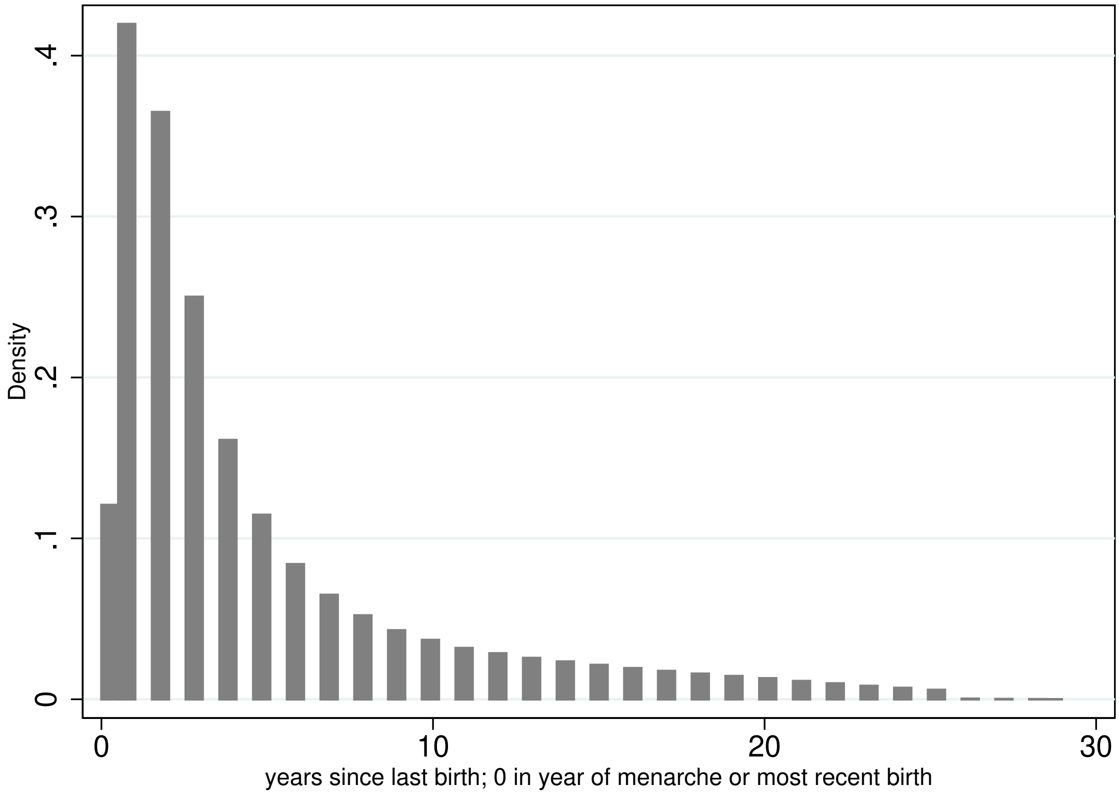


(c) Incidence, women aged 15-49



Note: The figures plot the lag and lead coefficients and 95% confidence intervals from panel event study models, where the lags and leads are calculated relative to the year 2004, as the intervention start year. The outcomes of interest are the mortality and incidence rates in the years leading up to and following on from 2004. The event study models include DHS cluster fixed effects and standard errors are clustered at the DHS cluster. These figures were plotted using the eventdd command on Stata.

FIGURE C.3: Distribution of time since last birth



Notes: The graph plots the distribution of the years since last birth. For each woman it is equal to zero in the year of menarche, or in the year of the most recent birth.

TABLE C.1: Probability of higher order birth as a function of exposure to the malaria intervention: results from the hazard model estimation by birth order

	probability of second birth				probability of third birth				probability of fourth or higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post-2004 * base under 5 malaria mortality rate	0.1943***	0.0785	-0.0816	0.1142	0.1782***	0.2571**	-0.0900	0.0947	0.0581	0.2570***	-0.1438*	-0.0247
	(0.0552)	(0.1159)	(0.0868)	(0.2285)	(0.0564)	(0.1130)	(0.1020)	(0.2330)	(0.0451)	(0.0747)	(0.0758)	(0.1365)
primary education	-0.0283***	0.0000	-0.0187***	0.0000	-0.0358***	0.0000	-0.0287***	0.0000	-0.0313***	0.0000	-0.0256***	0.0000
	(0.0040)	(.)	(0.0041)	(.)	(0.0045)	(.)	(0.0045)	(.)	(0.0030)	(.)	(0.0030)	(.)
secondary education	-0.0593***	0.0000	-0.0533***	0.0000	-0.0684***	0.0000	-0.0618***	0.0000	-0.0676***	0.0000	-0.0585***	0.0000
	(0.0058)	(.)	(0.0059)	(.)	(0.0070)	(.)	(0.0072)	(.)	(0.0052)	(.)	(0.0053)	(.)
higher education	-0.0978***	0.0000	-0.0724***	0.0000	-0.1132***	0.0000	-0.0838***	0.0000	-0.0787***	0.0000	-0.0591***	0.0000
	(0.0144)	(.)	(0.0158)	(.)	(0.0195)	(.)	(0.0184)	(.)	(0.0194)	(.)	(0.0195)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.133	0.344	0.151	0.356	0.133	0.325	0.152	0.339	0.119	0.219	0.132	0.229
Number of observations	88,893	88,893	88,893	88,893	68,821	68,821	68,821	68,821	154,590	154,590	154,590	154,590
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		28,815		28,815		22,116		22,116		18,819		18,819

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of giving birth to a second child was 0.25, 0.24 for a third child or a fourth and higher order child.

TABLE C.2: Probability of live birth as a function of exposure to the malaria intervention: results from the hazard model estimation, sample of women aged 15–40 in 1992-2016

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post-2004 * base under 5 malaria mortality rate	0.0438*	0.1439***	-0.0435	0.0407	-0.1098***	-0.1597***	0.0118	0.0738	0.1348***	0.1863***	-0.0701	0.0381
	(0.0229)	(0.0376)	(0.0384)	(0.0634)	(0.0237)	(0.0387)	(0.0446)	(0.0773)	(0.0350)	(0.0531)	(0.0571)	(0.0945)
primary education	-0.0222***	0.0000	-0.0175***	0.0000	-0.0132***	0.0000	-0.0121***	0.0000	-0.0272***	0.0000	-0.0203***	0.0000
	(0.0016)	(.)	(0.0015)	(.)	(0.0021)	(.)	(0.0020)	(.)	(0.0022)	(.)	(0.0021)	(.)
secondary education	-0.0621***	0.0000	-0.0590***	0.0000	-0.0740***	0.0000	-0.0720***	0.0000	-0.0487***	0.0000	-0.0445***	0.0000
	(0.0020)	(.)	(0.0020)	(.)	(0.0023)	(.)	(0.0023)	(.)	(0.0036)	(.)	(0.0035)	(.)
higher education	-0.0830***	0.0000	-0.0735***	0.0000	-0.0925***	0.0000	-0.0903***	0.0000	-0.0811***	0.0000	-0.0617***	0.0000
	(0.0038)	(.)	(0.0039)	(.)	(0.0042)	(.)	(0.0041)	(.)	(0.0102)	(.)	(0.0100)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.095	0.124	0.101	0.132	0.054	0.134	0.061	0.144	0.108	0.189	0.119	0.196
Number of observations	597,056	597,056	597,056	597,056	284,752	284,752	284,752	284,752	312,304	312,304	312,304	312,304
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,542		55,542		45,849		45,849		35,626		35,626

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016, born between 1952 and 2001. Between 1992 and 2003, the average probability of giving birth to a child who was still alive was 0.14, 0.07 for women who were likely to give birth to their first child, and 0.22 for women who were likely to have higher order births.

TABLE C.3: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation considering the decline in malaria mortality for infants

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post-2004 * base infant malaria mortality rate	0.0759	0.2957***	-0.1027	0.0647	-0.2366***	-0.3413***	0.0443	0.2069	0.2485***	0.4067***	-0.1813	0.0343
	(0.0479)	(0.0815)	(0.0826)	(0.1381)	(0.0515)	(0.0808)	(0.0956)	(0.1623)	(0.0716)	(0.1152)	(0.1178)	(0.2017)
primary education	-0.0268***	0.0000	-0.0219***	0.0000	-0.0170***	0.0000	-0.0157***	0.0000	-0.0322***	0.0000	-0.0252***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0021)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0733***	0.0000	-0.0688***	0.0000	-0.0857***	0.0000	-0.0828***	0.0000	-0.0620***	0.0000	-0.0555***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0025)	(.)	(0.0025)	(.)	(0.0038)	(.)	(0.0037)	(.)
higher education	-0.0955***	0.0000	-0.0840***	0.0000	-0.1045***	0.0000	-0.1011***	0.0000	-0.0968***	0.0000	-0.0747***	0.0000
	(0.0040)	(.)	(0.0042)	(.)	(0.0045)	(.)	(0.0045)	(.)	(0.0102)	(.)	(0.0101)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.103	0.141	0.110	0.151	0.058	0.144	0.065	0.154	0.118	0.215	0.130	0.222
Number of observations	597,056	597,056	597,056	597,056	284,752	284,752	284,752	284,752	312,304	312,304	312,304	312,304
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,542		55,542		45,849		45,849		35,626		35,626

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016, born between 1952 and 2001. Between 1992 and 2003, the average probability of birth was 0.16, 0.08 for women who were likely to give birth to their first child, and 0.24 for women who were likely to have higher order births.

TABLE C.4: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation using regional malaria mortality rates, sample of women aged 15–40 in 1992-2016

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post 2004 x base region level u5 mort rate	-0.0735**	-0.0097	-0.0027	-0.0084	-0.3510***	-0.4461***	-0.0967**	-0.0520	0.1685***	0.1138*	0.0923	0.0483
	(0.0326)	(0.0459)	(0.0404)	(0.0421)	(0.0415)	(0.0464)	(0.0491)	(0.0553)	(0.0392)	(0.0639)	(0.0584)	(0.0619)
primary education	-0.0239***	0.0000	-0.0243***	0.0000	-0.0151***	0.0000	-0.0158***	0.0000	-0.0301***	0.0000	-0.0305***	0.0000
	(0.0017)	(.)	(0.0017)	(.)	(0.0021)	(.)	(0.0021)	(.)	(0.0023)	(.)	(0.0023)	(.)
secondary education	-0.0724***	0.0000	-0.0723***	0.0000	-0.0813***	0.0000	-0.0811***	0.0000	-0.0641***	0.0000	-0.0647***	0.0000
	(0.0021)	(.)	(0.0021)	(.)	(0.0024)	(.)	(0.0024)	(.)	(0.0036)	(.)	(0.0036)	(.)
higher education	-0.0849***	0.0000	-0.0858***	0.0000	-0.0912***	0.0000	-0.0926***	0.0000	-0.0861***	0.0000	-0.0874***	0.0000
	(0.0040)	(.)	(0.0040)	(.)	(0.0043)	(.)	(0.0041)	(.)	(0.0097)	(.)	(0.0098)	(.)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional time trend	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.103	0.141	0.104	0.149	0.050	0.145	0.052	0.148	0.121	0.215	0.122	0.220
Number of observations	597,056	597,056	597,056	597,056	284,752	284,752	284,752	284,752	312,304	312,304	312,304	312,304
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,542		55,542		45,849		45,849		35,626		35,626

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016, born between 1952 and 2001. Between 1992 and 2003, the average probability of birth was 0.16, 0.08 for women who were likely to give birth to their first child, and 0.24 for women who were likely to have higher order births.

TABLE C.5: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation, sample of women aged 12-38 in 1992-2016

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post-2004 indicator * pre-intevention under 5 malaria mortality rate	0.0189	0.0756**	-0.0354	0.0446	-0.1024***	-0.2245***	0.0210	0.1100*	0.1307***	0.1942***	-0.0750	0.0254
	(0.0209)	(0.0368)	(0.0367)	(0.0638)	(0.0198)	(0.0337)	(0.0364)	(0.0641)	(0.0370)	(0.0601)	(0.0609)	(0.1076)
primary education	-0.0247***	0.0000	-0.0213***	0.0000	-0.0151***	0.0000	-0.0145***	0.0000	-0.0331***	0.0000	-0.0263***	0.0000
	(0.0016)	(.)	(0.0015)	(.)	(0.0016)	(.)	(0.0016)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0611***	0.0000	-0.0568***	0.0000	-0.0634***	0.0000	-0.0618***	0.0000	-0.0625***	0.0000	-0.0563***	0.0000
	(0.0018)	(.)	(0.0018)	(.)	(0.0018)	(.)	(0.0018)	(.)	(0.0039)	(.)	(0.0037)	(.)
higher education	-0.0788***	0.0000	-0.0691***	0.0000	-0.0842***	0.0000	-0.0826***	0.0000	-0.0986***	0.0000	-0.0766***	0.0000
	(0.0036)	(.)	(0.0038)	(.)	(0.0035)	(.)	(0.0035)	(.)	(0.0104)	(.)	(0.0105)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.114	0.131	0.119	0.140	0.075	0.137	0.080	0.146	0.120	0.221	0.132	0.230
Number of observations	679,057	679,057	679,057	679,057	379,940	379,940	379,940	379,940	299,117	299,117	299,117	299,117
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,473		55,473		45,773		45,773		35,439		35,439

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. Figure 3.4 shows that the age range for mothers spanning two standard deviations around the mean is 12 to 38, so the regressions in this table are run on a woman-year panel dataset for women aged 12 to 38 between 1992 and 2016, born between 1954 and 2004. Between 1992 and 2003, the average probability of giving birth was 0.14, 0.06 for women who were likely to give birth to their first child, and 0.25 for women who were likely to have higher order births.

TABLE C.6: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation, sample of women aged 18–40 in 1992-2016

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post-2004 * base under 5 malaria mortality rate	0.0584**	0.2254***	-0.0736	0.0140	-0.1437***	-0.0583	0.0310	0.0762	0.1202***	0.1955***	-0.0939	0.0192
	(0.0285)	(0.0448)	(0.0492)	(0.0741)	(0.0369)	(0.0474)	(0.0687)	(0.0911)	(0.0356)	(0.0571)	(0.0586)	(0.0996)
primary education	-0.0238***	0.0000	-0.0180***	0.0000	-0.0001	0.0000	0.0012	0.0000	-0.0325***	0.0000	-0.0256***	0.0000
	(0.0020)	(.)	(0.0019)	(.)	(0.0029)	(.)	(0.0028)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0715***	0.0000	-0.0668***	0.0000	-0.0855***	0.0000	-0.0809***	0.0000	-0.0622***	0.0000	-0.0555***	0.0000
	(0.0026)	(.)	(0.0026)	(.)	(0.0034)	(.)	(0.0035)	(.)	(0.0038)	(.)	(0.0037)	(.)
higher education	-0.0937***	0.0000	-0.0798***	0.0000	-0.1091***	0.0000	-0.1026***	0.0000	-0.0973***	0.0000	-0.0750***	0.0000
	(0.0048)	(.)	(0.0051)	(.)	(0.0059)	(.)	(0.0060)	(.)	(0.0102)	(.)	(0.0102)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.097	0.166	0.105	0.175	0.057	0.158	0.068	0.169	0.118	0.216	0.130	0.224
Number of observations	490,781	490,781	490,781	490,781	181,687	181,687	181,687	181,687	309,094	309,094	309,094	309,094
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		47,474		47,474		33,068		33,068		35,433		35,433

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions in this table exclude young mothers aged below 18 years who are more likely to change their education in response to the changes in child mortality. The regressions are run on a woman-year panel dataset for women aged 18 to 40 between 1992 and 2016, born between 1952 and 2001. Between 1992 and 2003, the average probability of giving birth was 0.19, 0.10 for women who were likely to give birth to their first child, and 0.24 for women who were likely to have higher order births.

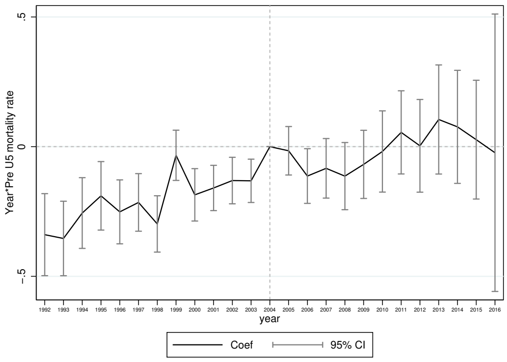
TABLE C.7: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation, sample of women aged 15–40 in 1992-2016, excluding years from analysis

		probability of birth				probability of first birth				probability of higher order birth		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Excluding years 2004 to 2006												
post-2004 * base under 5 malaria mortality rate	0.0186	0.1409**	-0.0675	-0.0119	-0.1649***	-0.3027***	0.0183	0.0695	0.0916**	0.1564**	-0.1285*	-0.0489
	(0.0296)	(0.0569)	(0.0523)	(0.0908)	(0.0349)	(0.0758)	(0.0644)	(0.1346)	(0.0410)	(0.0790)	(0.0690)	(0.1322)
primary education	-0.0258***	0.0000	-0.0208***	0.0000	-0.0144***	0.0000	-0.0131***	0.0000	-0.0322***	0.0000	-0.0251***	0.0000
	(0.0019)	(.)	(0.0018)	(.)	(0.0024)	(.)	(0.0023)	(.)	(0.0026)	(.)	(0.0025)	(.)
secondary education	-0.0701***	0.0000	-0.0658***	0.0000	-0.0836***	0.0000	-0.0815***	0.0000	-0.0599***	0.0000	-0.0529***	0.0000
	(0.0023)	(.)	(0.0023)	(.)	(0.0027)	(.)	(0.0027)	(.)	(0.0039)	(.)	(0.0039)	(.)
higher education	-0.0901***	0.0000	-0.0787***	0.0000	-0.1014***	0.0000	-0.0988***	0.0000	-0.0887***	0.0000	-0.0655***	0.0000
	(0.0043)	(.)	(0.0046)	(.)	(0.0049)	(.)	(0.0049)	(.)	(0.0110)	(.)	(0.0110)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.104	0.146	0.111	0.156	0.060	0.141	0.067	0.151	0.118	0.219	0.130	0.227
Number of observations	502,131	502,131	502,131	502,131	237,214	237,214	237,214	237,214	264,917	264,917	264,917	264,917
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,056		55,056		45,010		45,010		35,218		35,218
Panel B: Excluding years 2011 onwards												
post-2004 * base under 5 malaria mortality rate	0.0262	0.1242***	-0.0560	0.0215	-0.1186***	-0.1617***	0.0290	0.1128	0.1156***	0.1845***	-0.0934	-0.0067
	(0.0248)	(0.0386)	(0.0428)	(0.0664)	(0.0274)	(0.0403)	(0.0505)	(0.0805)	(0.0369)	(0.0561)	(0.0595)	(0.0982)
primary education	-0.0266***	0.0000	-0.0217***	0.0000	-0.0174***	0.0000	-0.0162***	0.0000	-0.0320***	0.0000	-0.0249***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0022)	(.)	(0.0025)	(.)	(0.0024)	(.)
secondary education	-0.0747***	0.0000	-0.0706***	0.0000	-0.0848***	0.0000	-0.0822***	0.0000	-0.0636***	0.0000	-0.0569***	0.0000
	(0.0022)	(.)	(0.0023)	(.)	(0.0026)	(.)	(0.0026)	(.)	(0.0041)	(.)	(0.0041)	(.)
higher education	-0.1011***	0.0000	-0.0896***	0.0000	-0.1052***	0.0000	-0.1023***	0.0000	-0.1043***	0.0000	-0.0824***	0.0000
	(0.0044)	(.)	(0.0047)	(.)	(0.0049)	(.)	(0.0050)	(.)	(0.0109)	(.)	(0.0107)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.106	0.146	0.113	0.155	0.057	0.142	0.064	0.151	0.120	0.220	0.132	0.228
Number of observations	535,528	535,528	535,528	535,528	260,893	260,893	260,893	260,893	274,635	274,635	274,635	274,635
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		52,011		52,011		42,318		42,318		32,690		32,690

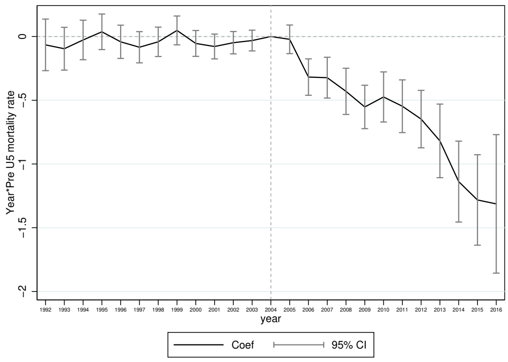
Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016, born between 1952 and 2001. Panel A excludes rollout years 2004-2006 from analysis and Panel B excludes years after 2011 from analysis. Between 1992 and 2003, the average probability of birth was 0.16, 0.08 for women who were likely to give birth to their first child, and 0.24 for women who were likely to have higher order births.

FIGURE C.4: Event studies of probability of birth (excluding region-year fixed effects)

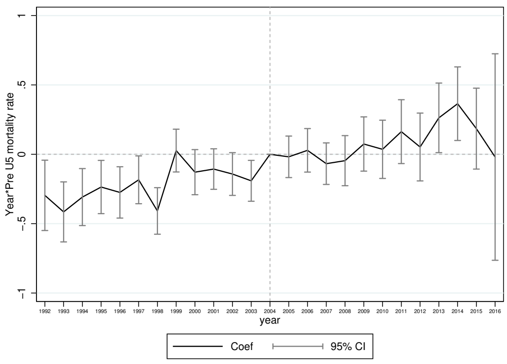
(a) Probability of birth



(b) Probability of first birth



(c) Probability of higher order birth



Notes: The figures plot the coefficients and 95% confidence intervals from panel event study models looking at the evolution of the probability of birth in the years leading up and following the intervention in 2004. Panel a plots the coefficients on variables $pre\_u5mortality * year$ on the probability of birth overall, panel b on the probability of first birth, and panel c on the probability of the higher order birth. The dependent variable is a dummy variable taking the value 1 if the women gave birth in that year and 0 otherwise. The dataset is a woman-year panel of birth outcomes for women aged 15–40 between 1992 to 2016. The regressions include sample cluster fixed effects, child birth year fixed effects, education fixed effects, birth timing fixed effects, and woman fixed effects. Confidence intervals (at 95%) around the plotted coefficients are calculated using standard errors clustered at the DHS sample cluster.

TABLE C.8: Labour force participation as a function of exposure to the malaria intervention: results for women of childbearing age (aged 18–40)

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 18-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0267***	-0.0267***	-0.0278***	-0.0213***
	(0.0046)	(0.0056)	(0.0045)	(0.0054)
primary education	0.0071	0.0091*	0.0068	0.0061
	(0.0064)	(0.0055)	(0.0059)	(0.0049)
secondary education	-0.1436***	-0.0967***	-0.1533***	-0.1107***
	(0.0100)	(0.0091)	(0.0096)	(0.0085)
higher education	-0.0224	0.0326	-0.0403*	0.0059
	(0.0233)	(0.0219)	(0.0217)	(0.0207)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.148	0.214	0.157	0.222
Number of observations	45,107	45,107	45,107	45,107
Panel B: 18-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0185***	-0.0064	-0.0178***	-0.0002
	(0.0065)	(0.0108)	(0.0065)	(0.0106)
primary education	0.0231	0.0383**	0.0110	0.0232
	(0.0191)	(0.0182)	(0.0175)	(0.0167)
secondary education	-0.2363***	-0.1936***	-0.2631***	-0.2248***
	(0.0211)	(0.0209)	(0.0200)	(0.0199)
higher education	-0.1401***	-0.0920**	-0.1745***	-0.1362***
	(0.0377)	(0.0379)	(0.0378)	(0.0382)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.231	0.283	0.245	0.294
Number of observations	9,451	9,451	9,451	9,451
Panel C: 18-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0269***	-0.0263***	-0.0282***	-0.0204***
	(0.0052)	(0.0062)	(0.0049)	(0.0058)
primary education	0.0048	0.0037	0.0054	0.0019
	(0.0065)	(0.0055)	(0.0059)	(0.0048)
secondary education	-0.0433***	0.0059	-0.0473***	-0.0020
	(0.0104)	(0.0098)	(0.0097)	(0.0088)
higher education	0.0859***	0.1288***	0.0695***	0.1053***
	(0.0231)	(0.0229)	(0.0223)	(0.0220)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.105	0.189	0.107	0.193
Number of observations	35,656	35,656	35,656	35,656

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.76 and 0.82 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.66 and 0.74 respectively for women without children, and 0.78 and 0.84 respectively for women with children.

TABLE C.9: Labour force participation after the malaria intervention: results using reductions in infant mortality rates for women aged 15–40

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
fertile years post-2004 * base infant malaria mortrate	-0.0539***	-0.0479***	-0.0568***	-0.0388***
	(0.0085)	(0.0103)	(0.0085)	(0.0102)
primary education	-0.0203***	-0.0144***	-0.0237***	-0.0201***
	(0.0064)	(0.0055)	(0.0060)	(0.0049)
secondary education	-0.1874***	-0.1407***	-0.1995***	-0.1561***
	(0.0097)	(0.0086)	(0.0095)	(0.0082)
higher education	-0.0383*	0.0148	-0.0568***	-0.0112
	(0.0232)	(0.0217)	(0.0217)	(0.0204)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.204	0.262	0.220	0.276
Number of observations	52,859	52,859	52,859	52,859
Panel B: 15-40 year old women without children				
fertile years post-2004 * base infant malaria mortrate	-0.0420***	-0.0125	-0.0410***	0.0001
	(0.0099)	(0.0167)	(0.0101)	(0.0165)
primary education	-0.1074***	-0.0849***	-0.1274***	-0.1059***
	(0.0149)	(0.0138)	(0.0139)	(0.0125)
secondary education	-0.3614***	-0.3130***	-0.3937***	-0.3465***
	(0.0177)	(0.0166)	(0.0170)	(0.0159)
higher education	-0.2629***	-0.2129***	-0.3041***	-0.2608***
	(0.0370)	(0.0360)	(0.0368)	(0.0359)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.240	0.293	0.259	0.312
Number of observations	16,649	16,649	16,649	16,649
Panel C: 15-40 year old women with children				
fertile years post-2004 * base infant malaria mortrate	-0.0556***	-0.0561***	-0.0589***	-0.0457***
	(0.0104)	(0.0124)	(0.0100)	(0.0116)
primary education	0.0038	0.0036	0.0047	0.0020
	(0.0065)	(0.0055)	(0.0059)	(0.0048)
secondary education	-0.0450***	0.0053	-0.0487***	-0.0024
	(0.0103)	(0.0097)	(0.0097)	(0.0087)
higher education	0.0842***	0.1289***	0.0686***	0.1062***
	(0.0231)	(0.0227)	(0.0223)	(0.0218)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.106	0.191	0.109	0.194
Number of observations	36,210	36,210	36,210	36,210

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.58 and 0.65 respectively for women without children, and 0.78 and 0.83 respectively for women with children.

TABLE C.10: Labour force participation after the malaria intervention: results using regional mortality rates for women aged 15–40

	currently working (1)	(2)	worked in the last 12 months (3)	(4)
Panel A: 15-40 year old women				
fertile years post2004 x base region level u5 mort rate	-0.0568***	-0.0802***	-0.0617***	-0.0827***
	(0.0080)	(0.0081)	(0.0075)	(0.0077)
primary education	-0.0224***	-0.0212***	-0.0259***	-0.0252***
	(0.0060)	(0.0059)	(0.0054)	(0.0054)
secondary education	-0.1555***	-0.1566***	-0.1691***	-0.1699***
	(0.0092)	(0.0091)	(0.0087)	(0.0086)
higher education	-0.0047	-0.0046	-0.0294	-0.0292
	(0.0209)	(0.0210)	(0.0190)	(0.0191)
Region FE	Yes	Yes	Yes	Yes
Mother Birth Year FE	Yes	Yes	Yes	Yes
Survey Year FE	Yes	Yes	Yes	Yes
Regional time trend	No	Yes	No	Yes
R-squared	0.217	0.223	0.235	0.240
Number of observations	52,859	52,859	52,859	52,859
Panel B: 15-40 year old women without children				
fertile years post2004 x base region level u5 mort rate	-0.0001	-0.0346	-0.0129	-0.0382*
	(0.0208)	(0.0224)	(0.0202)	(0.0215)
primary education	-0.1008***	-0.0966***	-0.1193***	-0.1169***
	(0.0133)	(0.0133)	(0.0124)	(0.0124)
secondary education	-0.3406***	-0.3362***	-0.3720***	-0.3687***
	(0.0159)	(0.0158)	(0.0153)	(0.0153)
higher education	-0.2387***	-0.2337***	-0.2822***	-0.2795***
	(0.0341)	(0.0340)	(0.0330)	(0.0332)
Region FE	Yes	Yes	Yes	Yes
Mother Birth Year FE	Yes	Yes	Yes	Yes
Survey Year FE	Yes	Yes	Yes	Yes
Regional time trend	No	Yes	No	Yes
R-squared	0.210	0.215	0.234	0.237
Number of observations	16,649	16,649	16,649	16,649
Panel C: 15-40 year old women with children				
fertile years post2004 x base region level u5 mort rate	-0.0729***	-0.1013***	-0.0760***	-0.1031***
	(0.0093)	(0.0094)	(0.0087)	(0.0087)
primary education	-0.0023	-0.0022	-0.0016	-0.0017
	(0.0060)	(0.0059)	(0.0053)	(0.0053)
secondary education	-0.0060	-0.0089	-0.0119	-0.0143
	(0.0101)	(0.0100)	(0.0092)	(0.0091)
higher education	0.1173***	0.1121***	0.0922***	0.0874***
	(0.0227)	(0.0221)	(0.0214)	(0.0209)
Region FE	Yes	Yes	Yes	Yes
Mother Birth Year FE	Yes	Yes	Yes	Yes
Survey Year FE	Yes	Yes	Yes	Yes
Regional time trend	No	Yes	No	Yes
R-squared	0.125	0.136	0.130	0.138
Number of observations	36,210	36,210	36,210	36,210

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.58 and 0.65 respectively for women without children, and 0.78 and 0.83 respectively for women with children.

TABLE C.11: Labour force participation as a function of exposure to the malaria intervention: results excluding rollout years 2004-6

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0243***	-0.0247***	-0.0248***	-0.0178***
	(0.0050)	(0.0057)	(0.0050)	(0.0056)
primary education	-0.0033	0.0029	-0.0072	-0.0037
	(0.0078)	(0.0065)	(0.0072)	(0.0059)
secondary education	-0.1677***	-0.1238***	-0.1811***	-0.1401***
	(0.0107)	(0.0093)	(0.0104)	(0.0090)
higher education	-0.0722**	-0.0278	-0.0915***	-0.0527**
	(0.0287)	(0.0260)	(0.0277)	(0.0251)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.214	0.267	0.229	0.280
Number of observations	39,814	39,814	39,814	39,814
Panel B: 15-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0139**	-0.0055	-0.0135**	0.0035
	(0.0059)	(0.0098)	(0.0061)	(0.0097)
primary education	-0.0675***	-0.0477***	-0.0950***	-0.0737***
	(0.0190)	(0.0177)	(0.0178)	(0.0163)
secondary education	-0.3216***	-0.2766***	-0.3636***	-0.3169***
	(0.0218)	(0.0202)	(0.0210)	(0.0194)
higher education	-0.3067***	-0.2653***	-0.3541***	-0.3144***
	(0.0447)	(0.0423)	(0.0456)	(0.0426)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.257	0.305	0.276	0.323
Number of observations	12,514	12,514	12,514	12,514
Panel C: 15-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0264***	-0.0306***	-0.0259***	-0.0215***
	(0.0061)	(0.0066)	(0.0058)	(0.0063)
primary education	0.0096	0.0110*	0.0106	0.0087
	(0.0079)	(0.0066)	(0.0071)	(0.0057)
secondary education	-0.0354***	0.0127	-0.0397***	0.0044
	(0.0113)	(0.0105)	(0.0105)	(0.0094)
higher education	0.0767**	0.1112***	0.0570*	0.0859***
	(0.0301)	(0.0281)	(0.0294)	(0.0269)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.121	0.197	0.123	0.203
Number of observations	27,300	27,300	27,300	27,300

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.58 and 0.65 respectively for women without children, and 0.78 and 0.83 respectively for women with children.

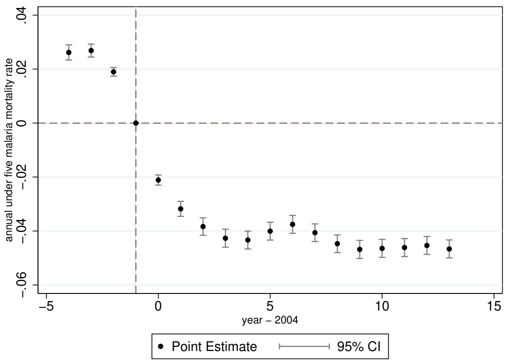
TABLE C.12: Labour force participation after the malaria intervention: results for all women excluding years after 2011 from analysis

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0285***	-0.0231***	-0.0298***	-0.0207***
	(0.0053)	(0.0059)	(0.0053)	(0.0058)
primary education	-0.0333***	-0.0264***	-0.0378***	-0.0332***
	(0.0075)	(0.0065)	(0.0070)	(0.0058)
secondary education	-0.2044***	-0.1595***	-0.2149***	-0.1741***
	(0.0122)	(0.0108)	(0.0120)	(0.0104)
higher education	-0.0102	0.0434*	-0.0337	0.0092
	(0.0247)	(0.0241)	(0.0236)	(0.0235)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.225	0.284	0.247	0.304
Number of observations	34,117	34,117	34,117	34,117
Panel B: 15-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0273***	-0.0047	-0.0252***	-0.0002
	(0.0063)	(0.0098)	(0.0063)	(0.0096)
primary education	-0.1304***	-0.1053***	-0.1539***	-0.1298***
	(0.0157)	(0.0149)	(0.0148)	(0.0135)
secondary education	-0.3802***	-0.3361***	-0.4110***	-0.3685***
	(0.0194)	(0.0184)	(0.0194)	(0.0181)
higher education	-0.2223***	-0.1785***	-0.2586***	-0.2237***
	(0.0418)	(0.0435)	(0.0417)	(0.0435)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.254	0.308	0.275	0.327
Number of observations	11,250	11,250	11,250	11,250
Panel C: 15-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0305***	-0.0332***	-0.0336***	-0.0318***
	(0.0069)	(0.0072)	(0.0064)	(0.0067)
primary education	-0.0002	0.0007	0.0011	-0.0003
	(0.0078)	(0.0065)	(0.0070)	(0.0057)
secondary education	-0.0558***	0.0010	-0.0557***	-0.0040
	(0.0136)	(0.0133)	(0.0127)	(0.0120)
higher education	0.1034***	0.1514***	0.0843***	0.1234***
	(0.0260)	(0.0248)	(0.0251)	(0.0244)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.108	0.197	0.112	0.202
Number of observations	22,867	22,867	22,867	22,867

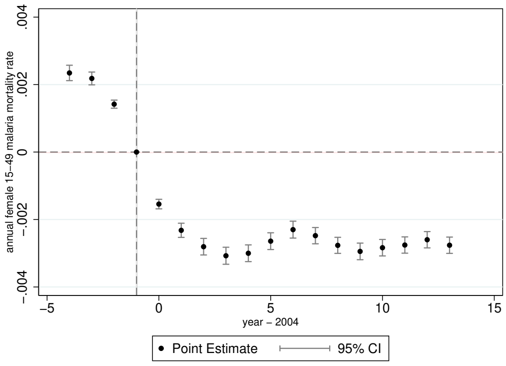
Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.58 and 0.65 respectively for women without children, and 0.78 and 0.83 respectively for women with children.

FIGURE C.5: Event study of mortality and incidence rates, non-endemic areas

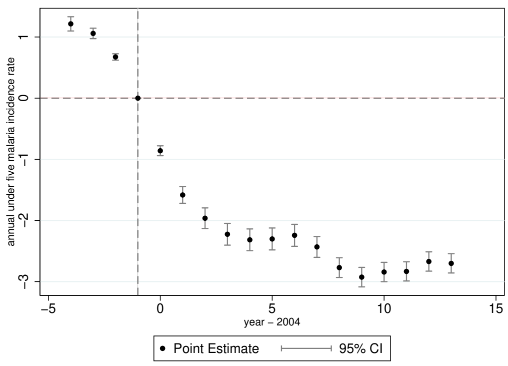
(a) Mortality, children under five



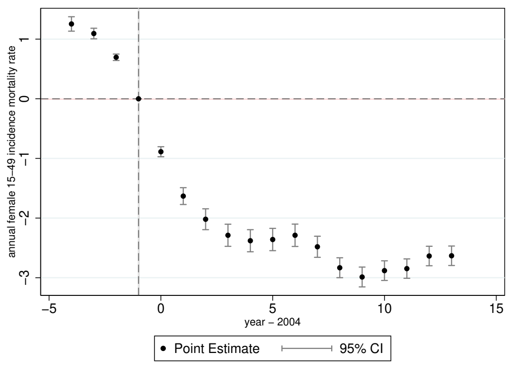
(b) Mortality, women aged 15-49



(c) Incidence, under five



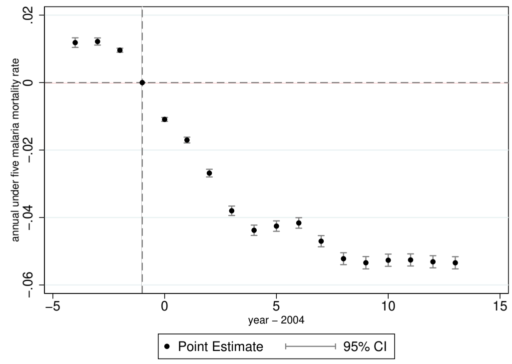
(d) Incidence, women aged 15-49



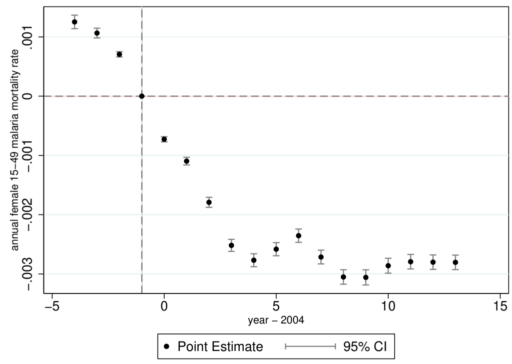
Note: The figures plot the lag and lead coefficients and 95% confidence intervals from panel event study models, where the lags and leads are calculated relative to the year 2004, as the intervention start year. The outcomes of interest are the mortality and incidence rates in the years leading up to and following on from 2004. The event study models include region fixed effects and standard errors are clustered at the region level. These figures were plotted using the eventdd command on Stata.

FIGURE C.6: Event study of mortality and incidence rates, endemic areas

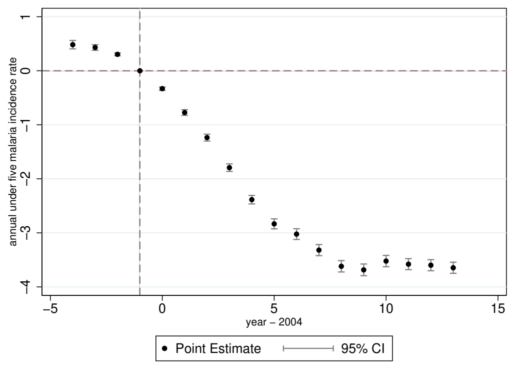
(a) Mortality, children under five



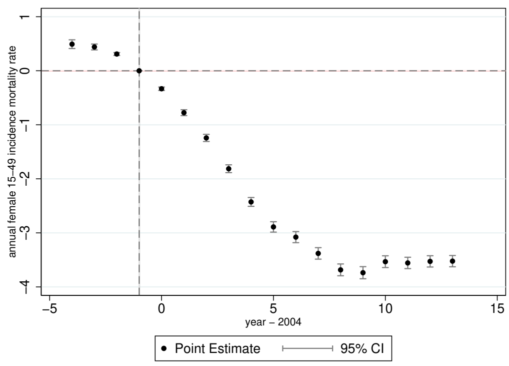
(b) Mortality, women aged 15-49



(c) Incidence, under five



(d) Incidence, women aged 15-49



Note: The figures plot the lag and lead coefficients and 95% confidence intervals from panel event study models, where the lags and leads are calculated relative to the year 2004, as the intervention start year. The outcomes of interest are the mortality and incidence rates in the years leading up to and following on from 2004. The event study models include cluster fixed effects and standard errors are clustered at the DHS sample cluster level. These figures were plotted using the eventdd command on Stata.

TABLE C.13: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation, by endemicity

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Non-malarious areas												
post-2004 * base under 5 malaria mortality rate	0.1440***	0.7358***	0.2021	0.4354**	-0.0932*	0.1018	0.2758	0.4864**	0.3712***	0.7635***	0.3223*	0.6027**
	(0.0477)	(0.0589)	(0.1370)	(0.1833)	(0.0560)	(0.0718)	(0.1839)	(0.2306)	(0.0646)	(0.0977)	(0.1669)	(0.2775)
primary education	-0.0238***	0.0000	-0.0161***	0.0000	-0.0130**	0.0000	-0.0100**	0.0000	-0.0223***	0.0000	-0.0085	0.0000
	(0.0045)	(.)	(0.0040)	(.)	(0.0054)	(.)	(0.0049)	(.)	(0.0057)	(.)	(0.0054)	(.)
secondary education	-0.0514***	0.0000	-0.0475***	0.0000	-0.0652***	0.0000	-0.0633***	0.0000	-0.0202***	0.0000	-0.0108	0.0000
	(0.0048)	(.)	(0.0043)	(.)	(0.0054)	(.)	(0.0051)	(.)	(0.0073)	(.)	(0.0066)	(.)
higher education	-0.0479***	0.0000	-0.0336***	0.0000	-0.0848***	0.0000	-0.0773***	0.0000	0.0057	0.0000	0.0359	0.0000
	(0.0117)	(.)	(0.0104)	(.)	(0.0128)	(.)	(0.0103)	(.)	(0.0251)	(.)	(0.0224)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.106	0.126	0.114	0.138	0.053	0.119	0.068	0.136	0.128	0.206	0.142	0.221
Number of observations	118,233	118,233	118,233	118,233	61,066	61,066	61,066	61,066	57,167	57,167	57,167	57,167
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		11,006		11,006		9,252		9,252		6,350		6,350
Panel B: low epidemic areas												
post-2004 * base under 5 malaria mortality rate	-0.3005	-0.7029*	0.2417	-0.3940	-0.2043	-0.8828	0.0228	-1.2464**	-0.2323	-1.1001**	0.0799	-0.5211
	(0.3494)	(0.4084)	(0.4702)	(0.4206)	(0.4663)	(0.5893)	(0.5663)	(0.5043)	(0.3999)	(0.5252)	(0.4586)	(0.6981)
primary education	-0.0041	0.0000	-0.0030	0.0000	-0.0004	0.0000	0.0002	0.0000	-0.0167	0.0000	-0.0127	0.0000
	(0.0096)	(.)	(0.0092)	(.)	(0.0105)	(.)	(0.0106)	(.)	(0.0169)	(.)	(0.0163)	(.)
secondary education	-0.0469***	0.0000	-0.0453***	0.0000	-0.0695***	0.0000	-0.0671***	0.0000	-0.0537**	0.0000	-0.0531**	0.0000
	(0.0120)	(.)	(0.0120)	(.)	(0.0149)	(.)	(0.0150)	(.)	(0.0245)	(.)	(0.0243)	(.)
higher education	-0.1012***	0.0000	-0.0987***	0.0000	-0.1420***	0.0000	-0.1374***	0.0000	-0.0934*	0.0000	-0.0963*	0.0000
	(0.0186)	(.)	(0.0189)	(.)	(0.0339)	(.)	(0.0342)	(.)	(0.0551)	(.)	(0.0558)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.124	0.153	0.134	0.169	0.100	0.164	0.121	0.191	0.153	0.231	0.168	0.250
Number of observations	20,444	20,444	20,444	20,444	10,253	10,253	10,253	10,253	10,191	10,191	10,191	10,191
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		1,737		1,737		1,489		1,489		1,159		1,159
Panel C: high epidemic areas												
post-2004 * base under 5 malaria mortality rate	0.3256	0.5103	0.2929	-0.5686	1.1118*	3.4689***	1.4087*	2.8237***	-0.0747	0.0673	-0.2351	-1.3704*
	(0.5219)	(0.7101)	(0.6153)	(0.5940)	(0.6142)	(0.7556)	(0.8262)	(1.0622)	(0.5337)	(0.7153)	(0.5272)	(0.7771)
primary education	-0.0162*	0.0000	-0.0134	0.0000	-0.0038	0.0000	-0.0058	0.0000	-0.0194	0.0000	-0.0134	0.0000
	(0.0090)	(.)	(0.0088)	(.)	(0.0108)	(.)	(0.0101)	(.)	(0.0124)	(.)	(0.0127)	(.)
secondary education	-0.0538***	0.0000	-0.0468***	0.0000	-0.0708***	0.0000	-0.0697***	0.0000	-0.0494***	0.0000	-0.0338*	0.0000
	(0.0104)	(.)	(0.0105)	(.)	(0.0126)	(.)	(0.0123)	(.)	(0.0178)	(.)	(0.0179)	(.)
higher education	-0.0516***	0.0000	-0.0466**	0.0000	-0.0767***	0.0000	-0.0782***	0.0000	-0.0103	0.0000	-0.0080	0.0000
	(0.0185)	(.)	(0.0196)	(.)	(0.0291)	(.)	(0.0299)	(.)	(0.0386)	(.)	(0.0366)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.125	0.149	0.136	0.164	0.101	0.174	0.120	0.197	0.150	0.221	0.168	0.241
Number of observations	28,056	28,056	28,056	28,056	13,020	13,020	13,020	13,020	15,036	15,036	15,036	15,036
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		2,428		2,428		2,054		2,054		1,606		1,606
Panel D: endemic areas												
post-2004 * base under 5 malaria mortality rate	-0.0379	-0.0547	-0.0374	-0.0101	-0.1520***	-0.2203***	0.0052	0.0354	0.0362	0.0186	-0.0423	-0.0040
	(0.0344)	(0.0563)	(0.0502)	(0.0749)	(0.0376)	(0.0538)	(0.0568)	(0.0848)	(0.0472)	(0.0781)	(0.0676)	(0.1076)
primary education	-0.0227***	0.0000	-0.0219***	0.0000	-0.0175***	0.0000	-0.0183***	0.0000	-0.0280***	0.0000	-0.0268***	0.0000
	(0.0021)	(.)	(0.0020)	(.)	(0.0027)	(.)	(0.0026)	(.)	(0.0031)	(.)	(0.0030)	(.)
secondary education	-0.0730***	0.0000	-0.0714***	0.0000	-0.0899***	0.0000	-0.0903***	0.0000	-0.0684***	0.0000	-0.0667***	0.0000
	(0.0030)	(.)	(0.0028)	(.)	(0.0035)	(.)	(0.0034)	(.)	(0.0055)	(.)	(0.0053)	(.)
higher education	-0.1001***	0.0000	-0.0983***	0.0000	-0.1178***	0.0000	-0.1177***	0.0000	-0.1040***	0.0000	-0.0975***	0.0000
	(0.0055)	(.)	(0.0056)	(.)	(0.0063)	(.)	(0.0061)	(.)	(0.0172)	(.)	(0.0178)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.110	0.141	0.116	0.151	0.069	0.153	0.078	0.164	0.130	0.215	0.139	0.223
Number of observations	342,903	342,903	342,903	342,903	168,080	168,080	168,080	168,080	174,823	174,823	174,823	174,823
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		30,581		30,581		26,171		26,171		19,849		19,849

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016, born between 1952 and 2001. Between 1992 and 2003, the average probability of birth in non-endemic areas was 0.15, 0.07 for women who were likely to give birth to their first child, and 0.24 for women who were likely to have higher order births. In endemic areas, the average probability of birth was 0.15, 0.07 for women who were likely to give birth to their first child, and 0.25 for women who were likely to have higher order births.

TABLE C.14: Labour force participation as a function of exposure to the malaria intervention: results by endemicity for women aged 15-40

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: Non-malarious areas				
fertile years post-2004 * base u5 malaria mortrate	-0.0603***	-0.0503***	-0.0587***	-0.0509***
	(0.0100)	(0.0119)	(0.0100)	(0.0118)
primary education	0.0064	-0.0041	0.0047	-0.0059
	(0.0155)	(0.0147)	(0.0152)	(0.0147)
secondary education	-0.0463**	-0.0427**	-0.0523***	-0.0504***
	(0.0193)	(0.0179)	(0.0185)	(0.0174)
higher education	-0.0018	0.0108	-0.0113	-0.0043
	(0.0448)	(0.0450)	(0.0433)	(0.0421)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.267	0.291	0.273	0.295
Number of observations	10,207	10,207	10,207	10,207
Panel B: low epidemic areas				
fertile years post-2004 * base u5 malaria mortrate	-0.0090	0.0071	-0.0208	-0.0033
	(0.0840)	(0.0876)	(0.0877)	(0.0920)
primary education	0.0140	0.0156	0.0025	0.0052
	(0.0268)	(0.0270)	(0.0245)	(0.0244)
secondary education	-0.2260***	-0.2251***	-0.2377***	-0.2359***
	(0.0451)	(0.0451)	(0.0432)	(0.0430)
higher education	-0.2272	-0.2259	-0.2761	-0.2736
	(0.1784)	(0.1783)	(0.1734)	(0.1732)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.398	0.399	0.407	0.408
Number of observations	1,652	1,652	1,652	1,652
Panel C: high epidemic areas				
fertile years post-2004 * base u5 malaria mortrate	0.1833*	0.0808	0.2549**	0.1665
	(0.0929)	(0.1230)	(0.1025)	(0.1198)
primary education	0.0129	0.0158	-0.0040	-0.0047
	(0.0287)	(0.0287)	(0.0253)	(0.0255)
secondary education	-0.1796***	-0.1707***	-0.2034***	-0.1985***
	(0.0389)	(0.0397)	(0.0355)	(0.0358)
higher education	0.0102	0.0152	-0.0647	-0.0784
	(0.1350)	(0.1324)	(0.1332)	(0.1379)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.330	0.340	0.332	0.342
Number of observations	2,363	2,363	2,363	2,363
Panel D: endemic areas				
fertile years post-2004 * base u5 malaria mortrate	-0.0030	-0.0110*	0.0010	-0.0018
	(0.0062)	(0.0067)	(0.0060)	(0.0067)
primary education	-0.0177**	-0.0048	-0.0203***	-0.0094
	(0.0083)	(0.0071)	(0.0076)	(0.0064)
secondary education	-0.2133***	-0.1606***	-0.2261***	-0.1779***
	(0.0126)	(0.0117)	(0.0120)	(0.0112)
higher education	-0.0897***	-0.0277	-0.1086***	-0.0501
	(0.0333)	(0.0321)	(0.0332)	(0.0324)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes

TABLE C.15: Probability of net birth as a function of exposure to the malaria intervention: results from the hazard model estimation, sample of women aged 15–40 in 1992-2016, by endemicity

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Non-endemic areas												
post-2004 * base under 5 malaria mortality rate	0.0987***	0.3801***	0.0935	0.3128*	-0.1018***	-0.0903	0.2156	0.3355	0.2727***	0.4168***	0.1389	0.2960
	(0.0342)	(0.0509)	(0.1110)	(0.1603)	(0.0383)	(0.0554)	(0.1382)	(0.2117)	(0.0509)	(0.0755)	(0.1502)	(0.2430)
primary education	-0.0188***	0.0000	-0.0122***	0.0000	-0.0099***	0.0000	-0.0063**	0.0000	-0.0217***	0.0000	-0.0106***	0.0000
	(0.0028)	(.)	(0.0026)	(.)	(0.0034)	(.)	(0.0032)	(.)	(0.0037)	(.)	(0.0035)	(.)
secondary education	-0.0544***	0.0000	-0.0481***	0.0000	-0.0680***	0.0000	-0.0614***	0.0000	-0.0305***	0.0000	-0.0199***	0.0000
	(0.0031)	(.)	(0.0029)	(.)	(0.0036)	(.)	(0.0035)	(.)	(0.0051)	(.)	(0.0047)	(.)
higher education	-0.0675***	0.0000	-0.0553***	0.0000	-0.0862***	0.0000	-0.0824***	0.0000	-0.0509***	0.0000	-0.0258**	0.0000
	(0.0060)	(.)	(0.0055)	(.)	(0.0061)	(.)	(0.0056)	(.)	(0.0142)	(.)	(0.0131)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.096	0.125	0.102	0.136	0.056	0.125	0.066	0.140	0.111	0.191	0.123	0.200
Number of observations	254,153	254,153	254,153	254,153	116,672	116,672	116,672	116,672	137,481	137,481	137,481	137,481
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		24,961		24,961		19,678		19,678		15,777		15,777
Panel B: Endemic areas												
post-2004 * base under 5 malaria mortality rate	-0.0370	-0.0410	-0.0418	-0.0044	-0.1432***	-0.2209***	-0.0058	0.0168	0.0357	0.0272	-0.0472	0.0142
	(0.0329)	(0.0525)	(0.0464)	(0.0699)	(0.0349)	(0.0521)	(0.0531)	(0.0819)	(0.0460)	(0.0722)	(0.0658)	(0.1021)
primary education	-0.0189***	0.0000	-0.0182***	0.0000	-0.0138***	0.0000	-0.0147***	0.0000	-0.0239***	0.0000	-0.0226***	0.0000
	(0.0019)	(.)	(0.0019)	(.)	(0.0025)	(.)	(0.0024)	(.)	(0.0029)	(.)	(0.0028)	(.)
secondary education	-0.0629***	0.0000	-0.0630***	0.0000	-0.0780***	0.0000	-0.0791***	0.0000	-0.0569***	0.0000	-0.0582***	0.0000
	(0.0028)	(.)	(0.0026)	(.)	(0.0033)	(.)	(0.0031)	(.)	(0.0052)	(.)	(0.0051)	(.)
higher education	-0.0884***	0.0000	-0.0883***	0.0000	-0.1048***	0.0000	-0.1056***	0.0000	-0.0882***	0.0000	-0.0844***	0.0000
	(0.0052)	(.)	(0.0053)	(.)	(0.0059)	(.)	(0.0058)	(.)	(0.0166)	(.)	(0.0169)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.101	0.124	0.107	0.133	0.064	0.143	0.073	0.155	0.118	0.189	0.127	0.197
Number of observations	342,903	342,903	342,903	342,903	168,080	168,080	168,080	168,080	174,823	174,823	174,823	174,823
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		30,581		30,581		26,171		26,171		19,849		19,849

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016, born between 1952 and 2001.

TABLE C.16: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation by local baseline labour force participation rates for women aged 15–25

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Controlling for high LFP clusters												
post-2004 * base under 5 malaria mortality rate	0.0237	0.1056**	-0.0110	0.0945	-0.0263	-0.1064**	0.0670	0.2848***	0.1638***	0.1984	-0.1451	-0.4140*
	(0.0249)	(0.0527)	(0.0434)	(0.1085)	(0.0277)	(0.0518)	(0.0486)	(0.1100)	(0.0554)	(0.1261)	(0.0930)	(0.2403)
post2004 * high LFP cluster	0.0160***	0.0458***	0.0388	0.2600***	0.0295***	0.0591***	-0.0943	0.0533	-0.0024	0.0338**	0.1095	0.3527***
	(0.0031)	(0.0063)	(.)	(0.0455)	(0.0034)	(0.0065)	(.)	(0.0788)	(0.0060)	(0.0137)	(0.1141)	(0.1042)
primary education	-0.0254***	0.0000	-0.0228***	0.0000	-0.0213***	0.0000	-0.0205***	0.0000	-0.0303***	0.0000	-0.0252***	0.0000
	(0.0021)	(.)	(0.0020)	(.)	(0.0026)	(.)	(0.0025)	(.)	(0.0037)	(.)	(0.0035)	(.)
secondary education	-0.0898***	0.0000	-0.0873***	0.0000	-0.0963***	0.0000	-0.0948***	0.0000	-0.0640***	0.0000	-0.0615***	0.0000
	(0.0024)	(.)	(0.0025)	(.)	(0.0029)	(.)	(0.0029)	(.)	(0.0061)	(.)	(0.0060)	(.)
higher education	-0.1357***	0.0000	-0.1287***	0.0000	-0.1345***	0.0000	-0.1329***	0.0000	-0.1531***	0.0000	-0.1341***	0.0000
	(0.0037)	(.)	(0.0041)	(.)	(0.0042)	(.)	(0.0044)	(.)	(0.0242)	(.)	(0.0245)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.114	0.165	0.120	0.176	0.063	0.146	0.070	0.160	0.153	0.346	0.169	0.363
Number of observations	341,595	341,595	341,595	341,595	227,043	227,043	227,043	227,043	114,552	114,552	114,552	114,552
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		49,376		49,376		44,492		44,492		26,062		26,062
Panel B: Triple difference: high LFP cluster												
post-2004 * base under 5 malaria mortality rate	0.0270	0.1061*	0.0364	0.1563	-0.0538*	-0.1497***	0.0505	0.2911**	0.2833***	0.2918*	-0.0013	-0.3723
	(0.0287)	(0.0607)	(0.0521)	(0.1291)	(0.0304)	(0.0561)	(0.0525)	(0.1198)	(0.0699)	(0.1496)	(0.1243)	(0.3110)
post2004 * high LFP cluster	0.0171***	0.0460***	0.0478	0.2723***	0.0191***	0.0401***	-0.0882	0.0549	0.0309***	0.0621**	0.1324	0.3593***
	(0.0055)	(0.0116)	(.)	(0.0466)	(0.0063)	(0.0123)	(21.5699)	(0.0801)	(0.0115)	(0.0254)	(0.1133)	(0.1079)
post2004 * u5mort * high LFP cluster	-0.0155	-0.0027	-0.1771*	-0.2392	0.1446**	0.2722*	0.0699	-0.0304	-0.4449***	-0.3803	-0.4310**	-0.1298
	(0.0608)	(0.1350)	(0.0989)	(0.2307)	(0.0713)	(0.1501)	(0.1237)	(0.2874)	(0.1252)	(0.2868)	(0.1964)	(0.4963)
primary education	-0.0254***	0.0000	-0.0228***	0.0000	-0.0213***	0.0000	-0.0205***	0.0000	-0.0303***	0.0000	-0.0252***	0.0000
	(0.0021)	(.)	(0.0020)	(.)	(0.0026)	(.)	(0.0025)	(.)	(0.0037)	(.)	(0.0035)	(.)
secondary education	-0.0898***	0.0000	-0.0873***	0.0000	-0.0961***	0.0000	-0.0948***	0.0000	-0.0647***	0.0000	-0.0616***	0.0000
	(0.0024)	(.)	(0.0025)	(.)	(0.0029)	(.)	(0.0029)	(.)	(0.0060)	(.)	(0.0060)	(.)
higher education	-0.1357***	0.0000	-0.1287***	0.0000	-0.1345***	0.0000	-0.1329***	0.0000	-0.1539***	0.0000	-0.1342***	0.0000
	(0.0037)	(.)	(0.0041)	(.)	(0.0042)	(.)	(0.0044)	(.)	(0.0242)	(.)	(0.0245)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
post2004 * base u5 mortality: high FLFP clusters	0.012	0.103	-0.141*	-0.083	0.091	0.123	0.120	0.261	-0.162	-0.089	-0.432***	-0.502
	(0.053)	(0.117)	(0.082)	(0.193)	(0.065)	(0.139)	(0.113)	(0.263)	(0.098)	(0.242)	(0.145)	(0.378)
R-squared	0.114	0.165	0.120	0.176	0.064	0.146	0.070	0.160	0.153	0.346	0.170	0.363
Number of observations	341,595	341,595	341,595	341,595	227,043	227,043	227,043	227,043	114,552	114,552	114,552	114,552
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		49,376		49,376		44,492		44,492		26,062		26,062

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 25 between 1992 and 2016. High baseline LFP is a variable that takes the value one if the woman lives in a DHS cluster where labour force participation in 1999 was higher than the median for all clusters. Between 1992 and 2003, the average probability of birth for women aged 15–25 in clusters where baseline LFP was higher (lower) than the 1999 median was 0.16 (0.14), 0.10 (0.09) for women who were likely to give birth to their first child, and 0.27 (0.26) for women who were likely to have higher order births.

TABLE C.17: Labour force participation as a function of exposure to the malaria intervention: results for women controlling for baseline LFP in women aged 15-25

	currently working				worked in the last 12 months			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: 15-25 year old women								
fertile years post-2004 * base u5 malaria mortrate	-0.0004	-0.0028	0.0005	-0.0085	-0.0014	0.0061	-0.0025	0.0004
	(0.0043)	(0.0071)	(0.0050)	(0.0090)	(0.0043)	(0.0070)	(0.0050)	(0.0088)
fertile years post-2004 * high base FLFP cluster	0.0078***	0.0103***	0.0081***	0.0091***	0.0074***	0.0098***	0.0070***	0.0085***
	(0.0005)	(0.0019)	(0.0009)	(0.0021)	(0.0005)	(0.0018)	(0.0009)	(0.0020)
fertile years post-2004 * base u5mort * high base FLFP cluster			-0.0036	0.0156			0.0049	0.0155
			(0.0093)	(0.0145)			(0.0093)	(0.0145)
primary education	-0.0691***	-0.0622***	-0.0691***	-0.0621***	-0.0783***	-0.0721***	-0.0783***	-0.0719***
	(0.0092)	(0.0087)	(0.0092)	(0.0087)	(0.0086)	(0.0078)	(0.0086)	(0.0079)
secondary education	-0.3182***	-0.2935***	-0.3184***	-0.2933***	-0.3426***	-0.3182***	-0.3423***	-0.3180***
	(0.0123)	(0.0117)	(0.0123)	(0.0117)	(0.0124)	(0.0113)	(0.0123)	(0.0113)
higher education	-0.3796***	-0.3627***	-0.3795***	-0.3628***	-0.4227***	-0.4096***	-0.4229***	-0.4097***
	(0.0482)	(0.0472)	(0.0482)	(0.0472)	(0.0496)	(0.0476)	(0.0496)	(0.0476)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high FLFP clusters			-0.003	0.007			0.002	0.016
			(0.008)	(0.012)			(0.008)	(0.012)
R-squared	0.262	0.307	0.262	0.307	0.286	0.331	0.286	0.331
Number of observations	25,278	25,278	25,278	25,278	25,278	25,278	25,278	25,278
Panel B: 15-25 year old women without children								
fertile years post-2004 * base u5 malaria mortrate	-0.0057	-0.0059	-0.0047	-0.0106	-0.0055	0.0027	-0.0064	-0.0008
	(0.0052)	(0.0089)	(0.0059)	(0.0111)	(0.0051)	(0.0087)	(0.0059)	(0.0111)
fertile years post-2004 * high base FLFP cluster	0.0057***	0.0109***	0.0060***	0.0098***	0.0055***	0.0091***	0.0051***	0.0082***
	(0.0006)	(0.0027)	(0.0011)	(0.0029)	(0.0006)	(0.0026)	(0.0011)	(0.0028)
fertile years post-2004 * base u5mort * high base FLFP cluster			-0.0047	0.0141			0.0042	0.0105
			(0.0122)	(0.0194)			(0.0120)	(0.0187)
primary education	-0.1358***	-0.1231***	-0.1358***	-0.1231***	-0.1585***	-0.1455***	-0.1584***	-0.1455***
	(0.0156)	(0.0149)	(0.0156)	(0.0150)	(0.0145)	(0.0135)	(0.0145)	(0.0135)
secondary education	-0.4309***	-0.4096***	-0.4312***	-0.4095***	-0.4731***	-0.4505***	-0.4728***	-0.4504***
	(0.0186)	(0.0180)	(0.0186)	(0.0180)	(0.0182)	(0.0173)	(0.0181)	(0.0173)
higher education	-0.5089***	-0.5013***	-0.5087***	-0.5014***	-0.5841***	-0.5790***	-0.5843***	-0.5791***
	(0.0550)	(0.0542)	(0.0550)	(0.0543)	(0.0578)	(0.0568)	(0.0579)	(0.0568)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high FLFP clusters			-0.009	0.004			-0.002	0.010
			(0.011)	(0.016)			(0.010)	(0.015)
R-squared	0.256	0.308	0.256	0.308	0.277	0.328	0.277	0.328
Number of observations	14,596	14,596	14,596	14,596	14,596	14,596	14,596	14,596
Panel C: 15-25 year old women with children								
fertile years post-2004 * base u5 malaria mortrate	0.0035	-0.0036	0.0045	-0.0133	0.0006	0.0070	-0.0012	-0.0025
	(0.0066)	(0.0101)	(0.0081)	(0.0140)	(0.0061)	(0.0092)	(0.0078)	(0.0126)
fertile years post-2004 * high base FLFP cluster	0.0100***	0.0172***	0.0102***	0.0153***	0.0091***	0.0165***	0.0086***	0.0146***
	(0.0007)	(0.0030)	(0.0012)	(0.0034)	(0.0007)	(0.0026)	(0.0012)	(0.0030)
fertile years post-2004 * base u5mort * high base FLFP cluster			-0.0032	0.0223			0.0059	0.0221
			(0.0122)	(0.0195)			(0.0114)	(0.0187)
primary education	-0.0134	-0.0114	-0.0134	-0.0112	-0.0139	-0.0130	-0.0140	-0.0128
	(0.0106)	(0.0099)	(0.0106)	(0.0099)	(0.0098)	(0.0089)	(0.0098)	(0.0089)
secondary education	-0.1002***	-0.0612***	-0.1004***	-0.0611***	-0.1052***	-0.0683***	-0.1048***	-0.0682***
	(0.0180)	(0.0178)	(0.0179)	(0.0178)	(0.0176)	(0.0172)	(0.0176)	(0.0172)
higher education	-0.0510	-0.0578	-0.0509	-0.0582	-0.0566	-0.0642	-0.0567	-0.0646
	(0.1324)	(0.1223)	(0.1324)	(0.1227)	(0.1243)	(0.1104)	(0.1243)	(0.1108)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high FLFP clusters			0.001	0.009			0.005	0.020
			(0.010)	(0.014)			(0.009)	(0.014)
R-squared	0.208	0.292	0.208	0.292	0.215	0.297	0.215	0.298
Number of observations	10,682	10,682	10,682	10,682	10,682	10,682	10,682	10,682

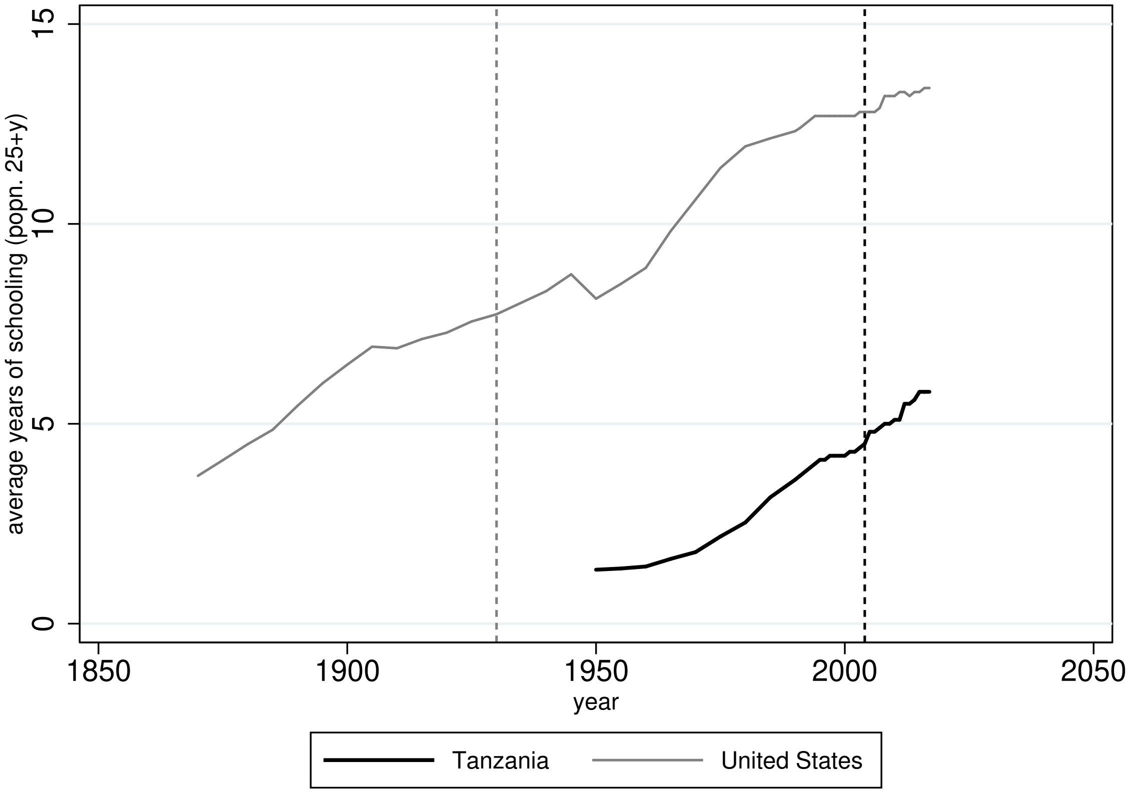
Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. High baseline LFP is a variable that takes the value one if the woman lives in a DHS cluster where labour force participation in 1999 was higher than the median for all clusters. Baseline labour force participation rates in 1999 for women in clusters with high baseline LFP were 0.83 and 0.87 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.45 and 0.53 respectively for women in clusters with LFP rates lower than the median for all clusters in 1999.

TABLE C.18: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation by local baseline labour force participation rates for women aged 26–40

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Controlling for high LFP clusters												
post-2004 * base under 5 malaria mortality rate	0.1108***	0.2977***	-0.0784	0.0244	0.0127	0.1410**	-0.0480	-0.0337	0.0880**	0.3191***	-0.0543	0.0512
	(0.0354)	(0.0519)	(0.0543)	(0.0937)	(0.0565)	(0.0648)	(0.1026)	(0.1080)	(0.0389)	(0.0663)	(0.0614)	(0.1214)
post2004 * high LFP cluster	0.0036	0.0144**	0.0046	-0.1291	0.0297***	0.0195***	-0.5913**	0.0895*	-0.0036	0.0100	0.0433	0.3584
	(0.0041)	(0.0056)	(.)	(36.7422)	(0.0062)	(0.0071)	(0.2506)	(0.0542)	(0.0043)	(0.0072)	(0.0426)	(43.1907)
primary education	-0.0247***	0.0000	-0.0189***	0.0000	-0.0002	0.0000	-0.0002	0.0000	-0.0287***	0.0000	-0.0231***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0033)	(.)	(0.0033)	(.)	(0.0027)	(.)	(0.0027)	(.)
secondary education	-0.0328***	0.0000	-0.0286***	0.0000	0.0023	0.0000	0.0017	0.0000	-0.0519***	0.0000	-0.0442***	0.0000
	(0.0034)	(.)	(0.0034)	(.)	(0.0054)	(.)	(0.0054)	(.)	(0.0042)	(.)	(0.0042)	(.)
higher education	-0.0217***	0.0000	-0.0084	0.0000	0.0212	0.0000	0.0181	0.0000	-0.0651***	0.0000	-0.0449***	0.0000
	(0.0078)	(.)	(0.0079)	(.)	(0.0162)	(.)	(0.0160)	(.)	(0.0106)	(.)	(0.0106)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.109	0.207	0.119	0.215	0.107	0.133	0.127	0.153	0.103	0.227	0.115	0.235
Number of observations	252,154	252,154	252,154	252,154	56,399	56,399	56,399	56,399	195,755	195,755	195,755	195,755
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		29,577		29,577		7,594		7,594		25,863		25,863
Panel B: Triple difference: high LFP cluster												
post-2004 * base under 5 malaria mortality rate	0.1544***	0.3924***	0.0010	0.1116	0.0136	0.1707**	-0.0271	-0.0038	0.1604***	0.4545***	0.0192	0.1727
	(0.0398)	(0.0582)	(0.0654)	(0.1116)	(0.0619)	(0.0711)	(0.1159)	(0.1170)	(0.0448)	(0.0749)	(0.0743)	(0.1475)
post2004 * high LFP cluster	0.0179**	0.0477***	0.0107	-0.1095	0.0300***	0.0293**	-0.5859**	0.0962*	0.0196**	0.0588***	0.0592	0.3854
	(0.0076)	(0.0107)	(.)	(25.2483)	(0.0113)	(0.0131)	(0.2505)	(0.0562)	(0.0084)	(0.0139)	(0.0440)	(.)
post2004 * u5mort * high LFP cluster	-0.1970**	-0.4611***	-0.2887**	-0.3360	-0.0048	-0.1377	-0.0902	-0.1279	-0.3192***	-0.6736***	-0.2577*	-0.4496*
	(0.0911)	(0.1282)	(0.1233)	(0.2052)	(0.1422)	(0.1687)	(0.2318)	(0.2617)	(0.0928)	(0.1606)	(0.1380)	(0.2617)
primary education	-0.0247***	0.0000	-0.0190***	0.0000	-0.0002	0.0000	-0.0002	0.0000	-0.0288***	0.0000	-0.0233***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0033)	(.)	(0.0033)	(.)	(0.0027)	(.)	(0.0027)	(.)
secondary education	-0.0331***	0.0000	-0.0286***	0.0000	0.0023	0.0000	0.0017	0.0000	-0.0525***	0.0000	-0.0442***	0.0000
	(0.0034)	(.)	(0.0034)	(.)	(0.0054)	(.)	(0.0054)	(.)	(0.0041)	(.)	(0.0042)	(.)
higher education	-0.0216***	0.0000	-0.0083	0.0000	0.0212	0.0000	0.0181	0.0000	-0.0652***	0.0000	-0.0448***	0.0000
	(0.0078)	(.)	(0.0079)	(.)	(0.0162)	(.)	(0.0160)	(.)	(0.0106)	(.)	(0.0106)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
post2004 * base u5 mortality: high FLFP clusters	-0.043	-0.069	-0.288***	-0.224	0.009	0.033	-0.117	-0.132	-0.159**	-0.219	-0.238**	-0.277
	(0.081)	(0.114)	(0.102)	(0.172)	(0.130)	(0.153)	(0.205)	(0.240)	(0.080)	(0.141)	(0.114)	(0.215)
R-squared	0.109	0.207	0.119	0.215	0.107	0.133	0.127	0.153	0.104	0.227	0.115	0.235
Number of observations	252,154	252,154	252,154	252,154	56,399	56,399	56,399	56,399	195,755	195,755	195,755	195,755
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		29,577		29,577		7,594		7,594		25,863		25,863

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 26 to 40 between 1992 and 2016. High baseline LFP is a variable that takes the value one if the woman lives in a DHS cluster where labour force participation in 1999 was higher than the median for all clusters. Between 1992 and 2003, the average probability of birth for women aged 26–40 in clusters where baseline LFP was higher (lower) than the 1999 median was 0.18 (0.18), 0.02 (0.03) for women who were likely to give birth to their first child, and 0.23 (0.23) for women who were likely to have higher order births.

FIGURE C.7: Average years of schooling, Tanzania and the historical United States



Source: UNDP HDR (2018); Barro and Lee (2010); Lee and Lee (2016); Roser and Ortiz-Ospina (2016)

Notes: The graph shows the average number of years of total schooling across all education levels for the population aged 25 years and older.

TABLE C.19: Labour force participation as a function of exposure to the malaria intervention: results for women controlling for baseline LFP in women aged 26-40

	currently working				worked in the last 12 months			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: 26-40 year old women								
fertile years post-2004 * base u5 malaria mortrate	-0.0021	-0.0206**	-0.0033	-0.0295***	-0.0045	-0.0149**	-0.0080	-0.0255**
	(0.0061)	(0.0080)	(0.0072)	(0.0107)	(0.0057)	(0.0075)	(0.0070)	(0.0104)
fertile years post-2004 * high base FLFP cluster	0.0086***	0.0068***	0.0082***	0.0046***	0.0081***	0.0066***	0.0071***	0.0040**
	(0.0006)	(0.0012)	(0.0011)	(0.0017)	(0.0006)	(0.0010)	(0.0010)	(0.0016)
fertile years post-2004 * base u5mort * high base FLFP cluster			0.0045	0.0277*			0.0132	0.0329**
			(0.0110)	(0.0151)			(0.0097)	(0.0140)
primary education	0.0209***	0.0172***	0.0208***	0.0174***	0.0207***	0.0150***	0.0206***	0.0152***
	(0.0067)	(0.0061)	(0.0067)	(0.0061)	(0.0060)	(0.0054)	(0.0060)	(0.0054)
secondary education	0.0174	0.0457***	0.0176	0.0460***	0.0133	0.0391***	0.0140	0.0395***
	(0.0112)	(0.0110)	(0.0112)	(0.0110)	(0.0102)	(0.0097)	(0.0102)	(0.0098)
higher education	0.1308***	0.1570***	0.1307***	0.1577***	0.1101***	0.1318***	0.1099***	0.1326***
	(0.0209)	(0.0213)	(0.0209)	(0.0213)	(0.0176)	(0.0185)	(0.0177)	(0.0185)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high FLFP clusters			0.001	-0.002			0.005	0.007
			(0.009)	(0.011)			(0.007)	(0.009)
R-squared	0.110	0.168	0.110	0.168	0.118	0.172	0.118	0.172
Number of observations	24,952	24,952	24,952	24,952	24,952	24,952	24,952	24,952
Panel B: 26-40 year old women without children								
fertile years post-2004 * base u5 malaria mortrate	-0.0410	-0.0305	-0.0441	-0.0533	-0.0151	0.0096	-0.0117	0.0007
	(0.0296)	(0.0491)	(0.0331)	(0.0592)	(0.0271)	(0.0449)	(0.0303)	(0.0536)
fertile years post-2004 * high base FLFP cluster	0.0060*	-0.0130*	0.0047	-0.0203	0.0062**	-0.0038	0.0075	-0.0067
	(0.0032)	(0.0078)	(0.0065)	(0.0124)	(0.0028)	(0.0067)	(0.0057)	(0.0115)
fertile years post-2004 * base u5mort * high base FLFP cluster			0.0180	0.1010			-0.0195	0.0396
			(0.0780)	(0.1245)			(0.0711)	(0.1187)
primary education	0.0594	0.0668	0.0594	0.0684	0.0709*	0.0706	0.0709*	0.0712
	(0.0460)	(0.0500)	(0.0461)	(0.0498)	(0.0419)	(0.0455)	(0.0419)	(0.0454)
secondary education	0.0516	0.0986*	0.0518	0.1005*	0.0789	0.1182**	0.0786	0.1189**
	(0.0551)	(0.0595)	(0.0551)	(0.0597)	(0.0490)	(0.0530)	(0.0491)	(0.0532)
higher education	0.1689**	0.2408***	0.1685**	0.2449***	0.1824***	0.2355***	0.1828***	0.2371***
	(0.0716)	(0.0771)	(0.0717)	(0.0778)	(0.0632)	(0.0697)	(0.0632)	(0.0703)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high FLFP clusters			-0.026	0.048			-0.031	0.040
			(0.070)	(0.104)			(0.063)	(0.100)
R-squared	0.402	0.519	0.402	0.520	0.420	0.519	0.420	0.519
Number of observations	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662
Panel C: 26-40 year old women with children								
fertile years post-2004 * base u5 malaria mortrate	0.0002	-0.0204**	0.0001	-0.0283**	-0.0029	-0.0152*	-0.0063	-0.0257**
	(0.0065)	(0.0083)	(0.0077)	(0.0111)	(0.0060)	(0.0078)	(0.0074)	(0.0108)
fertile years post-2004 * high base FLFP cluster	0.0088***	0.0074***	0.0088***	0.0055***	0.0083***	0.0071***	0.0074***	0.0046***
	(0.0007)	(0.0012)	(0.0012)	(0.0018)	(0.0006)	(0.0011)	(0.0011)	(0.0017)
fertile years post-2004 * base u5mort * high base FLFP cluster			0.0004	0.0239			0.0126	0.0319**
			(0.0113)	(0.0155)			(0.0099)	(0.0143)
primary education	0.0186***	0.0149**	0.0186***	0.0151**	0.0178***	0.0120**	0.0177***	0.0122**
	(0.0069)	(0.0062)	(0.0069)	(0.0062)	(0.0061)	(0.0054)	(0.0061)	(0.0054)
secondary education	0.0147	0.0425***	0.0147	0.0428***	0.0082	0.0333***	0.0088	0.0337***
	(0.0114)	(0.0112)	(0.0114)	(0.0113)	(0.0105)	(0.0100)	(0.0105)	(0.0100)
higher education	0.1228***	0.1415***	0.1228***	0.1421***	0.1015***	0.1167***	0.1013***	0.1175***
	(0.0221)	(0.0222)	(0.0221)	(0.0222)	(0.0209)	(0.0211)	(0.0209)	(0.0211)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high FLFP clusters			0.000	-0.004			0.006	0.006
			(0.009)	(0.011)			(0.007)	(0.009)
R-squared	0.114	0.173	0.114	0.173	0.121	0.178	0.121	0.178
Number of observations	23,290	23,290	23,290	23,290	23,290	23,290	23,290	23,290

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. High baseline LFP is a variable that takes the value one if the woman lives in a DHS cluster where labour force participation in 1999 was higher than the median for all clusters. Baseline labour force participation rates in 1999 for women in clusters with high baseline LFP were 0.95 and 0.98 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.69 and 0.77 respectively for women in clusters with LFP rates lower than the median for all clusters in 1999.

TABLE C.20: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation by women's education level, for women aged 15–25

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: 15-25 year old women with lower than secondary education												
post-2004 * base under 5 malaria mortality rate	0.0105	0.1918***	-0.0934*	-0.0877	-0.0567	0.1097	0.0523	0.2379	0.0662	0.0209	-0.2561***	-0.6169**
	(0.0314)	(0.0610)	(0.0546)	(0.1278)	(0.0384)	(0.0706)	(0.0671)	(0.1496)	(0.0573)	(0.1242)	(0.0989)	(0.2465)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.112	0.188	0.119	0.200	0.064	0.179	0.072	0.189	0.156	0.350	0.174	0.368
Number of observations	271,768	271,768	271,768	271,768	166,797	166,797	166,797	166,797	104,971	104,971	104,971	104,971
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		38,769		38,769		34,216		34,216		23,222		23,222
Panel B: 15-25 year old women with secondary or higher education												
post-2004 * base under 5 malaria mortality rate	0.0022	0.2324***	0.1308**	0.4623***	-0.0681**	-0.0898	0.1171**	0.2877**	0.7482***	1.2175***	0.4774	1.5700*
	(0.0267)	(0.0644)	(0.0578)	(0.1394)	(0.0264)	(0.0602)	(0.0549)	(0.1184)	(0.1318)	(0.3461)	(0.3188)	(0.8389)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.092	0.094	0.102	0.108	0.054	0.095	0.069	0.114	0.173	0.327	0.226	0.392
Number of observations	71,664	71,664	71,664	71,664	61,465	61,465	61,465	61,465	10,199	10,199	10,199	10,199
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		10,926		10,926		10,549		10,549		2,980		2,980

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 25 between 1992 and 2016. Between 1992 and 2003, the average probability of birth for more (less) educated women aged 15–25 was 0.08 (0.16), 0.05 (0.11) for women who were likely to give birth to their first child, and 0.23 (0.27) for women who were likely to have higher order births.

TABLE C.21: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation by women's education level for women aged 26–40

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: 26-40 year old women with lower than secondary education												
post-2004 * base under 5 malaria mortality rate	0.0769**	0.2469***	-0.1334**	-0.0762	-0.0531	0.0449	-0.1196	-0.1127	0.0699*	0.3134***	-0.1136*	-0.0293
	(0.0375)	(0.0566)	(0.0591)	(0.1004)	(0.0587)	(0.0676)	(0.1154)	(0.1267)	(0.0418)	(0.0734)	(0.0653)	(0.1306)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.116	0.210	0.126	0.218	0.128	0.140	0.151	0.162	0.108	0.229	0.120	0.237
Number of observations	221,613	221,613	221,613	221,613	47,530	47,530	47,530	47,530	174,083	174,083	174,083	174,083
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		25,599		25,599		5,951		5,951		22,774		22,774
Panel B: 26-40 year old women with secondary or higher education												
post-2004 * base under 5 malaria mortality rate	0.4288***	0.7143***	0.1672	0.4625**	0.3199***	0.3766***	0.1902	0.2396	0.5196***	0.6775***	0.3847*	0.5026*
	(0.0771)	(0.1038)	(0.1578)	(0.2083)	(0.1147)	(0.1251)	(0.2590)	(0.2466)	(0.0949)	(0.1378)	(0.2014)	(0.2955)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.092	0.193	0.113	0.215	0.129	0.118	0.197	0.195	0.103	0.221	0.133	0.248
Number of observations	32,011	32,011	32,011	32,011	8,960	8,960	8,960	8,960	23,051	23,051	23,051	23,051
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		4,160		4,160		1,661		1,661		3,258		3,258

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 26 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth for more (less) educated women aged 26–40 was 0.17 (0.18), 0.06 (0.02) for women who were likely to give birth to their first child, and 0.21 (0.23) for women who were likely to have higher order births.

TABLE C.22: Labour force participation as a function of exposure to the malaria intervention: results by women's education level for women aged 15–25

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A1: 15-25 year old women with lower than secondary education				
fertile years post-2004 * base u5 malaria mortrate	-0.0348***	-0.0099	-0.0351***	0.0001
	(0.0054)	(0.0085)	(0.0054)	(0.0080)
R-squared	0.193	0.277	0.211	0.295
Number of observations	18,476	18,476	18,476	18,476
Panel A2: 15-25 year old women with secondary or higher education				
fertile years post-2004 * base u5 malaria mortrate	0.0063	0.0070	0.0061	0.0181
	(0.0072)	(0.0124)	(0.0073)	(0.0128)
R-squared	0.275	0.321	0.291	0.341
Number of observations	6,802	6,802	6,802	6,802
Panel B1: 15-25 year old childless women with lower than secondary education				
fertile years post-2004 * base u5 malaria mortrate	-0.0452***	-0.0119	-0.0458***	-0.0057
	(0.0065)	(0.0113)	(0.0065)	(0.0109)
R-squared	0.227	0.307	0.246	0.325
Number of observations	9,161	9,161	9,161	9,161
Panel B2: 15-25 year old childless women with secondary or higher education				
fertile years post-2004 * base u5 malaria mortrate	0.0158**	-0.0036	0.0160**	0.0122
	(0.0076)	(0.0142)	(0.0076)	(0.0145)
R-squared	0.286	0.338	0.295	0.351
Number of observations	5,435	5,435	5,435	5,435
Panel C1: 15-25 year old mothers with lower than secondary education				
fertile years post-2004 * base u5 malaria mortrate	-0.0203***	-0.0082	-0.0193***	0.0064
	(0.0074)	(0.0111)	(0.0068)	(0.0098)
R-squared	0.171	0.298	0.175	0.301
Number of observations	9,315	9,315	9,315	9,315
Panel C2: 15-25 year old mothers with secondary or higher education				
fertile years post-2004 * base u5 malaria mortrate	-0.0464*	0.0075	-0.0483**	0.0014
	(0.0241)	(0.0553)	(0.0226)	(0.0521)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.454	0.571	0.469	0.590
Number of observations	1,367	1,367	1,367	1,367

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. Baseline labour force participation rates in 1999 for more educated women were 0.43 and 0.50 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.65 and 0.71 respectively for less educated women.

TABLE C.23: Labour force participation as a function of exposure to the malaria intervention: results by women's education level for women aged 26–40

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A1: 26-40 year old women with lower than secondary education				
fertile years post-2004 * base u5 malaria mortrate	-0.0174***	-0.0240***	-0.0199***	-0.0197**
	(0.0066)	(0.0086)	(0.0062)	(0.0081)
R-squared	0.102	0.186	0.108	0.190
Number of observations	21,437	21,437	21,437	21,437
Panel A2: 26-40 year old women with secondary or higher education				
fertile years post-2004 * base u5 malaria mortrate	-0.0759***	-0.0557**	-0.0659***	-0.0407*
	(0.0144)	(0.0227)	(0.0127)	(0.0221)
R-squared	0.233	0.273	0.232	0.270
Number of observations	3,515	3,515	3,515	3,515
Panel B1: 26-40 year old childless women with lower than secondary education				
fertile years post-2004 * base u5 malaria mortrate	-0.0656	0.0300	-0.0260	0.0644
	(0.0497)	(0.0919)	(0.0457)	(0.0804)
R-squared	0.493	0.673	0.513	0.696
Number of observations	1,055	1,055	1,055	1,055
Panel B2: 26-40 year old childless women with secondary or higher education				
fertile years post-2004 * base u5 malaria mortrate	-0.1471*	-0.1051	-0.1118	-0.0052
	(0.0749)	(0.1451)	(0.0690)	(0.1341)
R-squared	0.654	0.715	0.643	0.705
Number of observations	607	607	607	607
Panel C1: 26-40 year old mothers with lower than secondary education				
fertile years post-2004 * base u5 malaria mortrate	-0.0156**	-0.0256***	-0.0190***	-0.0212**
	(0.0069)	(0.0092)	(0.0064)	(0.0086)
R-squared	0.104	0.190	0.110	0.194
Number of observations	20,382	20,382	20,382	20,382
Panel C2: 26-40 year old mothers with secondary or higher education				
fertile years post-2004 * base u5 malaria mortrate	-0.0677***	-0.0425	-0.0593***	-0.0197
	(0.0158)	(0.0266)	(0.0144)	(0.0254)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.261	0.308	0.261	0.308
Number of observations	2,908	2,908	2,908	2,908

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. Baseline labour force participation rates in 1999 for more educated women were 0.78 and 0.85 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.81 and 0.86 respectively for less educated women.

TABLE C.24: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation by local education levels

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Controlling for high education clusters												
post-2004 * base under 5 malaria mortality rate	-0.0432*	-0.0223	-0.0519	0.0304	-0.1762***	-0.2446***	0.0198	0.1014	0.0544	0.0455	-0.0870	0.0150
	(0.0259)	(0.0441)	(0.0407)	(0.0682)	(0.0280)	(0.0439)	(0.0469)	(0.0803)	(0.0386)	(0.0604)	(0.0584)	(0.0994)
post2004 * high education cluster	-0.0225***	-0.0457***	-0.0048	-0.0062	-0.0156***	-0.0186***	-0.0117**	-0.0040	-0.0205***	-0.0460***	0.0068	-0.0059
	(0.0031)	(0.0050)	(0.0036)	(0.0054)	(0.0036)	(0.0050)	(0.0050)	(0.0074)	(0.0042)	(0.0064)	(0.0049)	(0.0075)
primary education	-0.0261***	0.0000	-0.0219***	0.0000	-0.0168***	0.0000	-0.0158***	0.0000	-0.0313***	0.0000	-0.0252***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0021)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0731***	0.0000	-0.0689***	0.0000	-0.0855***	0.0000	-0.0829***	0.0000	-0.0624***	0.0000	-0.0559***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0025)	(.)	(0.0025)	(.)	(0.0038)	(.)	(0.0037)	(.)
higher education	-0.0951***	0.0000	-0.0840***	0.0000	-0.1046***	0.0000	-0.1015***	0.0000	-0.0960***	0.0000	-0.0743***	0.0000
	(0.0040)	(.)	(0.0043)	(.)	(0.0045)	(.)	(0.0045)	(.)	(0.0102)	(.)	(0.0101)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.103	0.142	0.110	0.151	0.059	0.144	0.065	0.154	0.119	0.215	0.130	0.222
Number of observations	593,749	593,749	593,749	593,749	283,442	283,442	283,442	283,442	310,307	310,307	310,307	310,307
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,141		55,141		45,570		45,570		35,404		35,404
Panel B: Triple difference: high education clusters												
post-2004 * base under 5 malaria mortality rate	-0.0499	-0.0711	-0.0175	0.0512	-0.1956***	-0.3461***	0.0776	0.1101	0.0197	-0.0576	-0.0918	0.0092
	(0.0322)	(0.0533)	(0.0438)	(0.0703)	(0.0348)	(0.0503)	(0.0497)	(0.0830)	(0.0466)	(0.0757)	(0.0625)	(0.1058)
post2004 * high education cluster	-0.0241***	-0.0578***	0.0057	0.0009	-0.0203***	-0.0443***	0.0081	-0.0006	-0.0283***	-0.0712***	0.0055	-0.0078
	(0.0055)	(0.0089)	(0.0060)	(0.0101)	(0.0061)	(0.0086)	(0.0073)	(0.0111)	(0.0079)	(0.0119)	(0.0089)	(0.0137)
post2004 * u5mort * high education cluster	0.0219	0.1640*	-0.1291**	-0.0851	0.0655	0.3582***	-0.2389***	-0.0404	0.1067	0.3324***	0.0168	0.0221
	(0.0566)	(0.0951)	(0.0564)	(0.0989)	(0.0627)	(0.1021)	(0.0650)	(0.1202)	(0.0849)	(0.1251)	(0.0871)	(0.1303)
primary education	-0.0260***	0.0000	-0.0219***	0.0000	-0.0168***	0.0000	-0.0158***	0.0000	-0.0312***	0.0000	-0.0252***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0021)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0730***	0.0000	-0.0689***	0.0000	-0.0853***	0.0000	-0.0830***	0.0000	-0.0621***	0.0000	-0.0559***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0025)	(.)	(0.0025)	(.)	(0.0038)	(.)	(0.0037)	(.)
higher education	-0.0951***	0.0000	-0.0839***	0.0000	-0.1045***	0.0000	-0.1015***	0.0000	-0.0959***	0.0000	-0.0744***	0.0000
	(0.0040)	(.)	(0.0043)	(.)	(0.0045)	(.)	(0.0045)	(.)	(0.0102)	(.)	(0.0101)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
post2004 * base u5 mortality: high education clusters	-0.028	0.093	-0.147**	-0.034	-0.130**	0.012	-0.161**	0.070	0.126*	0.275***	-0.075	0.031
	(0.046)	(0.079)	(0.057)	(0.105)	(0.051)	(0.089)	(0.067)	(0.127)	(0.070)	(0.099)	(0.087)	(0.137)
R-squared	0.103	0.142	0.110	0.151	0.059	0.144	0.066	0.154	0.119	0.215	0.130	0.222
Number of observations	593,749	593,749	593,749	593,749	283,442	283,442	283,442	283,442	310,307	310,307	310,307	310,307
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,141		55,141		45,570		45,570		35,404		35,404

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth for women in clusters with high (low) education levels at baseline was 0.16 (0.17), 0.08 (0.08) for women who were likely to give birth to their first child, and 0.23 (0.26) for women who were likely to have higher order births.

TABLE C.25: Labour force participation as a function of exposure to the malaria intervention: controlling for and interacting with local education levels

	currently working				worked in the last 12 months			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: 15-40 year old women								
fertile years post-2004 * base u5 malaria mortrate	-0.0350***	-0.0231***	-0.0566***	-0.0254***	-0.0359***	-0.0181***	-0.0583***	-0.0215***
	(0.0045)	(0.0052)	(0.0055)	(0.0059)	(0.0045)	(0.0051)	(0.0058)	(0.0060)
fertile years post-2004 * high education cluster	-0.0036***	-0.0012**	-0.0081***	-0.0018**	-0.0035***	-0.0009*	-0.0082***	-0.0018**
	(0.0006)	(0.0005)	(0.0009)	(0.0009)	(0.0006)	(0.0005)	(0.0009)	(0.0009)
fertile years post-2004 * u5mort x high education cluster			0.0619***	0.0072			0.0643***	0.0107
			(0.0098)	(0.0083)			(0.0098)	(0.0083)
primary education	-0.0204***	-0.0143***	-0.0182***	-0.0143***	-0.0241***	-0.0199***	-0.0218***	-0.0200***
	(0.0064)	(0.0055)	(0.0063)	(0.0055)	(0.0059)	(0.0049)	(0.0059)	(0.0049)
secondary education	-0.1878***	-0.1412***	-0.1798***	-0.1411***	-0.2003***	-0.1566***	-0.1921***	-0.1564***
	(0.0096)	(0.0087)	(0.0097)	(0.0087)	(0.0094)	(0.0082)	(0.0094)	(0.0082)
higher education	-0.0368	0.0168	-0.0315	0.0167	-0.0561***	-0.0094	-0.0505**	-0.0095
	(0.0230)	(0.0218)	(0.0227)	(0.0217)	(0.0213)	(0.0205)	(0.0210)	(0.0204)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high education clusters			0.005	-0.018**			0.006	-0.011
			(0.008)	(0.007)			(0.008)	(0.007)
R-squared	0.206	0.260	0.208	0.260	0.222	0.273	0.225	0.273
Number of observations	52,506	52,506	52,506	52,506	52,506	52,506	52,506	52,506
Panel B: 15-40 year old women without children								
fertile years post-2004 * base u5 malaria mortrate	-0.0289***	-0.0050	-0.0398***	-0.0029	-0.0285***	0.0012	-0.0398***	0.0034
	(0.0054)	(0.0083)	(0.0069)	(0.0090)	(0.0055)	(0.0082)	(0.0073)	(0.0091)
fertile years post-2004 * high education cluster	-0.0037***	-0.0007	-0.0059***	-0.0001	-0.0038***	-0.0007	-0.0061***	-0.0000
	(0.0008)	(0.0010)	(0.0011)	(0.0014)	(0.0007)	(0.0009)	(0.0011)	(0.0013)
fertile years post-2004 * u5mort x high education cluster			0.0304***	-0.0072			0.0317***	-0.0074
			(0.0112)	(0.0115)			(0.0110)	(0.0108)
primary education	-0.1106***	-0.0887***	-0.1086***	-0.0886***	-0.1310***	-0.1099***	-0.1289***	-0.1098***
	(0.0146)	(0.0139)	(0.0145)	(0.0139)	(0.0135)	(0.0126)	(0.0134)	(0.0126)
secondary education	-0.3648***	-0.3190***	-0.3602***	-0.3189***	-0.3976***	-0.3529***	-0.3928***	-0.3528***
	(0.0173)	(0.0166)	(0.0173)	(0.0166)	(0.0166)	(0.0158)	(0.0166)	(0.0158)
higher education	-0.2670***	-0.2156***	-0.2634***	-0.2154***	-0.3089***	-0.2638***	-0.3051***	-0.2636***
	(0.0367)	(0.0362)	(0.0365)	(0.0362)	(0.0365)	(0.0360)	(0.0363)	(0.0361)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high education clusters			-0.009	-0.010			-0.008	-0.004
			(0.009)	(0.011)			(0.008)	(0.011)
R-squared	0.244	0.291	0.244	0.291	0.264	0.309	0.264	0.309
Number of observations	16,487	16,487	16,487	16,487	16,487	16,487	16,487	16,487
Panel C: 15-40 year old women with children								
fertile years post-2004 * base u5 malaria mortrate	-0.0344***	-0.0264***	-0.0633***	-0.0321***	-0.0354***	-0.0207***	-0.0649***	-0.0281***
	(0.0054)	(0.0062)	(0.0065)	(0.0070)	(0.0051)	(0.0058)	(0.0064)	(0.0067)
fertile years post-2004 * high education cluster	-0.0030***	-0.0004	-0.0089***	-0.0018*	-0.0029***	-0.0001	-0.0089***	-0.0018**
	(0.0006)	(0.0006)	(0.0011)	(0.0009)	(0.0006)	(0.0005)	(0.0010)	(0.0009)
fertile years post-2004 * u5mort x high education cluster			0.0830***	0.0177*			0.0847***	0.0230**
			(0.0119)	(0.0104)			(0.0114)	(0.0099)
primary education	0.0042	0.0044	0.0064	0.0045	0.0046	0.0029	0.0069	0.0029
	(0.0065)	(0.0055)	(0.0064)	(0.0055)	(0.0058)	(0.0047)	(0.0058)	(0.0047)
secondary education	-0.0454***	0.0069	-0.0364***	0.0071	-0.0494***	-0.0006	-0.0403***	-0.0003
	(0.0103)	(0.0097)	(0.0104)	(0.0097)	(0.0096)	(0.0087)	(0.0098)	(0.0088)
higher education	0.0897***	0.1356***	0.0940***	0.1355***	0.0732***	0.1127***	0.0775***	0.1126***
	(0.0226)	(0.0225)	(0.0226)	(0.0225)	(0.0216)	(0.0215)	(0.0214)	(0.0215)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Effect of u5 mortality decline: high education clusters			0.020**	-0.014			0.020**	-0.005
			(0.010)	(0.010)			(0.009)	(0.009)
R-squared	0.108	0.191	0.113	0.191	0.111	0.193	0.117	0.193
Number of observations	36,019	36,019	36,019	36,019	36,019	36,019	36,019	36,019

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in clusters with high education levels at baseline were 0.70 and 0.77 for working at time of survey and working in the preceding 12 months, respectively. These rates were 0.72 and 0.77 respectively for women in clusters with high levels of education at baseline.

TABLE C.26: Educational attainment as a function of exposure to the malaria intervention

	Total		Men		Women	
	(1)	(2)	(3)	(4)	(5)	(6)
post-2004 * base under 5 malaria mortality rate	-8.2146***	0.0251	-7.1991***	0.8413	-8.7236***	-0.3772
	(0.5062)	(0.9318)	(0.5942)	(1.0733)	(0.5609)	(1.0510)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes
Respondent birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes	No	Yes
R-squared	0.096	0.128	0.132	0.166	0.098	0.132
Number of observations	80,024	80,024	27,154	27,154	52,870	52,870

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The dependent variable is the highest year of education achieved by the respondent, and the sample considered is men and women in the age group 15-40. On average, men and women were educated for up to 4.7 years in this sample in 1999, with men in 1999 having on average 5.0 years of education, and women having 4.4 years of education.

TABLE C.27: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation controlling for desired fertility

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post-2004 * base under 5 malaria mortality rate	-0.1262***	0.1016*	-0.0834	-0.0663	-0.1695***	-0.4346***	0.0994	0.2559*	-0.0823**	0.1601**	-0.1658**	-0.0632
	(0.0277)	(0.0611)	(0.0512)	(0.1098)	(0.0320)	(0.0690)	(0.0636)	(0.1425)	(0.0408)	(0.0683)	(0.0729)	(0.1226)
ideal number of children	0.0117***	0.0000	0.0113***	0.0000	0.0064***	0.0000	0.0075***	0.0000	0.0147***	0.0000	0.0137***	0.0000
	(0.0005)	(.)	(0.0005)	(.)	(0.0006)	(.)	(0.0006)	(.)	(0.0006)	(.)	(0.0006)	(.)
primary education	-0.0181***	0.0000	-0.0183***	0.0000	-0.0181***	0.0000	-0.0159***	0.0000	-0.0155***	0.0000	-0.0161***	0.0000
	(0.0023)	(.)	(0.0022)	(.)	(0.0033)	(.)	(0.0033)	(.)	(0.0029)	(.)	(0.0028)	(.)
secondary education	-0.0716***	0.0000	-0.0647***	0.0000	-0.1022***	0.0000	-0.0933***	0.0000	-0.0456***	0.0000	-0.0383***	0.0000
	(0.0028)	(.)	(0.0028)	(.)	(0.0037)	(.)	(0.0038)	(.)	(0.0043)	(.)	(0.0042)	(.)
higher education	-0.0926***	0.0000	-0.0840***	0.0000	-0.1395***	0.0000	-0.1312***	0.0000	-0.0621***	0.0000	-0.0504***	0.0000
	(0.0051)	(.)	(0.0053)	(.)	(0.0052)	(.)	(0.0055)	(.)	(0.0120)	(.)	(0.0123)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.106	0.146	0.111	0.157	0.077	0.172	0.084	0.186	0.127	0.209	0.135	0.217
Number of observations	365,158	365,158	365,158	365,158	139,347	139,347	139,347	139,347	225,811	225,811	225,811	225,811
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		34,781		34,781		27,513		27,513		23,525		23,525

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016, born between 1952 and 2001. Between 1992 and 2003, the average probability of birth in this sample was 0.08, both for women who were likely to give birth to their first child, as well as for women who who were likely to have higher order births.

TABLE C.28: Labour force participation as a function of exposure to the malaria intervention: results controlling for desired fertility

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0235***	-0.0376***	-0.0246***	-0.0373***
	(0.0063)	(0.0071)	(0.0063)	(0.0069)
ideal number of children	-0.0014	0.0013	-0.0023	0.0010
	(0.0015)	(0.0013)	(0.0014)	(0.0013)
primary education	-0.0053	-0.0016	-0.0079	-0.0056
	(0.0081)	(0.0072)	(0.0074)	(0.0063)
secondary education	-0.1324***	-0.1082***	-0.1477***	-0.1228***
	(0.0122)	(0.0113)	(0.0118)	(0.0105)
higher education	0.0328	0.0537**	0.0149	0.0353
	(0.0259)	(0.0262)	(0.0240)	(0.0241)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.217	0.261	0.233	0.282
Number of observations	29,299	29,299	29,299	29,299
Panel B: 15-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0358***	-0.0282**	-0.0318***	-0.0202
	(0.0086)	(0.0126)	(0.0086)	(0.0127)
ideal number of children	0.0066**	0.0086***	0.0059**	0.0087***
	(0.0029)	(0.0027)	(0.0029)	(0.0027)
primary education	-0.0560**	-0.0441**	-0.0713***	-0.0605***
	(0.0217)	(0.0205)	(0.0201)	(0.0187)
secondary education	-0.2905***	-0.2628***	-0.3166***	-0.2872***
	(0.0264)	(0.0253)	(0.0251)	(0.0239)
higher education	-0.1500***	-0.1294***	-0.1913***	-0.1735***
	(0.0471)	(0.0472)	(0.0470)	(0.0471)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.279	0.320	0.297	0.342
Number of observations	8,991	8,991	8,991	8,991
Panel C: 15-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0121	-0.0303***	-0.0136*	-0.0302***
	(0.0076)	(0.0082)	(0.0073)	(0.0077)
ideal number of children	-0.0032*	-0.0005	-0.0040***	-0.0007
	(0.0016)	(0.0015)	(0.0015)	(0.0014)
primary education	0.0063	0.0045	0.0070	0.0039
	(0.0084)	(0.0073)	(0.0074)	(0.0063)
secondary education	-0.0009	0.0225*	-0.0118	0.0118
	(0.0133)	(0.0125)	(0.0120)	(0.0109)
higher education	0.1138***	0.1367***	0.1053***	0.1274***
	(0.0256)	(0.0267)	(0.0231)	(0.0245)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.146	0.206	0.154	0.221
Number of observations	20,308	20,308	20,308	20,308

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively.

C.2 The effect of malaria control measures on child and maternal health and survival

Since malaria control interventions have the potential to improve not just child mortality, but also maternal pregnancy and health outcomes, reductions in maternal malaria incidence and mortality may be additional mechanisms through which fertility may be affected. Appendix Figure C.2 shows that there were declines in adult female malaria mortality and incidence post-2004, though the initial levels of mortality and incidence were much lower among adult females, as malaria is endemic to most of Tanzania and there tend to be high levels of acquired immunity among adults.

Malaria incidence and mortality among adult women In addition to reducing malaria mortality among children under five, the malaria control interventions also reduced malaria mortality and incidence among adult women (as seen in Appendix Figure C.2). Research has shown that improvements in women's health reduce fertility and increase female labour force participation (Bloom et al., 2009, 2015; Jayachandran et al., 2010), with improved maternal health also lowering the risk of adverse birth outcomes and miscarriage. There is also evidence that malaria incidence among adult women reduces lactation and increases fertility through decreased child spacing (Bates et al., 2004). Appendix Tables C.2.1 and C.2.2 additionally control for exposure to the intervention during women's fertile years interacted with baseline malaria incidence rates among women aged 15-49 in their locality. These results show that controlling for the reduction in malaria incidence among women aged 15-49 did not qualitatively affect the nature of the results on fertility and labour market outcomes.[40]

[40] Appendix Tables C.2.3 and C.2.4 control for the reduction in malaria incidence among children under five instead but results are identical to those controlling for the reduction in adult female

Appendix Tables C.2.5 and C.2.6 estimate the effect of the decline in malaria mortality among adult women as a result of the malaria control interventions on fertility and labour force outcomes. Since the measures of child mortality and adult female mortality are constructed so that they are almost perfectly collinear it is not possible to include both measures in the regression analysis.[41] The adult female mortality measure is therefore also picking up some of the effects of the reduction in under five mortality, and the observed effects are qualitatively similar, though they are much larger in magnitude as the levels of adult female mortality rates are very low (as seen in Figure 3.10). Table 3.2 also shows that the post-2004 decline in child mortality rates was much larger than the decline in adult female mortality rates. Appendix Tables C.2.7 and C.2.8 additionally control for the reduction in malaria incidence among adult women, showing that the effects of the decline in adult female malaria mortality are not picking up the effect of the improvement in women's health, and are more likely to be coming from the correlated decline in child mortality. Recall also that malaria mortality rates among adult women were low in comparison to those among children under five even before the malaria control measures were introduced (Figure 3.1), so that the potential effect of a reduction in maternal mortality from malaria would be small. These results have also showed that the effect of reduced malaria incidence among adult women was small in comparison to the effect of reduced child mortality, suggesting that the effects in this table actually pick up some of the effects of reduced child mortality, which cannot be included alongside this measure.

incidence. This is because incidence rates in each age group are calculated as proportions of the total malaria incidence in the DHS cluster in the given year, and so they move proportionally together.

[41] Both the adult female malaria mortality rate and the under five malaria mortality in the DHS cluster are proportions of the total malaria mortality in the DHS cluster in a given year — since these two groups account for almost all of the malaria mortality burden they are fixed proportions of each other in any given year across all clusters. They are therefore statistically collinear and cannot be included together in regression analysis.

TABLE C.2.1: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation controlling for incidence among women aged 15-49

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post-2004 * base under 5 malaria mortality rate	0.0788*	0.2823***	-0.0900*	-0.0170	-0.2177***	-0.2446***	-0.0209	0.0451	0.2493***	0.1840**	-0.1696**	-0.0771
	(0.0437)	(0.0690)	(0.0491)	(0.0823)	(0.0439)	(0.0692)	(0.0543)	(0.0972)	(0.0621)	(0.0934)	(0.0715)	(0.1260)
post-2004 * base 15-49 female malaria incidence rate	-0.0011	-0.0035**	0.0017	0.0021	0.0026***	0.0020	0.0020	0.0027	-0.0032**	0.0004	0.0032*	0.0039
	(0.0010)	(0.0015)	(0.0012)	(0.0020)	(0.0010)	(0.0015)	(0.0014)	(0.0021)	(0.0013)	(0.0018)	(0.0018)	(0.0031)
primary education	-0.0269***	0.0000	-0.0218***	0.0000	-0.0169***	0.0000	-0.0156***	0.0000	-0.0325***	0.0000	-0.0251***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0021)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0736***	0.0000	-0.0687***	0.0000	-0.0852***	0.0000	-0.0827***	0.0000	-0.0627***	0.0000	-0.0553***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0025)	(.)	(0.0025)	(.)	(0.0037)	(.)	(0.0037)	(.)
higher education	-0.0955***	0.0000	-0.0840***	0.0000	-0.1043***	0.0000	-0.1011***	0.0000	-0.0969***	0.0000	-0.0746***	0.0000
	(0.0040)	(.)	(0.0042)	(.)	(0.0045)	(.)	(0.0045)	(.)	(0.0102)	(.)	(0.0101)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.103	0.142	0.110	0.151	0.059	0.144	0.065	0.154	0.118	0.215	0.130	0.222
Number of observations	597,056	597,056	597,056	597,056	284,752	284,752	284,752	284,752	312,304	312,304	312,304	312,304
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,542		55,542		45,849		45,849		35,626		35,626

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth in this sample was 0.08, both for women who were likely to give birth to their first child, as well as for women who who were likely to have higher order births.

TABLE C.2.2: Labour force participation as a function of exposure to the malaria intervention: results controlling for incidence in women aged 15-49

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0706***	-0.0274***	-0.0706***	-0.0220***
	(0.0067)	(0.0068)	(0.0068)	(0.0068)
fertile years post-2004 * base women 15-49 malaria incidence rate	0.0011***	0.0001	0.0011***	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
primary education	-0.0165**	-0.0143***	-0.0199***	-0.0200***
	(0.0064)	(0.0055)	(0.0059)	(0.0049)
secondary education	-0.1772***	-0.1404***	-0.1896***	-0.1559***
	(0.0097)	(0.0086)	(0.0095)	(0.0081)
higher education	-0.0332	0.0150	-0.0519**	-0.0111
	(0.0232)	(0.0217)	(0.0216)	(0.0204)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.207	0.262	0.224	0.276
Number of observations	52,859	52,859	52,859	52,859
Panel B: 15-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0418***	-0.0013	-0.0407***	0.0060
	(0.0086)	(0.0102)	(0.0089)	(0.0101)
fertile years post-2004 * base women 15-49 malaria incidence rate	0.0005***	-0.0002	0.0005***	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
primary education	-0.1053***	-0.0851***	-0.1253***	-0.1062***
	(0.0148)	(0.0138)	(0.0138)	(0.0125)
secondary education	-0.3563***	-0.3134***	-0.3888***	-0.3470***
	(0.0175)	(0.0166)	(0.0168)	(0.0158)
higher education	-0.2599***	-0.2128***	-0.3012***	-0.2607***
	(0.0370)	(0.0360)	(0.0369)	(0.0359)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.240	0.293	0.260	0.312
Number of observations	16,649	16,649	16,649	16,649
Panel C: 15-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0808***	-0.0343***	-0.0775***	-0.0261***
	(0.0079)	(0.0077)	(0.0074)	(0.0072)
fertile years post-2004 * base women 15-49 malaria incidence rate	0.0013***	0.0002	0.0012***	0.0001
	(0.0002)	(0.0001)	(0.0001)	(0.0001)
primary education	0.0079	0.0040	0.0084	0.0022
	(0.0065)	(0.0055)	(0.0058)	(0.0047)
secondary education	-0.0345***	0.0058	-0.0392***	-0.0021
	(0.0104)	(0.0097)	(0.0097)	(0.0087)
higher education	0.0878***	0.1292***	0.0718***	0.1064***
	(0.0228)	(0.0227)	(0.0218)	(0.0218)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.111	0.191	0.114	0.194
Number of observations	36,210	36,210	36,210	36,210

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively.

TABLE C.2.3: Probability of birth as a function of exposure to the malaria intervention: results from the hazard model estimation controlling for incidence among women aged 15-49

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post-2004 * base under 5 malaria mortality rate	0.0788*	0.2823***	-0.0900*	-0.0170	-0.2177***	-0.2446***	-0.0209	0.0451	0.2493***	0.1840**	-0.1696**	-0.0771
	(0.0437)	(0.0690)	(0.0491)	(0.0823)	(0.0439)	(0.0692)	(0.0543)	(0.0972)	(0.0621)	(0.0934)	(0.0715)	(0.1260)
post-2004 * base under 5 malaria incidence rate	-0.0011	-0.0036**	0.0018	0.0022	0.0027***	0.0020	0.0021	0.0028	-0.0033**	0.0005	0.0034*	0.0041
	(0.0010)	(0.0015)	(0.0012)	(0.0021)	(0.0010)	(0.0015)	(0.0014)	(0.0022)	(0.0014)	(0.0019)	(0.0018)	(0.0032)
primary education	-0.0269***	0.0000	-0.0218***	0.0000	-0.0169***	0.0000	-0.0156***	0.0000	-0.0325***	0.0000	-0.0251***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0021)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0736***	0.0000	-0.0687***	0.0000	-0.0852***	0.0000	-0.0827***	0.0000	-0.0627***	0.0000	-0.0553***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0025)	(.)	(0.0025)	(.)	(0.0037)	(.)	(0.0037)	(.)
higher education	-0.0955***	0.0000	-0.0840***	0.0000	-0.1043***	0.0000	-0.1011***	0.0000	-0.0969***	0.0000	-0.0746***	0.0000
	(0.0040)	(.)	(0.0042)	(.)	(0.0045)	(.)	(0.0045)	(.)	(0.0102)	(.)	(0.0101)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.103	0.142	0.110	0.151	0.059	0.144	0.065	0.154	0.118	0.215	0.130	0.222
Number of observations	597,056	597,056	597,056	597,056	284,752	284,752	284,752	284,752	312,304	312,304	312,304	312,304
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,542		55,542		45,849		45,849		35,626		35,626

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth in this sample was 0.08, both for women who were likely to give birth to their first child, as well as for women who who were likely to have higher order births.

TABLE C.2.4: Labour force participation as a function of exposure to the malaria intervention: results controlling for incidence in women aged 15-49

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
fertile years post-2004 * base u5 malaria mortrate	-0.0706***	-0.0274***	-0.0706***	-0.0220***
	(0.0067)	(0.0068)	(0.0068)	(0.0068)
fertile years post-2004 * base under 5 malaria incidence rate	0.0011***	0.0001	0.0011***	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
primary education	-0.0165**	-0.0143***	-0.0199***	-0.0200***
	(0.0064)	(0.0055)	(0.0059)	(0.0049)
secondary education	-0.1772***	-0.1404***	-0.1896***	-0.1559***
	(0.0097)	(0.0086)	(0.0095)	(0.0081)
higher education	-0.0332	0.0150	-0.0519**	-0.0111
	(0.0232)	(0.0217)	(0.0216)	(0.0204)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.207	0.262	0.224	0.276
Number of observations	52,859	52,859	52,859	52,859
Panel B: 15-40 year old women without children				
fertile years post-2004 * base u5 malaria mortrate	-0.0418***	-0.0013	-0.0407***	0.0060
	(0.0086)	(0.0102)	(0.0089)	(0.0101)
fertile years post-2004 * base under 5 malaria incidence rate	0.0005***	-0.0002	0.0005***	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
primary education	-0.1053***	-0.0851***	-0.1253***	-0.1062***
	(0.0148)	(0.0138)	(0.0138)	(0.0125)
secondary education	-0.3563***	-0.3134***	-0.3888***	-0.3470***
	(0.0175)	(0.0166)	(0.0168)	(0.0158)
higher education	-0.2599***	-0.2128***	-0.3012***	-0.2607***
	(0.0370)	(0.0360)	(0.0369)	(0.0359)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.240	0.293	0.260	0.312
Number of observations	16,649	16,649	16,649	16,649
Panel C: 15-40 year old women with children				
fertile years post-2004 * base u5 malaria mortrate	-0.0808***	-0.0343***	-0.0775***	-0.0261***
	(0.0079)	(0.0077)	(0.0074)	(0.0072)
fertile years post-2004 * base under 5 malaria incidence rate	0.0014***	0.0002	0.0012***	0.0001
	(0.0002)	(0.0001)	(0.0001)	(0.0001)
primary education	0.0079	0.0040	0.0084	0.0022
	(0.0065)	(0.0055)	(0.0058)	(0.0047)
secondary education	-0.0345***	0.0058	-0.0392***	-0.0021
	(0.0104)	(0.0097)	(0.0097)	(0.0087)
higher education	0.0878***	0.1292***	0.0718***	0.1064***
	(0.0228)	(0.0227)	(0.0218)	(0.0218)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.111	0.191	0.114	0.194
Number of observations	36,210	36,210	36,210	36,210

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively.

TABLE C.2.5: Probability of birth as a function of exposure to the malaria intervention and subsequent decline in adult female mortality: results from the hazard model estimation, sample of women aged 15–40 in 1992-2016

		probability of birth				probability of first birth				probability of higher order birth		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: 15-40 year old women												
post-2004 * base 15-49 female malaria mortality rate	0.4677	1.8219***	-0.6332	0.3987	-1.4582***	-2.1034***	0.2728	1.2752	1.5310***	2.5064***	-1.1170	0.2112
	(0.2953)	(0.5020)	(0.5088)	(0.8507)	(0.3171)	(0.4977)	(0.5890)	(1.0003)	(0.4411)	(0.7098)	(0.7262)	(1.2429)
primary education	-0.0268***	0.0000	-0.0219***	0.0000	-0.0170***	0.0000	-0.0157***	0.0000	-0.0322***	0.0000	-0.0252***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0021)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0733***	0.0000	-0.0688***	0.0000	-0.0857***	0.0000	-0.0828***	0.0000	-0.0620***	0.0000	-0.0555***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0025)	(.)	(0.0025)	(.)	(0.0038)	(.)	(0.0037)	(.)
higher education	-0.0955***	0.0000	-0.0840***	0.0000	-0.1045***	0.0000	-0.1011***	0.0000	-0.0968***	0.0000	-0.0747***	0.0000
	(0.0040)	(.)	(0.0042)	(.)	(0.0045)	(.)	(0.0045)	(.)	(0.0102)	(.)	(0.0101)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.103	0.141	0.110	0.151	0.058	0.144	0.065	0.154	0.118	0.215	0.130	0.222
Number of observations	597,056	597,056	597,056	597,056	284,752	284,752	284,752	284,752	312,304	312,304	312,304	312,304
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,542		55,542		45,849		45,849		35,626		35,626

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth in this sample was 0.08, both for women who were likely to give birth to their first child, as well as for women who who were likely to have higher order births.

TABLE C.2.6: Labour force participation as a function of exposure to the malaria intervention and subsequent decline in adult female mortality

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
fertile years post-2004 * base women 15-49 malaria mortrate	-0.3323***	-0.2954***	-0.3501***	-0.2390***
	(0.0522)	(0.0636)	(0.0525)	(0.0630)
primary education	-0.0203***	-0.0144***	-0.0237***	-0.0201***
	(0.0064)	(0.0055)	(0.0060)	(0.0049)
secondary education	-0.1874***	-0.1407***	-0.1995***	-0.1561***
	(0.0097)	(0.0086)	(0.0095)	(0.0082)
higher education	-0.0383*	0.0148	-0.0568***	-0.0112
	(0.0232)	(0.0217)	(0.0217)	(0.0204)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.204	0.262	0.220	0.276
Number of observations	52,859	52,859	52,859	52,859
Panel B: 15-40 year old women without children				
fertile years post-2004 * base women 15-49 malaria mortrate	-0.2589***	-0.0770	-0.2525***	0.0003
	(0.0612)	(0.1027)	(0.0623)	(0.1015)
primary education	-0.1074***	-0.0849***	-0.1274***	-0.1059***
	(0.0149)	(0.0138)	(0.0139)	(0.0125)
secondary education	-0.3614***	-0.3130***	-0.3937***	-0.3465***
	(0.0177)	(0.0166)	(0.0170)	(0.0159)
higher education	-0.2629***	-0.2129***	-0.3041***	-0.2608***
	(0.0370)	(0.0360)	(0.0368)	(0.0359)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.240	0.293	0.259	0.312
Number of observations	16,649	16,649	16,649	16,649
Panel C: 15-40 year old women with children				
fertile years post-2004 * base women 15-49 malaria mortrate	-0.3426***	-0.3454***	-0.3628***	-0.2814***
	(0.0643)	(0.0764)	(0.0619)	(0.0716)
primary education	0.0038	0.0036	0.0047	0.0020
	(0.0065)	(0.0055)	(0.0059)	(0.0048)
secondary education	-0.0450***	0.0053	-0.0487***	-0.0024
	(0.0103)	(0.0097)	(0.0097)	(0.0087)
higher education	0.0842***	0.1289***	0.0686***	0.1062***
	(0.0231)	(0.0227)	(0.0223)	(0.0218)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.106	0.191	0.109	0.194
Number of observations	36,210	36,210	36,210	36,210

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively.

TABLE C.2.7: Probability of birth as a function of exposure to the malaria intervention and subsequent decline in adult female mortality and incidence: results from the hazard model estimation, sample of women aged 15–40 in 1992-2016

	probability of birth				probability of first birth				probability of higher order birth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: 15-40 year old women												
post-2004 * base 15-49 female malaria mortality rate	0.9826*	3.5186***	-1.1215*	-0.2120	-2.7144***	-3.0496***	-0.2607	0.5624	3.1074***	2.2944**	-2.1139**	-0.9615
	(0.5445)	(0.8596)	(0.6117)	(1.0264)	(0.5467)	(0.8625)	(0.6772)	(1.2115)	(0.7740)	(1.1644)	(0.8912)	(1.5704)
post-2004 * base 15-49 female malaria incidence rate	-0.0011	-0.0035**	0.0017	0.0021	0.0026***	0.0020	0.0020	0.0027	-0.0032**	0.0004	0.0032*	0.0039
	(0.0010)	(0.0015)	(0.0012)	(0.0020)	(0.0010)	(0.0015)	(0.0014)	(0.0021)	(0.0013)	(0.0018)	(0.0018)	(0.0031)
primary education	-0.0269***	0.0000	-0.0218***	0.0000	-0.0169***	0.0000	-0.0156***	0.0000	-0.0325***	0.0000	-0.0251***	0.0000
	(0.0018)	(.)	(0.0017)	(.)	(0.0023)	(.)	(0.0021)	(.)	(0.0024)	(.)	(0.0023)	(.)
secondary education	-0.0736***	0.0000	-0.0687***	0.0000	-0.0852***	0.0000	-0.0827***	0.0000	-0.0627***	0.0000	-0.0553***	0.0000
	(0.0022)	(.)	(0.0022)	(.)	(0.0025)	(.)	(0.0025)	(.)	(0.0037)	(.)	(0.0037)	(.)
higher education	-0.0955***	0.0000	-0.0840***	0.0000	-0.1043***	0.0000	-0.1011***	0.0000	-0.0969***	0.0000	-0.0746***	0.0000
	(0.0040)	(.)	(0.0042)	(.)	(0.0045)	(.)	(0.0045)	(.)	(0.0102)	(.)	(0.0101)	(.)
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth timing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth order FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.103	0.142	0.110	0.151	0.059	0.144	0.065	0.154	0.118	0.215	0.130	0.222
Number of observations	597,056	597,056	597,056	597,056	284,752	284,752	284,752	284,752	312,304	312,304	312,304	312,304
Woman FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of women		55,542		55,542		45,849		45,849		35,626		35,626

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Birth controls FE include indicator variables for the time since last birth and potential birth order of the next birth. The regressions are run on a woman-year panel dataset for women aged 15 to 40 between 1992 and 2016. Between 1992 and 2003, the average probability of birth in this sample was 0.08, both for women who were likely to give birth to their first child, as well as for women who who were likely to have higher order births.

TABLE C.2.8: Labour force participation as a function of exposure to the malaria intervention and subsequent decline in adult female mortality and incidence

	currently working		worked in the last 12 months	
	(1)	(2)	(3)	(4)
Panel A: 15-40 year old women				
fertile years post-2004 * base women 15-49 malaria mortrate	-0.8799***	-0.3418***	-0.8804***	-0.2740***
	(0.0831)	(0.0851)	(0.0843)	(0.0849)
fertile years post-2004 * base women 15-49 malaria incidence rate	0.0011***	0.0001	0.0011***	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
primary education	-0.0165**	-0.0143***	-0.0199***	-0.0200***
	(0.0064)	(0.0055)	(0.0059)	(0.0049)
secondary education	-0.1772***	-0.1404***	-0.1896***	-0.1559***
	(0.0097)	(0.0086)	(0.0095)	(0.0081)
higher education	-0.0332	0.0150	-0.0519**	-0.0111
	(0.0232)	(0.0217)	(0.0216)	(0.0204)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.207	0.262	0.224	0.276
Number of observations	52,859	52,859	52,859	52,859
Panel B: 15-40 year old women without children				
fertile years post-2004 * base women 15-49 malaria mortrate	-0.5213***	-0.0160	-0.5073***	0.0751
	(0.1078)	(0.1266)	(0.1104)	(0.1255)
fertile years post-2004 * base women 15-49 malaria incidence rate	0.0005***	-0.0002	0.0005***	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
primary education	-0.1053***	-0.0851***	-0.1253***	-0.1062***
	(0.0148)	(0.0138)	(0.0138)	(0.0125)
secondary education	-0.3563***	-0.3134***	-0.3888***	-0.3470***
	(0.0175)	(0.0166)	(0.0168)	(0.0158)
higher education	-0.2599***	-0.2128***	-0.3012***	-0.2607***
	(0.0370)	(0.0360)	(0.0369)	(0.0359)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.240	0.293	0.260	0.312
Number of observations	16,649	16,649	16,649	16,649
Panel C: 15-40 year old women with children				
fertile years post-2004 * base women 15-49 malaria mortrate	-1.0073***	-0.4279***	-0.9661***	-0.3255***
	(0.0988)	(0.0963)	(0.0921)	(0.0894)
fertile years post-2004 * base women 15-49 malaria incidence rate	0.0013***	0.0002	0.0012***	0.0001
	(0.0002)	(0.0001)	(0.0001)	(0.0001)
primary education	0.0079	0.0040	0.0084	0.0022
	(0.0065)	(0.0055)	(0.0058)	(0.0047)
secondary education	-0.0345***	0.0058	-0.0392***	-0.0021
	(0.0104)	(0.0097)	(0.0097)	(0.0087)
higher education	0.0878***	0.1292***	0.0718***	0.1064***
	(0.0228)	(0.0227)	(0.0218)	(0.0218)
Cluster FE	Yes	Yes	Yes	Yes
Mother birth year FE	Yes	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes	Yes
Region-year FE	No	Yes	No	Yes
R-squared	0.111	0.191	0.114	0.194
Number of observations	36,210	36,210	36,210	36,210

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors clustered at DHS sample cluster in parentheses. The omitted category for the education controls is no education. Baseline labour force participation rates in 1999 for women in this analysis overall were 0.71 and 0.77 for working at time of survey and working in the preceding 12 months, respectively.