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The Dynamic Wage Effects of First and Second Births in the UK

Master Thesis

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AI Use Declaration

The author used generative artificial intelligence (AI) tools, primarily ChatGPT, during the preparation of this dissertation. AI assistance was used in a limited and supportive capacity for the following purposes:

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Lu Dong 19/05/2026

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Table of contents

1. Introduction 6
2. Literature review 9
2.1. Channels of the effects of childbirth on the women's wages 9
2.2. The motherhood wage penalty: prior empirical studies 21
3. Data and variable construction 24
3.1. Data and sample selection 24
3.2. Variable construction 25
4. Methodology 31
4.1. Overview 31
4.2. TWFE model 31
4.3. Inclusion of controls in baseline models 33
4.4. Event study framework 34
5. Heterogeneity analyses 37
5.1. Heterogeneity by firm size 37
5.2. Heterogeneity by ethnicity 39
5.3. Heterogeneity by institutional period 40
6. Results 41
6.1. Baseline estimates 41
6.2. Event study 43
6.3. Heterogeneity in the motherhood penalty in the UK 47
6.3.1. Firm size and the motherhood wage penalty 47
6.3.2. Ethnicity and labour market inequality 49
6.3.3. Policy period and institutional change 51
7. Robustness check 54
7.1. Labour supply effects 54
7.2. In-time placebo tests 57
7.3. Sensitivity to sample selection 59

7.4. Robustness check with staggered DID 60

8. Conclusion and discussion 62

List of references 66

Resümee 75

Abstract

This study examines the motherhood wage penalty in the United Kingdom by analysing how women's wages evolve following first and second childbirths. Using longitudinal panel data from the UK Household Longitudinal Study (UKHLS), the study first employs a baseline two-way fixed-effects model to establish the existence of motherhood wage penalties in the UK labour market. The main analysis then applies an event-study framework to estimate women's wage trajectories before and after childbirth. In addition, the dissertation investigates heterogeneity in wage penalties across firm size, ethnic background, and policy environments associated with Shared Parental Leave (SPL).

The findings indicate that childbirth generates substantial and persistent wage penalties for women in the UK, with first births producing the largest and most enduring declines in earnings. Wage losses are especially pronounced during the years immediately following first childbirth, suggesting that the transition into motherhood represents a critical turning point in women's labour-market trajectories. Although second births also reduce women's earnings, their effects are comparatively smaller. The results further show that women employed in larger firms experience relatively weaker wage penalties, while White women exhibit more pronounced post-birth wage declines than ethnic minority women. In addition, policy changes associated with Shared Parental Leave appear to mitigate wage penalties related to second births. Overall, the study highlights how fertility sequencing shapes women's long-term earnings trajectories and provides empirical evidence relevant to labour-market and family-policy discussions aimed at supporting maternal employment.

Keywords: motherhood wage penalty; childbirth order; event-study analysis; UK labour market; Shared Parental Leave (SPL)

1. Introduction

Over the past several decades, women's participation in the labour market has increased substantially across advanced economies, fundamentally reshaping household economic structures and workforce composition. In the United Kingdom, the employment rate of women aged 16–64 rose from approximately 53% in the early 1970s to more than 72% by 2023 (Office for National Statistics [ONS], 2024). At the same time, women's educational attainment has expanded rapidly: women accounted for nearly 57% of UK higher-education enrolments in 2022 (Higher Education Statistics Agency, 2023). These developments reflect the long-term strengthening of women's labour market attachment and human capital accumulation.

Despite these advances, substantial gender inequalities in earnings remain persistent throughout the life cycle. Importantly, these inequalities widen sharply during prime childbearing years. According to the ONS (2024), the gender pay gap among younger workers in the UK is relatively small before family formation, but increases considerably among workers aged over 30. Recent labour economics research increasingly argues that this divergence is closely linked to childbirth rather than gender differences alone. Using Danish administrative data, Kleven, Landais, and Søgaard (2019a) show that women experience large and persistent earnings declines immediately following childbirth, while men's earnings trajectories remain largely unchanged. Similar patterns have subsequently been documented across a wide range of advanced economies, suggesting that childbirth constitutes one of the central mechanisms generating long-run gender wage inequality (Andresen & Nix, 2022; Kleven et al., 2025).

However, an important limitation of much existing research is that it often focuses on average motherhood penalties rather than examining how women's wages evolve dynamically around childbirth itself. Understanding the timing and persistence of post-birth wage changes is crucial because childbirth may affect women's labour market outcomes through multiple channels operating over different horizons. Earnings may decline immediately due to maternity leave and temporary labour force withdrawal, but longer-run effects may additionally emerge through reduced working hours, slower promotion trajectories, occupational downgrading, or weaker wage growth. Analysing wage dynamics before and after childbirth therefore provides deeper insight into the mechanisms through which motherhood shapes women's economic outcomes.

The issue is particularly important in the United Kingdom. The UK labour market combines relatively high female employment with exceptionally high childcare costs,

widespread part-time employment, and substantial occupational inequality between mothers and non-mothers. OECD (2011) estimates indicate that childcare costs in the UK remain among the highest in Europe relative to median household income. Meanwhile, the average age at first birth has risen steadily from 27.7 years in 2000 to over 30.9 years in 2022, while the total fertility rate declined from 1.94 births per woman in 2010 to approximately 1.49 in 2022 (ONS, 2023a). These demographic trends reflect broader changes in educational attainment, career investment, housing costs, and economic uncertainty. At the same time, dual-earner households have become increasingly common, with more than 70% of UK households with dependent children now relying on two earners (Brewer et al., 2023). Consequently, any persistent wage reductions associated with childbirth may have substantial implications not only for gender inequality, but also for household welfare, labour supply, and long-run economic productivity.

While the international literature consistently identifies substantial motherhood wage penalties, existing research often treats childbirth as a single fertility event rather than distinguishing between first and higher-order births. This distinction is important because first and second childbirths may generate fundamentally different labour market consequences. First childbirth typically represents women's initial transition into motherhood and often coincides with the largest adjustment in labour supply, career interruption, and intra-household specialisation. Women experiencing first births may reduce working hours, interrupt career progression, or shift toward more flexible employment arrangements in response to new caregiving responsibilities.

Second childbirth, however, may involve different economic mechanisms. By the time women experience a second birth, many have already adjusted their employment arrangements, accumulated childcare experience, and renegotiated household divisions of labour following first motherhood. Consequently, second births may generate either smaller marginal labour market disruptions due to prior adaptation, or alternatively larger cumulative penalties due to intensified caregiving burdens. Recent demographic and labour market research increasingly emphasises that fertility decisions are sequential rather than independent, implying that first and second births should not necessarily be expected to produce identical economic effects (Berrington et al., 2023).

The distinction between first and second births may be particularly important within the UK institutional setting. Existing UK evidence suggests that fathers' involvement in childcare often increases following subsequent births, potentially reducing the marginal labour market disruption associated with second motherhood (Nolte & Forbes, 2023).

Moreover, second births may interact differently with workplace flexibility, childcare availability, and employer accommodation policies, particularly among highly educated dual-earner households.

Despite the growing literature on child penalties, relatively limited UK evidence directly examines the dynamic evolution of women's wages surrounding childbirth itself. Much of the existing British literature focuses on average gender wage gaps, labour force participation, or occupational segregation rather than tracing women's wage trajectories before and after fertility transitions. Furthermore, few UK studies explicitly distinguish between first and second childbirths within a dynamic event-study framework. Existing evidence also provides limited understanding of how motherhood penalties vary across institutional and demographic environments such as firm size, ethnicity, and policy periods.

The aim of the study is to quantify heterogeneous effects of childbirth on women's wages in the UK labour market.

The dissertation seeks to answer three central research questions. First, how does childbirth affect women's wages dynamically over time within the UK labour market? Second, do first and second childbirths generate different wage penalties in terms of magnitude and persistence? Third, to what extent do workplace characteristics, ethnic background, and institutional changes shape the motherhood wage penalty in the UK?

This study addresses these gaps by examining the dynamic impact of first and second childbirths on women's wages using longitudinal data from the UK Household Longitudinal Study (UKHLS), covering Waves 1–15. Methodologically, the analysis employs a two-way fixed effects (TWFE) event-study framework that estimates women's earnings trajectories relative to childbirth while controlling for individual fixed effects, calendar-year fixed effects, and time-varying characteristics. In addition to estimating average wage effects, the analysis further investigates heterogeneity across firm size, ethnicity, and institutional periods before and after major UK family-policy reforms.

The remainder of this dissertation is structured as follows. Section 2 reviews the theoretical and empirical literature on motherhood wage penalties, labour supply adjustments, and institutional determinants of gender inequality. Section 3 introduces the UKHLS dataset and presents descriptive statistics. Section 4 outlines the empirical methodology and identification strategy. Section 5 presents heterogeneity analysis. Section 6 presents the baseline event-study results, followed by heterogeneity analyses and robustness checks. The final section concludes and discusses the broader implications of the findings for gender inequality and family policy in the United Kingdom.

keywords characterizing the thesis:

motherhood wage penalty

childbirth order

event-study analysis

UK labour market

Shared Parental Leave (SPL)

CERCS research classification codes:

S180 Economics, econometrics, economic theory, economic systems, economic policy

S210 Sociology

S212 Sociology of labour, sociology of enterprise

S250 Demography

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2. Literature review

2.1. Channels of the effects of childbirth on the women's wages

The motherhood wage penalty (MWP) generally refers to the systematic disadvantage that women experience after becoming mothers, relative to childless women, men, or their own pre-birth counterfactual trajectories, in wages, earnings, employment probabilities, working hours, wage growth, or occupational advancement (Budig & England, 2001; Correll, Benard & Paik, 2007; Kleven, Landais & Søgaard, 2019a). In its narrower sense, the MWP refers to reductions in hourly wage rates and asks whether mothers are penalised in pay conditional on comparable working time (Waldfogel, 1997; Budig & Hodges, 2010). In its broader sense, the concept is closer to the recent literature on child penalties or parenthood penalties, which examines the overall changes in women's earnings, employment, hours, and occupational trajectories following childbirth (Angelov, Johansson & Lindahl, 2016; Kleven

et al., 2019a; Andresen & Nix, 2022). The broader definition is particularly important for research on the United Kingdom, because post-birth losses among British mothers are reflected not only in lower hourly wages, but also in employment exits, part-time employment, occupational downgrading, slower promotion, and flatter wage-growth trajectories (Adda, Dustmann & Stevens, 2017; Dias, Joyce & Parodi, 2020; Dias et al., 2020).

Early economic research primarily interpreted the motherhood wage penalty through the lens of human capital theory. Becker (1985) and Mincer and Polachek (1974) argue that women experience wage declines after childbirth because fertility interrupts their labour-market participation and reduces the accumulation of work experience, occupation-specific skills, and career continuity. Since mothers are more likely to interrupt employment temporarily or reduce working hours, they tend to accumulate less market-oriented human capital than otherwise comparable men or childless women. Within this theoretical framework, the wage penalty is mainly attributed to productivity differences generated by childcare responsibilities.

This explanation remains influential in contemporary research. Using UK data, Adda, Dustmann and Stevens (2017) show that career interruptions and occupational choices associated with childbirth are important in explaining women's long-term earnings losses. Over the past decade, however, the literature has gradually moved from the narrower concept of the motherhood wage penalty to the broader frameworks of child penalties and parenthood penalties. Kleven, Landais and Søgaard's (2019a) event-study analysis shows that women's earnings, employment, and hours decline sharply after childbirth, whereas the corresponding outcomes for men are almost unaffected. This finding has shifted scholarly attention from the wage gap between mothers and childless women to the question of how childbirth dynamically reshapes the labour-market trajectories of both parents. Angelov, Johansson and Lindahl (2016), in the Swedish context, find that gender earnings gaps widen rapidly after the birth of the first child and persist over the long term. Dias, Joyce and Parodi (2020) similarly show that, in the United Kingdom, the slower accumulation of work experience among women after childbirth is a key mechanism through which the gender pay gap expands. Cortés and Pan (2023) further argue that, in many high-income countries, a substantial share of the remaining gender earnings gap is now associated with childbearing, making children a central explanatory factor in contemporary gender inequality. Taken together, these studies suggest that childbirth initiates a persistent process that weakens women's labour-market attachment. In other words, motherhood is no longer merely a control variable in wage

equations, but a key entry point for understanding gender pay gaps, occupational stratification, and the consequences of family policy.

This conceptual shift is especially important for studying the wage dynamics of British mothers after first and second births. Traditional studies of the motherhood wage penalty often treat motherhood as a static status, whereas the child-penalty literature emphasises childbirth as a temporally ordered event whose effects evolve dynamically over event time. A first birth commonly marks a woman's first interruption of continuous career development and may therefore trigger major adjustments in labour supply, occupational sorting, and household organisation. A growing body of research shows that the first birth is a major source of women's lifetime earnings losses because it fundamentally changes women's labour-market behaviour (Angelov, Johansson, & Lindahl, 2016; Andresen & Nix, 2022). By contrast, the second birth occurs after women have already undergone an initial round of career adjustment, household division of labour, and changes in employer expectations. Accordingly, first and second births should not be treated as a simple linear increase in the number of children, but as two qualitatively different life-course events.

The existing literature generally regards the first birth as the most important labour-market turning point in women's life courses. The arrival of the first child is typically accompanied by maternity leave, breastfeeding and early childcare responsibilities, childcare arrangements, adjustments in working hours, and a reallocation of unpaid work within the household. Angelov et al. (2016), Kleven et al. (2019a), and Andresen and Nix (2022) all show that becoming a mother for the first time significantly alters women's earnings and employment trajectories, and that this effect tends to be persistent. For the United Kingdom, recent analysis by the Office for National Statistics (ONS, 2024) also shows that mothers' monthly earnings fall substantially and persistently after the first birth, indicating that the transition to motherhood is indeed a key point at which wage trajectories undergo structural change.

With regard to the second birth, the literature contains two competing interpretations. The first emphasises a diminishing marginal effect. According to this logic, mothers may have already completed the major career adjustments after the first birth, such as reducing working hours, moving into more flexible jobs, lowering promotion effort, or exiting high-pressure occupations. Although the second birth increases care responsibilities, its additional impact may therefore be smaller than that of the first birth. In other words, the first birth completes the transition from being a childless worker to being a mother-worker, while the second birth occurs on an already-adjusted trajectory. If empirical estimates show a smaller

second-birth wage penalty, this does not necessarily mean that the second child is low-cost; rather, it may indicate that the first birth has already absorbed most of the career shock.

Other scholars, however, argue that a second birth may intensify long-term negative effects through cumulative care burdens. Brehm and Milewski (2024), for example, find in Germany that having additional children significantly increases mothers' likelihood of remaining in long-term part-time employment, thereby reinforcing weaker labour-market attachment over the life course. More recent research also suggests that these cumulative effects are closely linked to changes in working arrangements and perceptions of career opportunities within households. Drawing on evidence from employees with children, Kurowska and Kasperska (2025) argue that the expansion of flexible and home-based working does not necessarily eliminate gender inequality in career development. Instead, mothers continue to assume a disproportionate share of childcare and domestic responsibilities, which may gradually reshape both their own and employers' expectations regarding career commitment and advancement. In this context, additional children may further consolidate gendered divisions of labour established after the first birth, increasing the likelihood that mothers prioritise flexibility and family accommodation over long-term career progression. Under this interpretation, the second birth is not merely a small marginal disturbance but may intensify long-term career stagnation through cumulative childcare responsibilities.

Whether the second birth generates smaller, or larger wage losses therefore becomes an empirical question, the answer to which depends on the institutional context, workplace flexibility, and the design of family policy.

As noted above, the strength of human capital theory lies in its clear explanation of why childbirth affects women's wages. Maternity leave and childcare-related employment interruptions reduce continuous work experience; part-time employment slows the accumulation of skills; and occupational mobility may move women away from higher-return jobs. This logic is particularly relevant in the United Kingdom, where women's part-time employment is common and the wage returns to part-time experience are often lower than those to full-time experience. Nevertheless, the human capital explanation has clear limitations. First, it tends to interpret the wage penalty as the natural outcome of women's individual labour-supply choices, thereby underestimating how institutions, organisations, and social norms structure the choice set. Second, it struggles to explain why motherhood wage penalties remain persistent in countries with high levels of education and comparatively developed welfare systems. Third, it provides only a thin account of differences between first

and second births. If wage penalties were simply the result of reduced work experience, then the additional experience loss associated with the second birth should be relatively predictable; yet empirical research shows that second-birth effects may vary considerably by occupation, household division of labour, childcare arrangements, and employer responses.

For this reason, recent research argues that human capital depreciation alone cannot fully explain the scale and persistence of contemporary motherhood wage penalties. Goldin (2014, 2021) shows that many high-paying modern occupations are characterised by nonlinear returns to hours: wages and promotions do not increase linearly with working time, but instead strongly reward continuous availability, immediate responsiveness, long hours, and non-substitutability. In finance, law, consulting, technology, and senior management, even a modest reduction in working hours or availability can lead to earnings losses that are far larger than the reduction in hours itself. This means that workers who reduce hours or seek flexibility in order to reconcile work and family responsibilities often experience earnings losses that are highly disproportionate to the decline in working time. From this perspective, the motherhood wage penalty arises not only because women work less, but also because labour markets penalise employment arrangements designed to accommodate care responsibilities. This perspective is particularly relevant to the United Kingdom, where promotion in many high-skilled occupations depends heavily on sustained commitment and visibility, while mothers after childbirth are more likely to seek flexible work, reduce travel, or move into more predictable positions. The penalty is therefore not simply a matter of lower income due to fewer hours; rather, it reflects the incompatibility between occupational organisation and care responsibilities. Boinet et al. (2024), in a UK-based study, further integrate gender norms, occupational sorting, and labour supply, showing that mothers' pre-birth occupational environments and gender beliefs shape the size of the post-birth penalty.

This argument should be understood as a revision and extension of the traditional human capital explanation rather than as a wholesale rejection of it. Earlier theories tended to view childbirth as a temporary interruption to career accumulation, whereas newer studies indicate that childbirth may permanently alter women's career trajectories. Women may move into jobs that offer greater temporal flexibility but lower pay; they may reduce their pursuit of promotion; or they may deliberately avoid occupational fields characterised by greedy work, namely work cultures that require unpredictable schedules and very long working hours (Cha & Weeden, 2014; Goldin, 2021). As a result, the wage penalty may persist even when mothers return to full-time employment after childbirth. The occupational sorting perspective also helps explain differences between first and second births. After the

first birth, women may already have moved from high-intensity, high-return jobs into more flexible positions with slower wage growth; in that case, the marginal earnings decline after the second birth may be smaller. However, if women remain in high-pressure occupations after the first birth, the second birth may become the trigger for further exit from the core promotion track. In other words, the significance of the second-birth penalty depends on whether occupational downgrading has already occurred after the first birth, and whether the occupation allows mothers to combine care responsibilities with career advancement without sacrificing promotion.

In addition to labour supply and occupational choice, employer responses constitute an important mechanism behind motherhood penalties. Correll, Benard and Paik's (2007) classic experimental study finds that, holding qualifications constant, employers are more likely to perceive mothers as less competent or less committed than childless women. Subsequent studies further show that motherhood can operate as a negative signal affecting hiring, training, promotion, and wage growth. Fuller and Hirsh (2019) and Pedulla and Thébaud (2015), among others, emphasise that firms may formally support flexible work while still rewarding, in actual promotion decisions, employment patterns associated with workers who appear free from care responsibilities. Importantly, employer responses may differ between first and second births. First-time motherhood may create greater uncertainty for employers, because the woman has not previously combined paid work with childcare. A second birth, however, may signal more permanent weakening of labour-market attachment, especially in occupations structured around the norm of the ideal worker. Employer expectations may therefore stabilise after childbirth or intensify, depending on the structure of the workplace. This also means that the motherhood wage penalty does not occur only at the moment of childbirth. Some penalties may appear in advance, when women reduce effort, change jobs, or encounter shifting employer expectations during pregnancy or when planning childbirth; other penalties may appear with a lag, through reduced promotion opportunities several years later.

Accordingly, recent research on motherhood wage penalties has increasingly moved beyond traditional explanatory frameworks and has emphasised the central role of institutional environments, organisational structures, and workplace cultures in shaping mothers' labour-market outcomes. Whereas earlier studies often treated post-birth wage declines as the result of women's voluntary reductions in labour supply, a growing body of scholarship argues that wage penalties in modern labour markets are deeply embedded in organisational logics and promotion systems. In other words, the motherhood wage penalty

reflects not only women's so-called choice to assume greater family responsibilities, but also how workplaces define and reward the characteristics of a qualified worker.

Within this mechanism, an expanding literature highlights organisational culture and ideal-worker norms. Williams et al. (2013) argue that many firms formally provide flexible working arrangements, yet their internal promotion cultures continue to assume that truly committed employees should prioritise work demands over family responsibilities. This implicit cultural expectation means that mothers may experience flexibility stigma even when they formally possess the right to work remotely or flexibly. Formal policies, therefore, do not automatically translate into substantive equality.

Thébaud and Halcomb (2019) further argue that whether flexible working arrangements actually reduce motherhood penalties depends largely on workplace norms surrounding caregiving. If organisational culture continues to treat childcare primarily as women's responsibility, flexibility policies may reinforce traditional gender divisions. For example, when women use family-friendly policies more frequently than men, employers may increasingly view women as secondary earners and reduce their access to promotion and training opportunities. Flexible working arrangements may therefore simultaneously alleviate and reproduce gender inequality.

This mechanism is particularly important in the UK context. Although the United Kingdom established statutory maternity leave relatively early and strengthened the right to request flexible working after 2014, there are substantial differences across firms in implementation. According to CIPD (2025), large firms and public-sector employers tend to have more developed human-resource systems, more formal family-support policies, and stronger job protection, whereas small and medium-sized enterprises rely more heavily on informal management practices and may be less tolerant of long childcare-related absences. Thus, even when national maternity protection is formally the same, the actual costs of childbirth for women may vary substantially across organisations.

More recently, research has also connected employer responses to motherhood with corporate social responsibility (CSR) and environmental, social, and governance (ESG) practices. Nyamae (2024) argue that, as UK firms face increasing public scrutiny concerning gender equality and diversity, large firms—especially listed companies—are more likely to establish family-friendly workplace policies in order to maintain corporate reputation and attract highly skilled female workers. In finance, consulting, and multinational corporations in particular, gender equality increasingly forms part of corporate governance narratives. Ernst Kossek (2017) similarly argue that firms adopting stronger diversity and inclusion

strategies are more likely to normalise parental leave use and flexible work arrangements for both mothers and fathers. Such organisational change implies that, in some institutional settings, motherhood penalties may be partially buffered by internal firm policies.

A more critical strand of research, however, questions the extent of this buffering effect. Pedulla and Thébaud (2015) find that even when firms formally promote flexibility and work-life balance, promotion standards for senior positions continue to reward uninterrupted commitment and long working hours. As a result, flexible work is often more available in middle- or lower-level positions, while the structure of career advancement itself remains largely unchanged. Similarly, Fuller and Hirsh (2019) show that maternal bias remains widespread inside organisations. Employers often assume that mothers are less committed than childless women or men, even when there is no clear evidence of weaker performance. Formal institutional reform, therefore, does not automatically eliminate workplace inequality.

This institutional and cultural perspective is also important for understanding differences between first and second births. The first birth usually marks a woman's first departure from the ideal-worker track, and firms and managers may therefore reassess her career commitment and future potential. Some women move after the first birth into more flexible roles with limited promotion prospects and thus already experience occupational downgrading. By contrast, the second birth may occur after this occupational adjustment has already taken place, in which case the additional wage penalty may be partly reduced. Yet the second birth may also reinforce employers' expectations that the mother is permanently family-oriented, thereby intensifying career stagnation. Which mechanism dominates depends to a large extent on organisational structure, industry culture, and the institutional environment.

Modern motherhood wage penalties therefore increasingly reflect the interaction between fertility behaviour and institutional labour-market structures rather than purely individual labour-supply decisions. This shift implies that understanding motherhood penalties requires attention not only to whether women reduce work, but also to how modern workplaces define ideal employees, how firms evaluate flexible work, and whether organisational institutions actually allow mothers to combine family responsibilities with career progression without leaving the promotion track.

Another important strand of literature emphasises the specialisation of labour within households. Becker's (1991) household economics framework predicts that couples allocate labour according to comparative advantage, with women taking on more unpaid childcare

after childbirth. Under this framework, the wage penalty associated with motherhood arises because women reduce labour supply while men increase market work. Recent sociological and behavioural research, however, increasingly emphasises the role of gender norms in shaping post-birth labour-market behaviour. Yerkes et al. (2020) show that, even during the expansion of remote work, women continued to undertake a disproportionate share of childcare and housework. Similarly, Borelli et al. (2017) argue that motherhood penalties reflect deeply embedded cultural expectations about care responsibilities rather than purely economic optimisation.

In the United Kingdom, although female employment rates have continued to rise, the gendered division of unpaid labour remains highly unequal. According to the UK Time Use Survey, mothers undertake substantially more unpaid childcare and housework than fathers, especially when children are young (ONS, 2024b). This pattern may lead even highly educated women to experience persistent wage losses after childbirth.

Although the traditional specialisation model remains influential, recent research questions whether comparative advantage alone can explain contemporary motherhood penalties. Kleven et al. (2019a, 2019b) find that even in Nordic welfare states, mothers' earnings still decline substantially after childbirth, indicating that welfare policy itself cannot automatically remove child penalties. Cortés and Pan (2023) also argue that child-related gender gaps arise not only from economic incentives, but also from the interaction of social norms, occupational structures, and family policies. Berniell et al. (2022), in studies of Latin American countries, further show that motherhood penalties are closely connected to informal employment, flexible jobs, and family-care norms. Although these studies are situated in different contexts, they jointly show that motherhood penalties are not unique to the United Kingdom but are produced by the interaction of modern labour markets and gendered caregiving arrangements.

The role of fathers has become an important extension of the recent literature. The policy objective of shared parental leave and father-specific leave is to increase fathers' participation in care and weaken the default assumption that mothers bear primary childcare responsibility. Birkett and Forbes (2019) show that take-up of shared parental leave in the United Kingdom has remained low, due to institutional complexity, insufficient financial compensation, and limited workplace support. Karu and Tremblay (2018) also show that fathers' use of paid parental leave depends on whether leave is sufficiently paid, whether it is reserved for fathers, and whether taking leave is normalised in the workplace. Perera et al.'s (2022) systematic review further indicates that the impact of paternity leave on household

division of labour and gender equality is not automatic but depends on policy design and social norms. Olivetti and Petrongolo (2017) argue that family policy may increase women's employment continuity but may also reinforce gender divisions if it extends mothers' time away from work. Kleven et al. (2024), in a study of several decades of Austrian family-policy reform, even find that large expansions of parental leave and childcare subsidies do not necessarily reduce long-term gender earnings gaps. This finding reminds us that the presence of policy does not guarantee policy effectiveness; the key question is whether policy changes employer behaviour, fathers' behaviour, and occupational organisation.

This discussion is especially important for first and second births. After the first birth, fathers' participation in care may shape whether household specialisation is established. After the second birth, if the first birth has already consolidated the mother as the primary caregiver, the second birth may reinforce this division of labour. Conversely, if fathers develop stable caregiving involvement after the first birth, the additional penalty associated with the second birth may be smaller. Parity differences therefore reflect not only the number of children, but also whether the household division of labour has been institutionalised after the first birth.

Post-pandemic research further complicates traditional interpretations of motherhood penalties. The rapid expansion of hybrid and remote working after COVID-19 has significantly altered work-family dynamics in the UK labour market (Felstead and Reuschke, 2023; Wielgoszewska et al., 2023). Flexible working arrangements may allow mothers to remain attached to the labour market during early childcare, thereby reducing career interruptions associated with childbirth. Emerging evidence, however, also suggests that remote work may increase women's unpaid domestic labour and thereby reinforce gender inequality within households (Yerkes et al., 2020).

Moreover, research on the motherhood wage penalty increasingly emphasises that the effect of childbirth on women's wages is not evenly distributed across ethnic groups. In a highly diverse society such as the United Kingdom, where ethnic stratification in the labour market has long been evident, ethnicity may profoundly shape women's post-birth labour-market adjustments. Ethnic differences are therefore not merely demographic control variables; they may alter the mechanisms through which motherhood penalties are produced.

Traditional human capital theory often assumes that women reduce labour supply after childbirth in order to assume more family responsibilities, but this mechanism may not apply equally across ethnic groups. Research on the UK labour market finds substantial differences across ethnic minority women in labour-force participation, occupational

structure, household division of labour, and sources of income (Brynin, 2015). For example, Pakistani and Bangladeshi women have long exhibited lower labour-market participation and stronger tendencies toward household specialisation, whereas Indian women and some Black African women tend to show higher educational participation and greater career continuity (Khattab & Hussein, 2018). The same childbirth event may therefore correspond to different degrees of career interruption and wage loss.

Recent research, however, has begun to question the conventional expectation that ethnic minority women necessarily face larger motherhood penalties. Some UK studies suggest that the wage decline after childbirth may be smaller for some minority women than for White women (Rose et al., 2023; Ojakorotu & Babayemi, 2025). This finding does not imply that minority women occupy a more favourable labour-market position. Rather, it may reflect differences in the mechanism of marginal penalties. Since some ethnic minority women already face occupational segregation, lower wage growth, and restricted promotion opportunities before childbirth, there may be less room for their wage trajectories to fall further after childbirth. The additional marginal effect of childbirth on their wages may therefore appear statistically weaker.

This interpretation is consistent with recent research on intersectionality theory argues that gender, ethnicity, and class do not operate as independent determinants of labour-market outcomes but intersect to produce complex structures of inequality (Crenshaw, 2022). In the UK context, White women's career paths may be more concentrated in high-return, high-promotion occupations that also require sustained work commitment. They may therefore experience more pronounced wage discontinuities after childbirth. By contrast, some ethnic minority women may be more concentrated in the public sector, care work, education, or occupations with limited promotion elasticity; because their wage-growth trajectories are already flatter, the impact of childbirth on their wage path may be comparatively smaller (Tomlinson et al., 2013).

Ethnic differences may also affect motherhood penalties through forms of work organisation. UK research shows that ethnic minority women are more likely to be employed in the public sector, where pay systems are typically more standardised, union protection is stronger, and family-friendly policies are more developed (Giupponi & Machin, 2024; Heath & Di Stasio, 2019). These institutional features may mitigate post-birth wage volatility. By contrast, White women are more concentrated in professional and managerial jobs in the private sector, where the ideal-worker culture may be stronger and where continuous working time and career commitment are more heavily rewarded (Goldin, 2021). Therefore, even if

White women have higher average wages, their post-birth wage penalties may be more visible.

Nevertheless, other studies argue that ethnic minority mothers may face a double disadvantage. Existing racial discrimination may intersect with motherhood discrimination, imposing additional constraints on promotion, wage growth, and job stability (Joseph Rowntree Foundation, 2022). Lupu (2015), for instance, find in the UK professional services sector that ethnic minority women are more likely to be marginalised from core promotion tracks after childbirth. This implies that ethnic minority mothers may still face motherhood penalties, but the form of the penalty may appear more as career stagnation, job segregation, or labour-market exit than as an immediate cliff-edge decline in wages.

The existing literature therefore has not reached a unified conclusion on the relationship between ethnicity and motherhood wage penalties. One strand of research emphasises that the disadvantaged position of ethnic minority women may amplify post-birth labour-market inequality; another suggests that, because pre-birth wage growth and occupational structure already differ substantially, White women may exhibit larger marginal wage penalties. This disagreement shows that motherhood penalties depend not only on childbirth itself, but also on women's pre-birth labour-market position and institutional environment.

This issue is particularly important for the United Kingdom. According to the 2021 UK Census, more than 40 per cent of the population in London and some other areas has an ethnic minority background, indicating a highly ethnically diverse labour-market structure (ONS, 2022b). At the same time, significant differences remain across ethnic groups in education, occupation, family formation, and labour-force participation. Incorporating ethnic heterogeneity into research on motherhood wage penalties therefore helps not only to understand the internal structure of gender inequality in the United Kingdom, but also to reveal how different institutional and occupational environments shape women's long-term post-birth wage trajectories.

Overall, a growing literature shows that the motherhood wage penalty is not the result of a single causal pathway, but of multiple interrelated mechanisms. Human capital depreciation, labour-supply adjustment, occupational sorting, employer responses, workplace flexibility, household bargaining, and institutional policy interact dynamically after childbirth. Crucially, these mechanisms may operate differently after first and second births.

2.2. The motherhood wage penalty: prior empirical studies

The modern empirical literature on motherhood penalties has been strongly influenced by the use of administrative data and event-study approaches. The central advantage of this research paradigm is that it can trace women's earnings trajectories dynamically around the clearly defined event of childbirth, while controlling for time-invariant heterogeneity through individual fixed effects. Compared with traditional cross-sectional research, event-study designs are therefore better able to identify the long-term effects of childbirth itself on women's labour-market outcomes.

One of the most influential studies in this literature is Henrik Kleven, Camille Landais and Jakob Søgaard's analysis of Danish administrative data. They find that women's earnings fall immediately by approximately 20 to 30 per cent after the first birth and that this earnings gap persists for more than ten years, whereas men's earnings are almost unaffected. This result gave rise to the prominent child-penalty framework, according to which modern gender earnings gaps largely arise from the long-term dynamic divergence that follows childbirth rather than from gender wage discrimination alone. The study's major contribution is to show that, even in a highly developed welfare state with comparatively strong gender equality, motherhood penalties remain substantial, indicating that childbirth itself has far-reaching consequences for women's career trajectories.

A large number of subsequent cross-national studies have adopted similar event-study frameworks and documented comparable patterns in different institutional contexts. Martin Andresen and Emily Nix (2022), using Norwegian administrative data, find that women experience long-term earnings declines after the first birth, with especially pronounced effects among highly educated women. Nikolay Angelov, Per Johansson and Erik Lindahl (2016), in their study of Sweden, similarly show that women's wages remain persistently below their previous growth path after childbirth. Studies of Germany likewise show that, even in a context with relatively generous parental leave and strong employment protection, women still experience significant long-term earnings losses. Butikofer et al. (2018) report that mothers' wage growth slows after childbirth and that their probability of entering high-income occupational tracks declines markedly.

At the same time, an increasing number of studies emphasise that the magnitude of motherhood penalties differs substantially across institutional settings. Kleven and colleagues' recent cross-national comparative work shows that child penalties tend to be smaller in Nordic countries than in Anglo-Saxon countries such as the United States and the United Kingdom, and that these differences are closely related to childcare accessibility,

fathers' involvement in childcare, and labour-market institutions (Kleven et al., 2024). Nordic countries generally have more extensive public childcare systems, higher rates of fathers' parental-leave use, and more stable long-term employment contracts, which can reduce the duration of women's post-birth career interruptions. Even so, childbirth continues to permanently alter women's earnings trajectories, suggesting that institutions can mitigate but not fully eliminate motherhood penalties.

By contrast, studies of the United States typically find larger and more persistent earnings losses. Recent research based on US administrative tax records shows that women's post-birth earnings declines are even larger than previously estimated in survey-based literature. Douglas Almond, Yi Cheng and Cecilia Machado (2023), using administrative earnings records for more than 800,000 women, find that the motherhood penalty remains substantial even in female-breadwinner families and does not converge significantly over the long term. Importantly, they also find that motherhood penalties are not substantially reduced in firms with a higher proportion of female employees or more female managers. This result suggests that motherhood penalties are not simply the product of individual employer bias but may be deeply embedded in the organisational structure of modern labour markets.

US research further emphasises the importance of occupational structure. Claudia Goldin (2021) argues that in many high-paying occupations, wages are characterised by nonlinear returns to hours worked. Even a small reduction in hours, or an increased need for flexibility, may therefore lead to disproportionately large earnings losses. In finance, law, consulting, and senior management in particular, career advancement often depends on continuous availability and long working hours; post-birth flexibility needs consequently reduce women's chances of entering or remaining on high-income tracks. Bertrand (2020) further argues that the US labour market's emphasis on the ideal worker reinforces motherhood penalties, because high-paid occupations increasingly reward long hours and constant availability rather than productivity alone.

These mechanisms are highly relevant to the British labour market. The United Kingdom also has a relatively flexible but unequal labour-market structure: on the one hand, women's labour-force participation is high and dual-earner households have increasingly become the norm; on the other hand, childcare costs in the United Kingdom have long been among the highest in Europe, and high-paying occupations similarly emphasise continuity of working time and occupational commitment. British women may therefore face substantial pressure to adjust their careers after childbirth. Recent UK research indicates that motherhood penalties have become a central source of the gender pay gap. According to estimates by the

Institute for Fiscal Studies, women's earnings fall sharply after the first birth and remain significantly below men's for many years, while men's earnings trajectories are largely unaffected.

Overall, although the existing literature provides extensive evidence on motherhood wage penalties, several important limitations remain.

First, many studies focus on the average wage effect of motherhood without distinguishing between first and second births. We therefore still lack a sufficiently detailed understanding of whether becoming a mother for the first time, or expanding family size through a second birth, generates more significant dynamic wage consequences.

Second, many studies focus on total earnings or employment, but pay less attention to jointly distinguishing wage rates, working hours, employment, and occupational mobility. As a result, the underlying mechanisms remain insufficiently clear.

Third, cross-national studies provide important comparative insights, but the United Kingdom has a distinctive institutional context, including high childcare costs, a strong part-time labour market, low take-up of shared parental leave, and pronounced occupational stratification. Few studies have used longitudinal event-study designs to examine dynamic wage trajectories within this specific UK institutional setting. Existing UK evidence often focuses on labour-market participation or static gender pay gaps rather than dynamic post-birth wage change.

Fourth, the literature has not sufficiently addressed heterogeneity. Ethnicity, education, occupation, region, partner income, child gender, and birth spacing may all alter the dynamic effects of first and second births. Estimating only an average penalty can obscure the different mechanisms faced by different groups. For example, highly educated professional women may face larger losses in wage growth, low-income women may face higher risks of labour-market exit, and ethnic minority women may be affected simultaneously by occupational segregation and family norms.

This dissertation seeks to address these gaps by using data from the UK Household Longitudinal Study (UKHLS) and a two-way fixed effects (TWFE) event-study framework to examine, separately, the dynamic effects of first and second births on women's wages in the British labour market. By distinguishing between different fertility transitions and examining heterogeneity by firm size, ethnicity, and institutional context, this research aims to provide a more nuanced understanding of how motherhood reshapes women's wage trajectories in contemporary Britain.

3. Data and variable construction

3.1. Data and sample selection

The panel data for this study are derived from Understanding Society: The UK Household Longitudinal Survey (UKHLS), specifically the Mainstage Waves 1–15 (SN 6614)[1]. Launched in 2009 as a successor to the British Household Panel Survey (BHPS), the UKHLS is a premier longitudinal study that tracks approximately 40,000 households annually (University of Essex, Institute for Social and Economic Research, 2025). The survey employs a multi-stage stratified cluster sample design, ensuring comprehensive geographic representation across England, Scotland, Wales, and Northern Ireland.

This dataset provides a robust longitudinal record of individual-level transitions in employment status, household income, fertility history, and evolving family structures. Our analytical sample spans 15 survey waves conducted between 2009 and 2024. Although the UKHLS data are collected in biennial waves, we have reorganized the individual-level response files based on the actual calendar year of the interview rather than the survey wave. To facilitate longitudinal analysis, we appended the individual-level response files across all 15 waves and reshaped the data into a "long format". This systematic integration resulted in a large-scale unbalanced panel dataset, with the "Individual-Year" serving as the fundamental unit of observation. This structure allows us to account for both time-invariant individual heterogeneity and time-varying social-economic shifts (Benzeval, 2020).

The primary analytical framework focuses on women of reproductive age, specifically those between 20 and 50 years old. This age range is broadly consistent with the demographic classifications adopted by the UK Office for National Statistics (ONS), which generally defines the childbearing period as spanning ages 15–49. The lower age threshold of 20 is applied to capture fertility transitions occurring within a more stable socio-economic context and to exclude the distinct behavioural and labour-market patterns associated with adolescent fertility. The upper threshold of 50 reflects both the biological end of the reproductive period and the increasing prevalence of late-parity births in the United Kingdom. Observations with incomplete records or missing values on key variables were excluded from the analysis.

The final analytical sample consists of 27,233 women. To identify the heterogeneous effects of motherhood across parity levels, the sample is divided into two subsamples. The first follows the transition from childlessness to first birth, comprising 2,740 women who gave birth to their first child during the observation period and 15,665 woman-year

[1] *University of Essex, Institute for Social and Economic Research. (2025). Understanding Society: Waves 1-15, 2009-2024. [Data set]. 11th Edition. UK Data Service. SN: 6614, https://datacatalogue.ukdataservice.ac.uk/studies/study/6614#details.*

observations from childless women who never had a child throughout the panel. The second captures the progression from first to second birth, consisting of 1,426 women who had a second child and 7,402 woman-year observations from women who had exactly one child and did not progress to a second birth during the observation period. This strategy enables the analysis to distinguish the differential wage dynamics associated with successive stages of family formation. Furthermore, to ensure the reliability of the longitudinal estimates and to capture sufficient pre- and post-transition information, the analysis is restricted to women who participated in at least six observation periods. This criterion filters out transient respondents and ensures a robust basis for modeling individual-level wage dynamics over time. For any instances where multiple records occurred within the same calendar year, only the most recent observation was retained to ensure a consistent annual panel structure. The emphasis on second births is further justified by the UK's average completed family size of 1.9 children (ONS, 2024). Accordingly, women who remained childless throughout the panel period serve as the counterfactual for first-time mothers, while those who had exactly one child serve as the counterfactual for second-time mothers. Women who had three or more children were excluded to ensure that the analytical sample remained representative of the dominant British family structure.

Consistent with the methodological approach adopted by Lebedinski, Perugini, and Vladisavljević (2023), women on maternity leave are retained in the analytical sample. Within the UKHLS framework, maternity leave is treated as a continuing employment status, and reported earnings include statutory maternity pay and occupational maternity benefits. Excluding these observations would bias the sample toward women with uninterrupted full-time employment trajectories and potentially underestimate the magnitude of the motherhood wage penalty. Their inclusion is therefore essential for capturing the full economic consequences of fertility, including the temporary earnings reductions that typically occur immediately following childbirth.

3.2. Variable construction

The dependent variable employed in this analysis is monthly gross earnings, which serves as a comprehensive measure of an individual's labor market position and economic well-being. The choice of monthly gross pay, rather than hourly wage rates, is motivated by its ability to capture both the price effect (changes in hourly pay) and the quantity effect (changes in labor supply/working hours) following childbirth—both of which are central components of the total motherhood wage penalty (Gangl & Ziefle, 2009). Furthermore, using gross earnings prior to tax and transfer adjustments provides a cleaner measure of

market-based productivity and employer-side valuation of maternal labor (Budig & England, 2001). As illustrated in Figure 1, the wage distribution exhibits substantial positive skewness. To reduce the influence of extreme values, the raw wage data were subjected to Winsorization, whereby observations above the 95th percentile were top-coded. Despite this adjustment, the distribution remained positively skewed, indicating that a small proportion of women continued to report substantially higher earnings than the rest of the sample. Such a pattern is common in wage data and may reflect underlying income inequality within the labour market.

To further address the issue of non-normality, the wage variable was transformed using the natural logarithm. Logarithmic transformation helps approximate a more normal distribution and reduces the disproportionate influence of extreme observations on the estimation results.

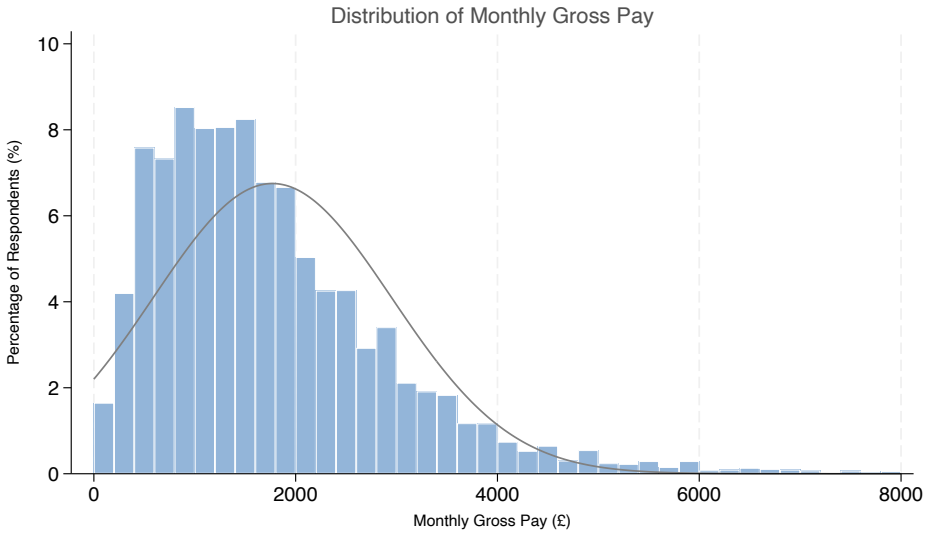

Figure 1. Distribution of monthly gross wage

Source: author's calculations

In defining the explanatory variables, this study adopts a combined strategy of static identification and dynamic tracking in order to capture both the magnitude and persistence of the motherhood wage penalty. First, to estimate the impact of childbirth on women's earnings, two static dummy variables representing fertility status are constructed: a "first-child status" indicator (0 = no first birth; 1 = transition to first birth) and a "second-child status" indicator (0 = no second birth; 1 = transition to second birth). These variables are incorporated into the baseline regressions to identify the average wage changes associated with different parity levels relative to the pre-childbearing period.

To further examine the temporal evolution of wage losses following childbirth, the study develops a dynamic indicator framework based on an event-study design. Specifically, each woman is assigned an "event year," defined as the survey wave in which her number of children increases from zero to one or from one to two between adjacent interview periods. This event year serves as the temporal anchor for the dynamic analysis. Relative-year dummy variables are then constructed for each year before and after the fertility event. Separate event-time indicators are generated for first and second births. Transitions from childlessness to one child are classified as first-birth events, whereas transitions from one to two children are classified as second-birth events. Event time is calculated as the difference between the interview year and the individual's year of childbirth.

The detailed definitions for all variables are provided in Table 1.

Table 1

Description and Measurement of Variables

Category	Variable Name	Definition and Measurement
Dependent Variable		
	Log Monthly Wage	Natural logarithm of gross monthly pay, top-winsorized at the 95th percentile to mitigate the influence of extreme right-tail outliers.
Key Independent Variables		
	One-Child Status	A binary indicator equals 1 if the respondent has exactly one child, and 0 otherwise.
	Two-Child Status	A binary indicator equals 1 if the respondent has two children, and 0 otherwise.
	Event-Study Dummies	A series of binary variables representing each year relative to childbirth, ranging from 5 years before (t−5) to 3 years after (t+3) childbirth. t−1 is the reference period.
Control Variables		
	Partnership Status	A dummy variable equals 1 if the respondent is married or in a stable cohabiting relationship, and 0 otherwise.
	Residential Area	A binary indicator equals 1 if the respondent resides in an urban area, and 0 for rural areas.
	Health Status	Physical health is measured using the SF-12 Physical Component Summary (PCS) score, where higher values indicate better physical well-being.
	Education	A categorical variable indicating the highest qualification attained: Degree (University degree or higher), Higher (Other higher education), A-level, GCSE, or other qualifications[2].

Source: compiled by the author

[2] Education levels are categorized to reflect the UK educational hierarchy: Degree refers to university-level tertiary education; Higher includes non-degree tertiary qualifications such as vocational diplomas or teaching certificates; A-level represents upper secondary education typically completed at age 18; GCSE denotes the completion of compulsory lower secondary education at age 16; and Other captures lower-level vocational or no formal qualifications.

The event window spans from (t = -5) to (t = 3), where (t = 0) denotes the childbirth year. Across all dynamic specifications, the year immediately preceding childbirth (t = -1) is used as the reference category, ensuring that the estimated coefficients capture wage changes relative to the pre-birth baseline.

In addition to the core fertility variables, the analysis incorporates a range of time-varying control variables to account for potential confounding factors. At the individual and household levels, controls include health status (measured by the SF-12 physical health score[3]) and partnership status. We control for maternal health using the SF-12 score to separate the earnings impact of physiological health shocks from the broader motherhood wage penalty. As maternal health shocks often co-occur with childbirth and can independently depress earnings (Buck & McFall, 2012). Partnership status is incorporated to capture the influence of intra-household labour division; according to the specialization model, partnered women may reduce their market work intensity in response to domestic demands, thereby exacerbating the motherhood penalty (Herrarte & Urcelay, 2022). Educational attainment is included to account for heterogeneity in human capital, which is strongly associated with both fertility timing and labour market outcomes (Goldin & Katz, 2002; Kreyenfeld & Konietzka, 2023). At the contextual level, an urban–rural residence indicator is included to account for regional labour-market disparities, such as variations in childcare availability and job density, which may moderate the economic consequences of motherhood (Abadie et al., 2023).

Based on the variable definitions established above, Table 2 presents the mean and standard deviation of labor market, health, education, and demographic variables for the analytical samples derived from the UKHLS (Waves 1–15). The table distinguishes between the first-birth and second-birth event-study samples and further separates observations into the periods before childbirth, at childbirth, and after childbirth in order to capture short-run labour market dynamics surrounding fertility transitions. Panel A summarises the time-varying variables used in the event-study analysis, while Panel B presents the background characteristics of the overall first- and second-birth samples. The first-birth sample consists of 2,740 women who experienced a first childbirth during the observation period, while the second-birth sample contains 1,426 women who experienced a second childbirth.

[3] The SF-12 (Short Form 12) is a widely validated 12-item survey used to measure functional health and well-being from the patient's perspective. It produces two summary scores: the Physical Component Summary (PCS) and the Mental Component Summary (MCS). In this study, we employ the PCS-12 to isolate the physical dimension of maternal health.

Table 2
Descriptive Statistics

	First Birth Sample								Second Birth Sample							
	Treatment Group (Mothers)						Control Group		Treatment Group (Mothers)						Control Group	
	Before birth		At birth		After birth		(Never-mothers)		Before birth		At birth		After birth		(1-Child-Mothers)	
Variables	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
Panel A: Dynamic Variables																
lnpay	7.521	-0.55	7.449	-0.674	7.395	-0.716	7.465	-0.646	7.21	-0.654	7.069	-0.857	7.219	-0.649	7.248	-0.661
partnered	0.402	-0.491	0.623	-0.485	0.636	-0.482	0.26	-0.439	0.577	-0.494	0.69	-0.463	0.722	-0.449	0.549	-0.498
urban	0.791	-0.406	0.772	-0.42	0.755	-0.43	0.794	-0.404	0.778	-0.416	0.757	-0.43	0.749	-0.434	0.777	-0.416
health	54.527	-6.934	54.287	-6.979	54.532	-7.384	53.697	-8.097	53.326	-7.97	54.172	-6.897	54.105	-7.168	52.492	-8.326
age	29.826	-5.159	32.772	-5.193	34.761	-5.441	35.141	-9.013	31.471	-4.975	33.952	-4.953	35.795	-4.982	41.943	-5.912
Observations	1568		395		777		15665		666		210		550		7402	
Panel B: Background Characteristics																
	Mean								Mean							
edu_degree	0.546								0.448							
edu_higher	0.119								0.157							
edu_alevel	0.212								0.185							
edu_gcse	0.111								0.194							
edu_other	0.008								0.016							
Observations	2740								1426							

Notes. The control group for the first birth sample consists of women who have never given birth during the sample period. The control group for the second birth sample consists of women who have only one child and do not have a second child within the observed window.

Source: author's calculations

By comparing the sub-samples across different transition stages, several systematic changes in women's characteristics emerge as they progress through motherhood. For instance, women in the first-birth sample have an average age of 29.8 before childbirth, which rises to 34.8 in the post-birth period. By contrast, women experiencing second childbirth are older throughout the observation window, with average age increasing from 31.5 before birth to 35.8 after birth.

Across both the first- and second-birth samples, average health scores remain relatively high and stable over time, generally ranging between 52 and 55 points. Partnership rates are also consistently higher among second-birth mothers. Before the second birth, approximately 57.7% of women report having a partner, compared with 40.2% in the first-birth sample. This pattern reflects the typical life-course progression associated with family expansion.

Furthermore, the raw mean of log monthly wages indicates a noticeable decline in earnings surrounding childbirth. For first births, average log wages decrease from 7.521 before childbirth to 7.449 in the year of birth, followed by a further decline to 7.395 in the post-birth period. A similar pattern is observed among second-birth mothers, where average log wages fall from 7.21 before childbirth to 7.069 at childbirth, although a modest recovery to 7.219 is observed after birth. While descriptive statistics alone cannot establish causality, these patterns provide preliminary evidence consistent with the existence of a marginal motherhood penalty.

As shown in Panel A (row 3), the two samples also appear relatively balanced in terms of urban residence. Across all transition stages, roughly four-fifths of women reside in urban areas. The proportion fluctuates only slightly between 75% and 79%, indicating limited compositional change in residential location during the transition into motherhood. Despite the relatively balanced distribution of urban residence, the educational composition differs substantially between the two transition stages. Specifically, the proportion of women holding a degree or above is 54.6% in the first-birth sample, whereas this figure declines to 44.8% in the second-birth sample. This pattern suggests a potential selection effect, whereby women with higher levels of human capital are more likely to be observed during the transition to first motherhood within the sample window but may postpone or forego second births due to higher opportunity costs associated with career progression and earnings potential.

4. Methodology

4.1. Overview

This section outlines the empirical strategy used to estimate the impact of childbirth on women's wages, with particular emphasis on differences across birth orders. Consistent with established approaches in the motherhood wage penalty (MWP) literature (e.g., Budig & England, 2001; Gough & Noonan, 2013), the analysis adopts an event-study framework to examine the wage consequences associated with first and second births. Given the longitudinal structure of the UKHLS data, fixed-effects estimators are employed to account for time-invariant unobserved heterogeneity and to reduce potential bias arising from individual-level characteristics correlated with both fertility decisions and labour-market outcomes (Gangl & Ziefle, 2009; Chwastek & Mynarska, 2025).

The empirical analysis proceeds in several stages. First, a baseline two-way fixed effects (TWFE) model is estimated without additional covariates to establish the initial association between fertility transitions and wages. Control variables are then introduced as part of a series of robustness checks designed to assess the stability and validity of the estimates. These specifications are estimated separately for first-birth and second-birth transitions in order to identify potential heterogeneity in wage effects across parity levels. Second, the analysis extends to a dynamic event-study specification that traces earnings trajectories before and after childbirth, thereby capturing both the timing and persistence of wage penalties associated with fertility transitions. In addition to identifying dynamic treatment effects, the event-study framework provides a useful diagnostic for assessing pre-treatment trends and the plausibility of the parallel-trends assumption. This is particularly important in light of recent methodological critiques of conventional TWFE estimators in settings characterised by staggered treatment timing and heterogeneous treatment effects (Goodman-Bacon, 2021; Sun & Abraham, 2021; Callaway & Sant'Anna, 2021).

4.2. TWFE model

To estimate the relationship between fertility transitions and women's wages, this study employs a two-way fixed effects (TWFE) modelling strategy. In the context of motherhood wage penalties, this approach is particularly appropriate because both fertility decisions and wage trajectories are shaped by unobserved characteristics that may remain constant over time, as well as by macroeconomic conditions that vary across survey waves.

The baseline specification estimates the association between childbirth and logged monthly earnings using individual and year fixed effects. Separate models are estimated for

first-birth and second-birth transitions. The baseline TWFE framework can be generally expressed as follows:

$$ln(Wage)_{it} = \beta_1 Fertility_{it} + \alpha_i + \lambda_t + \epsilon_{it} \quad (1)$$

where

$ln(Wage)_{it}$ – the natural logarithm of monthly earnings for individual i at time t

$Fertility_{it}$ – the relevant fertility transition indicator

α_i – individual fixed effects

λ_t – calendar year fixed effects (based on interview year)

ϵ_{it} – the idiosyncratic error term

For the first-birth subsample, $Fertility_{it}$ is operationalised as $Post1_{it}$, indicating the transition from childlessness to first motherhood. For the second-birth subsample, $Fertility_{it}$ is replaced by $Post2_{it}$, capturing the transition from one child to two children.

Individual fixed effects account for unobserved time-invariant characteristics that may influence both fertility behaviour and labour-market outcomes. As noted by Budig, Misra, and Böckmann (2012), such characteristics may include career orientation, long-term work preferences, and cultural attitudes toward family formation and childcare responsibilities, all of which are difficult to observe directly but may systematically shape women's wage trajectories. By differencing out these stable individual characteristics, the FE estimator reduces potential omitted-variable bias.

A Hausman specification test was conducted to assess the suitability of the fixed-effects estimator relative to a random-effects (RE) alternative. The null hypothesis of the Hausman test assumes that the RE estimator is consistent, implying no correlation between the unobserved individual effects and the explanatory variables. The null hypothesis was rejected at the 1% significance level ($p<0.001$), indicating that the RE estimator would likely produce inconsistent estimates due to endogeneity arising from correlated unobserved heterogeneity. Accordingly, the fixed-effects specification was retained as the preferred modelling strategy.

In addition to individual fixed effects, year fixed effects are included to account for macroeconomic conditions and period-specific shocks that may affect wages uniformly across individuals. A joint F-test confirmed the statistical relevance of the time fixed effects

($p<0.001$). These year effects capture broader structural influences on earnings, including wage inflation, labour-market fluctuations, and national policy changes occurring during the observation period. While some previous studies account for macroeconomic conditions through variables such as lagged GDP growth rates (Lebedinski, Perugini & Vladisavljevic, 2023), the inclusion of calendar-year fixed effects provides a more comprehensive adjustment for time-specific factors affecting wages across the UK economy.

Finally, diagnostic testing revealed the presence of serial correlation within individuals over time. The Wooldridge test for autocorrelation rejected the null hypothesis of no first-order serial correlation at the 1% significance level. To address both heteroskedasticity and within-individual error dependence, all models therefore employ cluster-robust standard errors at the individual level.

4.3. Inclusion of controls in baseline models

Building on the baseline TWFE specification, the extended models incorporate a set of time-varying control variables commonly used in the motherhood wage penalty literature. These include partnership status, urban–rural residence, physical health status (SF-12 physical component score) and education. The inclusion of these covariates aims to reduce omitted-variable bias and improve the precision of the estimated fertility effects.

Within a fixed-effects framework, only variables that vary within individuals over time can be identified, as time-invariant characteristics are absorbed by the individual fixed effects. The selected control variables all exhibit sufficient within-person variation across survey waves, confirmed by non-zero within standard deviations.

$$ln(Wage)_{it} = \beta_1 Fertility_{it} + \beta_2 X_{it} + \alpha_i + \lambda_t + \epsilon_{it} \quad (2)$$

where

$ln(Wage)_{it}$ – the natural logarithm of monthly earnings for individual i at time t

$Fertility_{it}$ – the relevant fertility transition indicator

X_{it} – the vector of time-varying controls

α_i – individual fixed effects

λ_t – calendar year fixed effects (based on interview year)

ϵ_{it} – the idiosyncratic error term

To assess multicollinearity, a variance inflation factor (VIF) test is employed after the inclusion of controls. Multicollinearity occurs when independent variables in a regression are

correlated, which can lead to inflated standard errors. The average VIF across all control variables is 6.13, which is well below the conservative threshold of 10, suggesting that multicollinearity is not a major concern, and the reliability of the estimated coefficients is maintained.

4.4. Event study framework

Building on the baseline TWFE models, the analysis further employs a TWFE event-study framework to examine the dynamic evolution of women's wages surrounding childbirth. The event-study specification is particularly suitable for analysing how labour market outcomes evolve before and after a fertility transition, as it aligns observations relative to a common childbirth event while preserving the longitudinal structure of the panel data (Kleven, Landais & Søgaard, 2019). In this study, childbirth constitutes the focal event, and women's earnings trajectories are analysed relative to the year in which they transition to first or second motherhood.

Unlike the baseline TWFE specifications, which estimate the average wage effect associated with fertility transitions, the event-study approach replaces the cumulative fertility indicators with a series of event-time dummy variables. These variables capture year-specific wage deviations before and after childbirth, thereby allowing the analysis to identify both the timing and persistence of the motherhood wage penalty. Event time is calculated as the difference between the interview year and the individual's childbirth year:

$$EventTime_{it} = Year_{it} - BirthYear_i$$

where negative values ($t < 0$) represent pre-birth periods and positive values ($t > 0$) indicate post-birth periods. For example, consider a woman in the UKHLS panel who gave birth to her first child in 2015. If she was interviewed in 2013, her event time would equal $t = -2$; if interviewed in 2015, the observation would correspond $t = 0$; and if interviewed in 2017, the event time would equal $t = 2$. In this way, observations from different individuals are aligned relative to the timing of childbirth rather than calendar year.

Therefore, each woman's earnings trajectory is evaluated relative to her own pre-birth wage profile, effectively treating the individual as her own control.

Separate event-study models are estimated for first-birth and second-birth transitions. For the first-birth analysis, the sample is restricted to women who were childless at baseline and who transitioned to exactly one child during the observation period. Similarly, the second-birth specification is limited to women who entered the panel with one child and subsequently progressed to two children. These restrictions are intended to isolate the wage

dynamics associated with each parity transition while minimising contamination from higher-order births.

For both models, event-time dummy variables are constructed for the period spanning five years prior to childbirth and three years following childbirth ($-5 \leq t \leq 3$). The year immediately preceding childbirth ($t = -1$) is omitted and used as the reference category. This specification follows standard practice in the event-study literature because the pre-birth year is generally assumed to represent a relatively stable earnings period before labour-market adjustments associated with childbirth begin (Gangl & Ziefle, 2009). Omitting this category also prevents perfect multicollinearity with the remaining event-time indicators and the fixed effects structure. Accordingly, all estimated coefficients are interpreted relative to women's earnings in the year immediately before childbirth. Figure 2 illustrates the event window.

The baseline event-study specification can be expressed as follows:

$$ln(Wage)_{it} = \sum_{j=-5, j\neq-1}^{3} \beta_k D_{it}^{k} + \gamma X_{it} + \delta(Treatment_i \times Age_{it}) + \alpha_i + \lambda_t + \epsilon_{it} \quad (3)$$

where

$ln(Wage)_{it}$ – the natural logarithm of monthly earnings for individual i at time t

D_{it}^{k} – a set of event-time dummy variables indicating whether individual i is observed k years relative to childbirth at time t

X_{it} – the vector of time-varying controls

$Treatment_i \times Age_{it}$ – the interaction term between treatment status and age

α_i – individual fixed effects

λ_t – calendar year fixed effects (based on interview year)

ϵ_{it} – the idiosyncratic error term

In addition, the specification includes an interaction term between treatment status and age ($Treatment_i \times Age_{it}$). This adjustment is particularly important because the treatment and control groups differ substantially in age composition over the observation window. Women who remain childless throughout the sample period tend to exhibit wider age variation and different life-cycle earnings trajectories relative to women who transition into motherhood. Without accounting for differential age profiles, estimated childbirth effects may partly capture underlying age-related wage dynamics rather than the causal impact of fertility transitions themselves.

Including treatment-specific age trends therefore helps improve comparability between mothers and non-mothers by allowing wage trajectories to evolve differently with age across the two groups. This approach is consistent with recent labour-economics research emphasising that age profiles and life-cycle earnings growth may differ systematically between parents and non-parents, particularly in long panel datasets (Andresen & Nix, 2022; Kleven, Landais & Søgaard, 2019).

Standard errors are clustered at the individual level throughout the analysis to account for serial correlation within individuals over time (Bertrand, Duflo & Mullainathan, 2004).

To ensure adequate longitudinal coverage, individuals with insufficient observations within the event window were excluded from the estimation sample. Specifically, women with fewer than six observations in the first-birth sample and the second-birth sample were removed. This restriction improves the reliability of estimated wage trajectories by ensuring sufficient within-person variation over time.

The event-study framework additionally provides an indirect diagnostic test of the parallel-trends assumption underlying the fixed-effects approach. Following standard practice, joint significance tests were conducted on the pre-treatment coefficients ($t = -5$ to $t = -2$). Statistically insignificant pre-treatment estimates would indicate the absence of systematic wage divergence prior to childbirth and strengthen the causal interpretation of the post-birth effects.

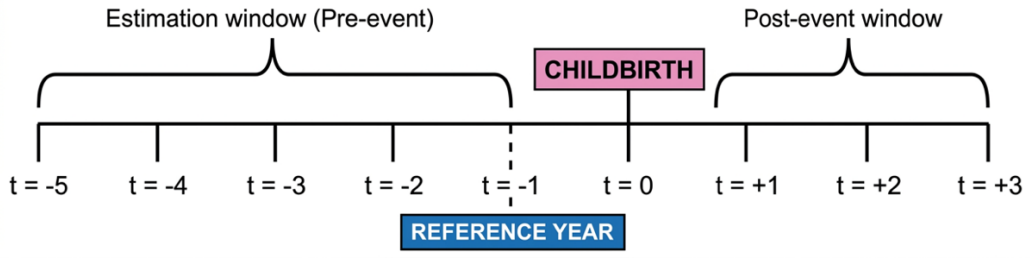

Figure 2. Event Window Schematic
Source: compiled by the author

An important identifying assumption underlying the event-study framework is that of parallel trends. This assumes that, in the absence of childbirth, women's wages would have evolved similarly over time. Under this assumption, pre-birth wage trajectories provide a credible counterfactual against which post-birth earnings changes can be evaluated (Angrist & Pischke, 2009). In the present analysis, the plausibility of this assumption is assessed

through the examination of pre-treatment event-time coefficients and joint significance tests of the pre-birth indicators.

5. Heterogeneity analyses

To examine whether the motherhood wage penalty varies across demographic, organisational, and spatial contexts, the baseline event-study specification is estimated separately across subgroup samples. Specifically, the analysis partitions the sample according to (i) firm size, (ii) ethnicity, and (iii) policy period (before and after the 2015 Shared Parental Leave Reforms). For each subgroup, the dynamic coefficients associated with childbirth are estimated over the event window spanning five years before to three years after childbirth, with the year immediately preceding childbirth ($t=-1$) serving as the omitted reference category.

The heterogeneity models retain the same control variables and fixed-effects structure used in the baseline specification, including partnership status, urban residence, physical health, educational attainment, individual fixed effects, and survey-year fixed effects. Standard errors are clustered at the individual level to account for serial correlation in women's earnings trajectories over time.

Estimating the models separately by subgroup allows the analysis to identify whether the timing, magnitude, and persistence of post-birth earnings penalties differ systematically across women facing distinct labour-market conditions and family-formation trajectories. Rather than treating the motherhood penalty as a uniform outcome, the heterogeneity framework recognises that childbirth may interact with institutional context, career stage, and regional opportunity structures in shaping women's post-birth labour-market outcomes.

5.1. Heterogeneity by firm size

The extent to which childbirth affects women's earnings may also depend on the institutional characteristics of their workplace. Recent labour market research suggests that larger firms are generally better equipped to accommodate work–family reconciliation through formal maternity policies, internal mobility opportunities, and flexible working arrangements, whereas smaller firms often operate with more limited organisational resources and less employment flexibility (Goldin, 2021; Chung & van der Lippe, 2020; Thébaud & Pedulla, 2016). As a result, the motherhood wage penalty may vary systematically according to firm size.

To explore this possibility, the analysis distinguishes between women employed in large establishments and those working in smaller firms. Firm size is measured using the UKHLS workplace-size indicator. Following the UKHLS classification framework,

establishments coded as category 6 or above are classified as large firms, corresponding to workplaces employing at least 100–199 employees. This threshold aligns with conventional organisational and labour market research, where firms employing more than 100 workers are generally considered sufficiently large to possess formalised managerial structures, dedicated human-resource departments, and institutionalised employment practices (OECD, 2021). Prior studies similarly identify organisational transitions around this size threshold, particularly regarding the provision of flexible working arrangements, parental leave support, and employee welfare policies (Borg et al., 2020; Lee, 2023).

The distinction is especially important within the UK labour market because workplace inequality is strongly structured by organisational size and sectoral composition. Evidence from UK labour market surveys suggests that employees in larger firms are substantially more likely to have access to formalised flexible working arrangements, structured return-to-work programmes, occupational maternity schemes, and internal redeployment opportunities following periods of leave (CIPD, 2023). Large employers are also more likely to possess specialised human-resource departments capable of administering complex leave arrangements and accommodating temporary productivity reductions associated with childbirth. In contrast, employment relations in smaller firms are often more personalised and operationally constrained, meaning that prolonged absences or reduced working hours may generate proportionally larger disruptions to workflow and staffing capacity (Dex & Scheibl, 2001; Gray & Tudball, 2003). Consequently, mothers employed in smaller firms may face greater pressure to reduce labour-market attachment or accept less favourable working arrangements after childbirth.

Firm size may additionally shape the long-term economic consequences of childbirth through differences in internal labour-market structure and wage-setting mechanisms. Internal labour-market theory suggests that larger firms tend to operate with more standardised promotion systems, formal pay scales, and clearer career ladders, which can partially stabilise earnings progression during periods of interrupted employment (Lazear & Oyer, 2004). By contrast, smaller firms often rely more heavily on discretionary pay-setting and informal promotion processes, making wage growth potentially more sensitive to interruptions in continuous employment. Recent UK evidence also indicates that career advancement penalties associated with part-time work and flexible schedules are particularly severe in smaller private-sector firms, where managerial roles frequently depend on continuous visibility and availability (Timewise, 2023). Examining heterogeneity by firm size

therefore allows the analysis to capture how organisational structure conditions the extent to which childbirth translates into persistent wage penalties within the UK labour market.

5.2. Heterogeneity by ethnicity

The motherhood wage penalty may also vary across ethnic groups because the UK labour market is characterised by substantial ethnic diversity, differentiated migration histories, and persistent inequalities in employment opportunities. According to recent UK population statistics, ethnic minorities account for an increasingly large share of the working-age population, particularly in major urban labour markets such as London, Birmingham, Manchester, and Leicester (Office for National Statistics, 2024). As a result, ethnicity has become a central dimension of labour market stratification in contemporary Britain.

Due to sample-size limitations, the present study classifies respondents into two broad categories: White women and ethnic minority women. Although this aggregation does not permit detailed analysis of specific ethnic groups, it remains appropriate within the UK context because ethnic minorities collectively represent a significant and institutionally recognised category in British labour market policy and equality monitoring. UK employment regulation, Equalities Act reporting, and diversity frameworks frequently distinguish between White British workers and minority ethnic groups at an aggregate level when evaluating labour market inequalities (Equality and Human Rights Commission, 2022). Moreover, longitudinal household surveys often face insufficient subgroup sample sizes when analysing fertility transitions, particularly for second births, making broader ethnic aggregation necessary for statistical reliability.

Several characteristics of the UK labour market further suggest that the economic consequences of childbirth may differ across ethnic groups because minority women are unevenly distributed across employment types, contract arrangements, and patterns of labour-market attachment. Research on ethnic segmentation in Britain shows that minority women are more likely to work in occupations characterised by relatively compressed wage structures, higher union coverage, and more standardised pay determination, particularly within public administration, healthcare, transport, and routine service sectors (Heath & Di Stasio, 2019; Foster & George, 2025). Such institutional settings may reduce short-term wage volatility following childbirth because earnings progression depends less heavily on discretionary promotion systems and continuous overtime-intensive career trajectories. By contrast, White British women are more strongly represented in professional and managerial occupations where earnings growth is often tied to uninterrupted career progression, long working hours, and performance-related pay (Goldin, 2021). Consequently, childbirth-related

interruptions may produce more visible wage discontinuities among women whose pre-birth wage trajectories are steeper and more promotion-oriented.

Another relevant factor concerns differences in employment precarity and labour-market mobility. Recent UK evidence suggests that some ethnic minority women experience lower rates of inter-firm mobility and slower upward occupational transitions over the life course compared with White British women (Forth et al., 2023). Lower baseline wage growth prior to childbirth may mechanically reduce the observable marginal decline associated with motherhood. In this context, a smaller estimated post-birth wage penalty does not necessarily imply weaker structural disadvantage; rather, it may reflect flatter earnings trajectories that already existed before childbirth occurred. This interpretation is consistent with intersectional labour-market research emphasising that gender and ethnicity interact cumulatively across the life course rather than generating separate and additive forms of inequality (Collins & Bilge, 2020).

Finally, the interaction between ethnicity and motherhood may also reflect differences in fertility timing and family formation behaviour. Recent demographic studies show that some minority groups in the UK transition into motherhood at younger ages and within more stable family structures relative to White British women, who increasingly delay childbirth because of educational investment and career progression (Berrington et al., 2023). Since delayed fertility is often associated with higher pre-birth earnings and steeper wage trajectories, childbirth interruptions may impose larger opportunity costs on highly career-oriented women.

The ethnicity heterogeneity analysis therefore examines whether the wage consequences of childbirth differ systematically between White and minority mothers within the institutional and demographic context of the UK labour market.

5.3. Heterogeneity by institutional period

The magnitude of the motherhood wage penalty may also vary across institutional periods because family policies, workplace norms, and flexible working arrangements in the UK have changed substantially during the past decade. To capture these changes, the analysis divides the sample into two periods: an early period (2009–2016) and a later period (2017–2024). The period classification is motivated primarily by major changes in the UK work–family policy framework during the mid-2010s. Most importantly, Shared Parental Leave (SPL) was introduced in April 2015 for eligible births occurring on or after 5 April 2015. The policy allowed parents to share up to 50 weeks of leave and 37 weeks of statutory pay, replacing the previous maternity-focused leave structure with a more gender-neutral parental

leave system. Because firms and households may require time to adjust to new policy arrangements, observations after 2016 are classified as belonging to the post-reform institutional environment. This lag structure is consistent with recent policy-evaluation studies emphasising that behavioural responses to parental leave reforms often emerge gradually rather than instantaneously (Duvander and Johansson, 2020).

The division between the two periods also reflects broader changes in employer practices and labour market regulation in the UK. Following the mid-2010s, British employers increasingly expanded flexible working policies, remote work opportunities, and formal diversity-management strategies in response to tightening labour markets and growing policy attention to work–life balance (CIPD, 2023). In particular, the legal right to request flexible working became more widely institutionalised during this period, potentially improving mothers' ability to remain attached to employment after childbirth.

The period heterogeneity analysis is particularly important in the UK context because the country combines relatively high female labour-force participation with comparatively expensive childcare markets and uneven access to family-friendly workplace practices (Cribb, 2020). Under these conditions, institutional reforms affecting parental leave and workplace flexibility may substantially alter the economic costs associated with motherhood. Comparing the pre- and post-reform periods allows us to examine whether the motherhood wage penalty differs across policy regimes.

6. Results

6.1. Baseline estimates

Table 3 presents the baseline two-way fixed effects (TWFE) estimates of the motherhood wage penalty associated with first and second childbirths. Columns (1) and (2) report the results for the transition to first motherhood, while Columns (3) and (4) focus on the transition to second motherhood.

The results reveal a substantial and statistically significant wage penalty associated with motherhood. In Column (1), transitioning to first motherhood is associated with a 31.1% reduction in women's wages. After controlling for observable socioeconomic and demographic characteristics in Column (2), the estimated penalty remains large at 28.4% and highly statistically significant at the 1% level. This suggests that the decline in earnings following first childbirth cannot be fully explained by differences in education, health, or household characteristics.

A similar but slightly smaller pattern emerges for second childbirths. Column (3) shows that having two children is associated with a 24.6% reduction in wages, while the coefficient remains highly significant and only marginally smaller after adding controls in Column (4), where the estimated penalty equals 23.7%. Compared with the first-birth estimates, the second-child penalty appears somewhat weaker, indicating that the largest labour market disruption may occur during the transition into motherhood rather than subsequent fertility expansions.

Table 3

Baseline Regression of Motherhood Wage Penalty

	(1)	(2)	(3)	(4)
	First Child		Second Child	
One kid	-0.311***	-0.284***		
	(-15.279)	(-14.108)		
Two children			-0.246***	-0.237***
			(-8.468)	(-8.213)
Partnered		-0.008		-0.043
		(-0.471)		(-1.543)
Urban		-0.001		0.036
		(-0.025)		(0.763)
Health		0.002***		0.000
		(3.564)		(0.526)
Degree		0.720***		0.230
		(2.803)		(1.231)
Higher		0.122		0.132
		(0.487)		(0.748)
A-level		-0.219		0.050
		(-0.854)		(0.284)
GCSE		0.007		-0.009
		(0.030)		(-0.048)
Other Qualification		0.184		-0.102
		(0.993)		(-0.629)
Individual FEs	Included	Included	Included	Included
Year FEs	Included	Included	Included	Included
N	18405	18405	8828	8828
R^2_adj	0.635	0.673	0.771	0.772

Note: *** p < 0.1, ** p < 0.05, *** p < 0.01. t-statistics are reported in parentheses.

Source: author's calculations

Among the control variables, health status exhibits a positive and statistically significant association with wages in the first-birth specification, implying that healthier women tend to maintain stronger labour market attachment and earnings capacity. Educational attainment also plays an important role. Women holding a university degree earn

significantly higher wages than those in the omitted education category, consistent with standard human capital theory, which posits that investments in education increase individual productivity and are subsequently rewarded with higher earnings in the labour market (Becker, 1964; Mincer, 1974). However, the estimated coefficients for several other education categories are statistically insignificant, suggesting that changes in educational qualifications over time contribute relatively little to within-individual wage variation once individual and year fixed effects are controlled for.

Overall, the baseline TWFE estimates provide strong evidence of a sizeable motherhood wage penalty in the UK labour market. The findings indicate that both first and second childbirths are associated with persistent reductions in women's earnings, although the magnitude of the penalty is considerably larger following the transition to first motherhood.

6.2. Event study

Table 4 reports the results from the TWFE event-study specifications for first and second childbirths. The coefficients measure women's wage trajectories relative to the omitted baseline period, defined as one year before childbirth ($t = -1$). This framework allows the analysis to distinguish between pre-birth trends and post-birth wage adjustments, thereby providing a clearer picture of the timing and persistence of the motherhood wage penalty.

As shown in Columns (1) and (2), estimates for the pre-birth periods provide little evidence of differential wage trends prior to childbirth. For both first and second births, the coefficients for the periods five to two years before childbirth are small in magnitude and statistically insignificant. This pattern supports the parallel-trends assumption underlying the TWFE event-study design and suggests that treated women did not experience systematically different wage trajectories relative to the control group before entering motherhood.

The absence of systematic pre-birth wage divergence implies that the post-childbirth earnings penalties identified in the analysis are unlikely to be driven by pre-existing differences in wage trajectories. Instead, the observed wage declines emerge primarily after childbirth occurs. Similar patterns have been documented in recent studies using longitudinal administrative and panel data, which consistently find that motherhood-related earnings divergence arises predominantly after childbirth rather than beforehand (Kleven et al., 2019a; Angelov, Johansson & Lindahl, 2021; Andresen & Nix, 2022).

A substantial decline in women's wages emerges immediately in the year of childbirth. For first births, wages decrease by approximately 20.1% in the birth year, while

second births are associated with an even larger contemporaneous decline of 28.2%. Both estimates are statistically significant at the 1% level, indicating a sharp labour market disruption surrounding childbirth.

Table 4

Event Study Estimates of the Motherhood Wage Penalty

	(1) First Child	(2) Second Child
5 years before	0.027	0.030
	(0.196)	(0.140)
4 years before	0.024	-0.015
	(0.231)	(-0.100)
3 years before	0.061	0.030
	(0.868)	(0.300)
2 years before	0.057	0.007
	(1.518)	(0.117)
Year of birth	-0.201***	-0.282***
	(-4.818)	(-3.870)
1 year after	-0.334***	-0.245**
	(-4.387)	(-2.320)
2 years after	-0.304***	-0.291*
	(-2.856)	(-1.941)
3 years after	-0.345**	-0.281
	(-2.426)	(-1.420)
Partnered	-0.011	-0.035
	(-0.613)	(-1.272)
Urban	-0.001	0.039
	(-0.054)	(0.821)
Health	0.002***	0.000
	(3.599)	(0.649)
Degree	0.729***	0.259
	(2.782)	(1.430)
Higher	0.132	0.161
	(0.513)	(0.960)
A-level	-0.207	0.052
	(-0.792)	(0.307)
GCSE	0.018	-0.002
	(0.072)	(-0.012)
Other Qualification	0.192	-0.107
	(1.020)	(-0.677)
Individual FEs	Included	Included
Year FEs	Included	Included
N	18405	8828
R^2_adj	0.673	0.768

Note: *** p < 0.1, ** p < 0.05, *** p < 0.01. t-statistics are reported in parentheses.

Source: author's calculations

The wage penalty becomes more pronounced after childbirth, particularly following first births. One year after the first child is born, women's wages are approximately 33.4% lower relative to the pre-birth baseline period. The penalty remains persistently large two and three years after childbirth, with estimated wage reductions of 30.4% and 34.5%, respectively.

Previous research shows that first childbirth frequently triggers reductions in working hours, transitions into part-time employment, occupational downgrading, and slower wage growth due to interrupted human capital accumulation (Goldin, 2021; Blundell et al., 2022). In the UK context, these effects may be intensified by the highly gendered distribution of unpaid care responsibilities and the high cost of formal childcare, both of which disproportionately affect mothers' post-birth employment continuity (Costa Dias, Joyce & Parodi, 2020; De Henau & Himmelweit, 2021). The persistence of the first-child penalty therefore reflects not only temporary labour-force withdrawal but also longer-term adjustments in women's employment trajectories following the transition into parenthood.

Although wages also decline significantly following second childbirth, the post-birth effects appear less persistent. The wage penalty equals approximately 24.5% one year after childbirth and 29.1% two years after childbirth, although statistical significance weakens over time. By the third year after the second birth, the estimated coefficient remains negative but is no longer statistically significant. This may indicate that the labour market adjustment associated with second births is more heterogeneous across women or that a substantial portion of labour-market adjustment may already have occurred following the first child. By the time of second childbirth, many mothers may already have transitioned into more flexible occupations, reduced working hours, or adapted their employment arrangements to accommodate caregiving responsibilities. Consequently, the marginal disruption associated with an additional child becomes comparatively smaller.

The contrast between first and second births is particularly informative for understanding the cumulative nature of the motherhood penalty. The first child appears to constitute the critical turning point in women's earnings trajectories, generating the largest and most persistent disruption to wage growth. The second child, by comparison, largely reinforces an already existing pattern of labour-market adjustment rather than initiating an entirely new decline in earnings. This interpretation is consistent with recent comparative evidence showing that the majority of long-run gender inequality in earnings emerges at the transition to first parenthood, while higher-order births exert smaller additional effects (Kleven, 2022).

Among the control variables, health status remains positively associated with wages in the first-birth specification, while urban residence and partnership status are not statistically significant in either model. Degree-level education is positively correlated with earnings, particularly among first-birth mothers, consistent with the role of human capital in mitigating wage losses associated with motherhood.

Figure 3 further illustrates the dynamic wage trajectories surrounding first and second childbirth. The graphical evidence closely mirrors the regression estimates. Wage trajectories remain relatively flat prior to childbirth, followed by an immediate downward shift after birth. The first-child trajectory displays a substantially steeper and more persistent decline, whereas the second-child trajectory exhibits a more moderate but still sustained reduction in earnings. These findings suggest that motherhood penalties emerge sharply after childbirth and remain highly persistent over the medium term.

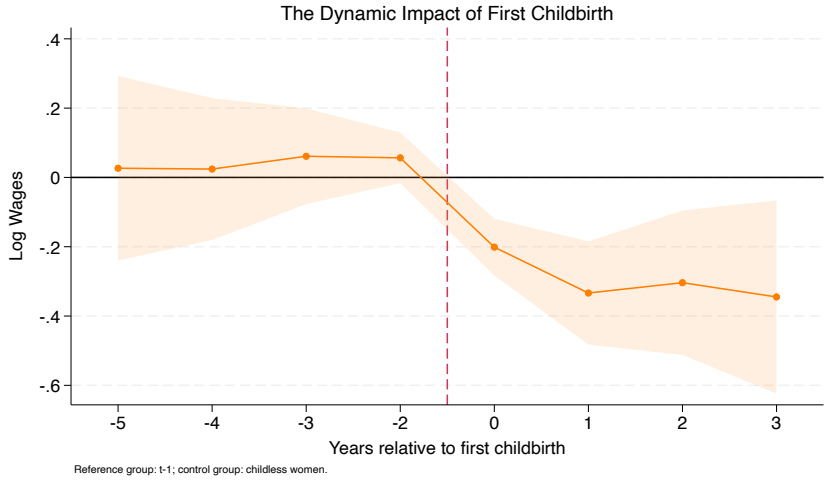

Figure 3(a). Dynamic Wage Effects Around First Childbirth

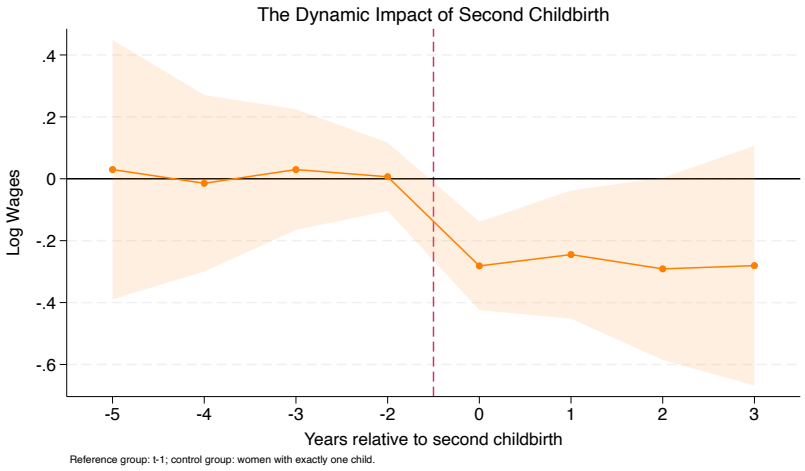

Figure 3(b). Dynamic Wage Effects Around Second Childbirth

Source: compiled by the author

6.3. Heterogeneity in the motherhood penalty in the UK

To further investigate whether the motherhood wage penalty differs across institutional and demographic contexts, this section examines heterogeneity in the wage effects of childbirth by firm size, ethnicity, and policy period[4]. Tables 5 and 6 report the heterogeneity analysis based on the TWFE event-study framework, separately for first and second childbirths. The results reveal substantial variation in the magnitude and persistence of the motherhood penalty across labour market environments and population groups in the UK.

6.3.1. Firm size and the motherhood wage penalty

Columns (1) and (2) of Tables 5 and 6 compare wage trajectories between women employed in large firms and those working in small firms. Among first-time mothers, those employed in small firms experience substantially larger and more persistent wage penalties following childbirth. In small firms, wages decline by approximately 41.3% one year after first childbirth and remain significantly lower even three years later. By contrast, women employed in large firms experience smaller (10%) and statistically weaker post-birth wage reductions. Consistent with the results in Figure 4.

Several institutional and economic mechanisms may explain this disparity. Larger firms in the UK generally possess greater organisational capacity to accommodate work-family balance through flexible working arrangements, internal mobility, remote work options, and formal human resource policies (Chung & van der Horst, 2018; CIPD, 2023). Moreover, corporate social responsibility (CSR) initiatives and diversity, equity, and inclusion (DEI) policies have become increasingly important among large UK firms, particularly publicly listed companies facing investor and regulatory pressure regarding gender equality (Kaufman & Taniguchi, 2021).

In contrast, small firms may face tighter staffing constraints and higher replacement costs when employees take maternity leave. As a result, mothers working in small firms may encounter greater difficulties returning to equivalent positions or maintaining wage progression after childbirth. Small employers are also less likely to provide enhanced parental benefits beyond statutory requirements (Bryson et al., 2020). This interpretation is consistent

[4] The policy period focuses on the 2015 Shared Parental Leave (SPL) reform, which enabled parents to share up to 50 weeks of leave and 37 weeks of pay.

with recent UK evidence suggesting that flexible work arrangements and employer family-support policies remain highly uneven across firms of different sizes (Andrew et al., 2020).

Table 5

Heterogeneity of Wage Penalty (First Birth)

	Firm Size		Ethnicity		Period	
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Large	Small	White	Minority	2009-2016	2017-2024
Event-Study Dummies						
5 years before	-0.192	0.055	-0.029	0.062	-0.009	0.206
	(-1.196)	(0.270)	(-0.210)	(0.157)	(-0.041)	(1.173)
4 years before	-0.117	0.047	-0.029	0.109	-0.011	0.152
	(-0.938)	(0.302)	(-0.269)	(0.365)	(-0.066)	(1.167)
3 years before	-0.036	0.058	0.018	0.168	0.050	0.106
	(-0.430)	(0.541)	(0.241)	(0.859)	(0.457)	(1.187)
2 years before	0.001	0.062	0.033	0.110	0.043	0.095**
	(0.032)	(1.044)	(0.862)	(1.058)	(0.748)	(2.022)
Year of birth	-0.103**	-0.265***	-0.202***	-0.101	-0.259***	-0.179***
	(-2.079)	(-3.924)	(-4.539)	(-0.926)	(-3.829)	(-3.360)
1 year after	-0.160	-0.413***	-0.363***	-0.009	-0.463***	-0.310***
	(-1.541)	(-3.871)	(-4.606)	(-0.044)	(-3.670)	(-3.333)
2 years after	-0.089	-0.392**	-0.307***	-0.044	-0.372**	-0.349***
	(-0.674)	(-2.422)	(-2.784)	(-0.150)	(-2.218)	(-2.634)
3 years after	-0.072	-0.453**	-0.316**	-0.171	-0.371*	-0.452**
	(-0.416)	(-2.110)	(-2.188)	(-0.403)	(-1.684)	(-2.517)
Control Variables						
Partnered	0.007	-0.010	-0.007	-0.019	-0.032	-0.003
	(0.317)	(-0.432)	(-0.346)	(-0.489)	(-1.362)	(-0.140)
Urban	0.008	-0.024	0.002	-0.040	0.026	0.017
	(0.205)	(-0.627)	(0.085)	(-0.427)	(0.505)	(0.707)
Health	0.002***	0.002**	0.002***	0.002	0.001	0.002**
	(2.685)	(2.419)	(3.441)	(1.084)	(1.415)	(2.022)
Degree	0.251	0.736*	0.649	0.670**	0.456*	1.223***
	(1.503)	(1.908)	(1.405)	(2.510)	(1.933)	(3.474)
Higher	-0.173	0.309	0.048	0.106	0.024	0.629*
	(-1.109)	(0.812)	(0.106)	(0.411)	(0.102)	(1.837)
A-level	-0.530***	-0.116	-0.296	-0.216	-0.376*	0.493
	(-3.009)	(-0.304)	(-0.644)	(-0.755)	(-1.656)	(1.403)
GCSE	-0.198	0.108	-0.094	0.272	-0.156	0.438
	(-1.203)	(0.297)	(-0.205)	(0.984)	(-0.684)	(1.201)
Other Qualification	0.041	0.166	0.121	0.170	-0.166	0.659
	(0.334)	(0.790)	(0.358)	(0.677)	(-1.087)	(1.456)
Individual FEs	Included	Included	Included	Included	Included	Included
Year FEs	Included	Included	Included	Included	Included	Included
N	8,890	9,224	14,978	3,395	9,115	8,936
R^2_adj	0.705	0.683	0.691	0.612	0.728	0.712

Note: *** p < 0.1, ** p < 0.05, *** p < 0.01. t-statistics are reported in parentheses. The sub-sample regressions are estimated using the reghdfe command in Stata, which automatically removes singleton observations after absorbing fixed effects. Consequently, the total number of observations in the sub-sample estimations may be marginally lower than in the full sample.

Source: author's calculations

Interestingly, the firm-size gap is less pronounced for second births. Although both groups experience substantial earnings declines following second childbirth, the estimated differences between large and small firms become statistically weaker. One possible explanation is that women who remain continuously employed after a first birth may already constitute a positively selected group with stronger labour market attachment and greater job stability, thereby reducing the marginal role of firm characteristics during subsequent fertility transitions.

These findings broadly align with recent international evidence showing that family-friendly workplace institutions can partially mitigate motherhood penalties (Andresen & Nix, 2022; Kleven et al., 2019). However, the magnitude of the small-firm penalty observed in the UK appears particularly persistent relative to Nordic countries, likely reflecting the UK's comparatively liberal labour market and more limited public childcare provision during much of the sample period.

6.3.2. Ethnicity and labour market inequality

Columns (3) and (4) examine heterogeneity by ethnicity. The results indicate that White women experience larger and more statistically significant wage penalties following first childbirth than minority women. For White mothers, wages decline by approximately 36.3% one year after first childbirth and remain persistently negative over the subsequent years. By contrast, the coefficients for ethnic minority women are generally smaller and statistically insignificant.

Previous research often predicts that ethnic minority women may face more severe labour market disadvantages following childbirth because ethnicity and gender inequalities can overlap within hiring, promotion, and career progression processes. However, the findings of this study suggest a more complex pattern within the UK context. One possible explanation relates to differences in pre-birth career trajectories rather than post-birth treatment alone. White British women are more likely to be concentrated in occupations characterised by steep earnings profiles, strong promotion incentives, and high returns to uninterrupted employment, particularly in professional and managerial sectors (Goldin, 2021). As a result, childbirth may interrupt faster wage-growth trajectories among White women, generating more visible post-birth earnings declines. By contrast, some ethnic minority women may already face flatter wage-growth trajectories before childbirth due to slower career progression or concentration in occupations with lower promotion elasticity.

The observed marginal wage penalty after childbirth may therefore appear smaller because pre-birth wage growth was already comparatively constrained.

Table 6

Heterogeneity of Wage Penalty (Second Birth)

	Firm Size		Ethnicity		Period	
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Large	Small	White	Minority	2009-2016	2017-2024
Event-Study Dummies						
5 years before	0.247	0.034	-0.019	0.545	0.033	0.296
	(0.762)	(0.140)	(-0.083)	(1.122)	(0.134)	(0.558)
4 years before	0.124	-0.007	-0.023	0.192	-0.004	-0.022
	(0.521)	(-0.042)	(-0.139)	(0.575)	(-0.024)	(-0.056)
3 years before	0.137	0.001	0.013	0.255	0.043	-0.041
	(0.842)	(0.010)	(0.121)	(1.191)	(0.372)	(-0.145)
2 years before	0.057	0.000	0.011	0.000	0.016	-0.022
	(0.697)	(0.005)	(0.178)	(0.003)	(0.255)	(-0.123)
Year of birth	-0.347***	-0.274***	-0.299***	-0.215	-0.289***	-0.254
	(-2.712)	(-3.516)	(-3.679)	(-1.448)	(-3.453)	(-1.429)
1 year after	-0.313*	-0.261**	-0.240**	-0.361	-0.227*	-0.342
	(-1.893)	(-2.013)	(-2.091)	(-1.338)	(-1.883)	(-1.146)
2 years after	-0.346	-0.352*	-0.286*	-0.458	-0.303*	-0.286
	(-1.464)	(-1.923)	(-1.754)	(-1.154)	(-1.734)	(-0.704)
3 years after	-0.385	-0.323	-0.275	-0.508	-0.321	-0.199
	(-1.228)	(-1.368)	(-1.271)	(-1.060)	(-1.386)	(-0.367)
Control Variables						
Partnered	-0.041	-0.044	-0.039	-0.032	-0.039	-0.032
	(-1.056)	(-1.155)	(-1.333)	(-0.428)	(-1.273)	(-0.512)
Urban	0.122*	-0.039	0.024	0.143	-0.006	0.015
	(1.730)	(-0.690)	(0.493)	(0.834)	(-0.116)	(0.199)
Health	-0.000	0.001	0.001	-0.001	0.000	0.000
	(-0.159)	(1.360)	(1.136)	(-0.891)	(0.511)	(0.478)
Degree	0.541***	-0.036	0.292	0.020	0.112	-0.040
	(3.302)	(-0.217)	(1.233)	(0.184)	(0.391)	(-0.311)
Higher	0.339***	0.004	0.156	0.188**	-0.031	0.080
	(2.595)	(0.024)	(0.686)	(2.060)	(-0.112)	(0.711)
A-level	0.244*	-0.082	0.064	0.010	-0.150	0.081
	(1.826)	(-0.573)	(0.284)	(0.077)	(-0.568)	(0.613)
GCSE	0.144	-0.135	-0.022	0.073	-0.144	0.169
	(1.107)	(-0.914)	(-0.093)	(0.687)	(-0.498)	(1.381)
Other Qualification	0.176	-0.256	-0.059	-0.189*	-0.272	-0.109
	(1.302)	(-1.647)	(-0.280)	(-1.936)	(-1.035)	(-1.321)
Individual FEs	Included	Included	Included	Included	Included	Included
Year FEs	Included	Included	Included	Included	Included	Included
N	3,506	5,193	7,256	1,572	5,885	2,747
R^2_adj	0.774	0.770	0.768	0.768	0.800	0.780

Note: *** p < 0.1, ** p < 0.05, *** p < 0.01. t-statistics are reported in parentheses.

Source: author's calculations

A second explanation concerns differences in household economic strategies and labour market attachment. Research on migration and minority households in Britain suggests

that labour supply decisions among ethnic minority women are often shaped by broader family-based economic arrangements rather than purely individual career maximisation (Dale & Ahmed, 2011). In some households, women's employment trajectories may already incorporate expectations surrounding childcare, extended family support, or intermittent labour market participation before motherhood occurs. Consequently, childbirth itself may generate a less abrupt disruption to observed wage trajectories because employment adjustments partially precede fertility transitions. This interpretation aligns with life-course approaches emphasising that labour market outcomes are shaped cumulatively through earlier educational, occupational, and family decisions rather than by childbirth alone.

In addition, the ethnic minority category in the UK is highly heterogeneous. Indian women generally display relatively strong labour market attachment and high educational attainment, whereas Pakistani and Bangladeshi women exhibit lower employment rates and more traditional household specialisation patterns (Li & Heath, 2018). Aggregating all minority groups into a single category may therefore conceal substantial within-group variation.

For second births, the ethnic differences remain broadly consistent with the first-birth results. White mothers continue to exhibit statistically significant post-birth wage penalties, whereas the estimated coefficients for minority mothers remain statistically insignificant throughout the post-birth periods. One likely explanation is the stronger selection into continued employment among minority women who remain attached to the labour market after a first childbirth. Ethnic minority mothers who remain in the workforce after childbirth are likely a highly selected group with above-average human capital, career commitment, or employer support. By contrast, White British mothers returning to work are more representative of the broader population. This differential selection may compress the estimated wage penalty for ethnic minority mothers relative to their White counterparts.

These findings differ somewhat from studies conducted in the United States, where minority women often experience larger motherhood penalties due to compounded racial and gender inequalities (Budig & Hodges, 2014). The UK context differs because of its universal healthcare system, stronger maternity protections, and comparatively compressed wage structure, all of which may moderate ethnic disparities in post-birth wage adjustment.

6.3.3. Policy period and institutional change

Columns (5) and (6) divide the sample into an early period (2009–2016) and a later period (2017–2024) to assess whether the motherhood penalty changed following major UK

family policy reforms, particularly the implementation of Shared Parental Leave (SPL) in 2015.

For first births, the results indicate that the motherhood penalty remains substantial in both periods but becomes somewhat less severe immediately after childbirth in the later period. In the early period, wages decline by approximately 46.3% one year after childbirth, whereas the corresponding decline in the later period is around 31.0%. Although wage losses remain persistent, the reduction in magnitude suggests that institutional changes may have partially improved mothers' labour market outcomes.

Several policy developments may explain this pattern. The introduction of Shared Parental Leave allowed eligible fathers and partners to share up to 50 weeks of leave and 37 weeks of statutory pay, thereby encouraging a more equal division of childcare responsibilities (Department for Business and Trade, 2023). Although take-up rates among fathers initially remained relatively low, the reform contributed to broader cultural changes surrounding paternal caregiving and workplace flexibility (Birkett & Forbes, 2019). At the same time, the expansion of flexible working rights and growing employer adoption of hybrid work arrangements following the COVID-19 pandemic may have improved mothers' ability to maintain labour market attachment after childbirth.

Nevertheless, the persistence of sizeable post-birth penalties even in the later period suggests that policy reforms alone have not eliminated structural gender inequalities in the UK labour market. High childcare costs remain a major barrier to full-time employment among British mothers, particularly in England where childcare expenses are among the highest in Europe relative to median earnings (OECD, 2023). Occupational segregation and unequal unpaid care responsibilities also continue to constrain women's long-term earnings trajectories.

For second births, a clearer contrast emerges between the early and later periods. During the early period (2009–2016), second childbirth is associated with substantial and statistically significant post-birth wage penalties. Wages decline by approximately 28.9% in the year of birth and remain significantly lower one and two years after childbirth. By contrast, in the later period (2017–2024), although the estimated post-birth coefficients remain negative, they are no longer statistically significant.

This pattern suggests that the labour market consequences of second childbirth may have weakened under the more recent UK family-policy environment. Although the overall uptake of SPL in the UK has remained relatively modest, the reform may have had a stronger effect on families experiencing second births. Compared with first-time parents, couples with

previous childcare experience are likely to be more familiar with parental leave arrangements and more capable of coordinating childcare responsibilities between partners.

Second-birth households may therefore be more willing to utilise shared care arrangements, optimise household labour specialisation, and increase paternal involvement in early childcare. Greater father participation can reduce the extent to which mothers need to interrupt employment or reduce working hours following childbirth, thereby mitigating the long-run wage penalty associated with motherhood. In addition, families proceeding to a second child after 2017 may increasingly represent dual-earner households with stronger labour market attachment and greater access to flexible work arrangements, particularly following the expansion of hybrid and remote working practices after the COVID-19 pandemic.

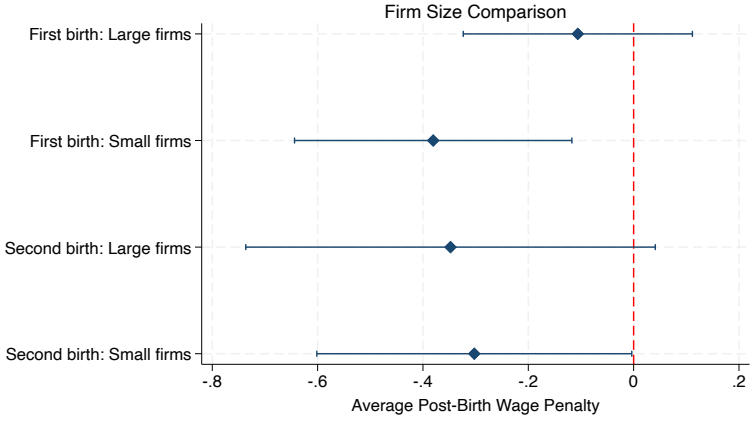

Figure 4(a). Heterogeneity by firm size

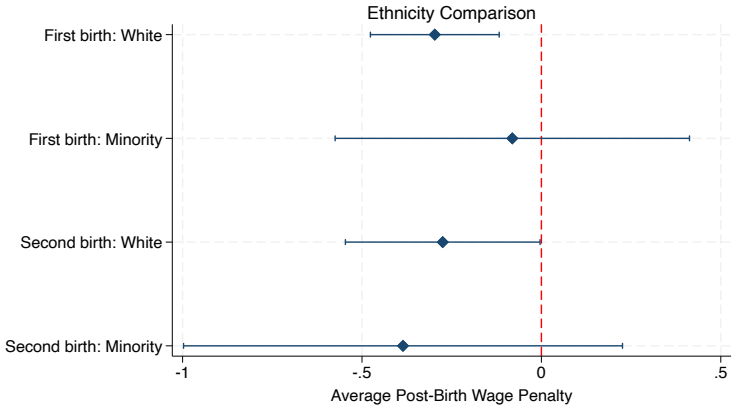

Figure 4(b). Heterogeneity by ethnicity

Figure 4(c). Heterogeneity by time period

Figure 4. Heterogeneity in Motherhood Wage Penalties

Notes. The figure reports the average post-birth wage effects estimated from the event-study specifications. The coefficients are calculated as the average of the post-birth indicators from year 0 to year 3 relative to childbirth. Error bars represent 95% confidence intervals based on clustered standard errors at the individual level. All regressions include individual and year fixed effects, as well as controls for partnership status, urban residence, health condition, education, and age trends. The omitted reference period is one year before childbirth (t = -1).

Source: compiled by the author

7. Robustness check

7.1. Labour supply effects

To ensure the robustness of the primary findings, this section introduces weekly working hours as an alternative dependent variable to re-estimate the event-study models for first and second childbirths. Examining labour supply responses provides an important complementary perspective because motherhood penalties may operate not only through lower wage rates or slower career progression, but also through reductions in labour supply following childbirth. A large literature in labour economics argues that childbirth often affects women's earnings indirectly through changes in working time, labour-force attachment, and transitions into part-time employment (Kleven, Landais & Søgaard, 2019; Angelov, Johansson & Lindahl, 2016). Consequently, analysing working hours helps distinguish whether post-birth earnings losses primarily reflect lower hourly productivity, employer discrimination, reduced career advancement, or declines in labour supply itself.

Table 7

Robustness Check of Wage Penalty

	Weekly working hours		Sample of full-time working women		Staggered DID model
	(1)	(2)	(3)	(4)	(5)
Variables	First Child	Second Child	First Child	Second Child	Second Child
5 years before	1.978	1.053	-0.032	0.158	-0.060
	(0.684)	(0.284)	(-0.212)	(-0.946)	(-0.68)
4 years before	1.223	0.585	-0.021	0.079	-0.001
	(0.558)	(0.217)	(-0.184)	(-0.694)	(-0.02)
3 years before	1.236	0.990	0.023	0.071	-0.009
	(0.818)	(0.539)	(-0.29)	(-0.879)	(-0.19)
2 years before	1.247	1.002	0.041	0.058	0.167
	(1.507)	(1.012)	(-0.949)	(-1.41)	(0.32)
Year of birth	-3.988***	-1.784*	-0.239***	-0.263***	-0.276***
	(-4.527)	(-1.865)	(-4.834)	(-4.590)	(-4.13)
1 year after	-7.565***	-4.520**	-0.238***	-0.245***	-0.248***
	(-4.688)	(-2.486)	(-2.873)	(-2.667)	(-4.78)
2 years after	-7.172***	-4.234	-0.219*	-0.310**	-0.238***
	(-3.193)	(-1.632)	(-1.866)	(-2.389)	(-4.16)
3 years after	-7.117**	-4.342	-0.225	-0.324*	-0.190***
	(-2.396)	(-1.219)	(-1.424)	(-1.926)	(-3.63)
Partnered	-0.428	-0.330	0.001	-0.044	
	(-1.331)	(-0.776)	(-0.034)	(-1.534)	
Urban	0.186	0.982	0.034	0.06	
	(0.428)	(1.148)	(-1.437)	-1.264	
Health	0.019*	-0.004	0.002***	0.000	
	(1.843)	(-0.264)	(-3.825)	(-0.129)	
Degree	11.356*	2.297	0.661***	0.164	
	(1.835)	(0.786)	(-3.143)	(-0.929)	
Higher	3.111	1.466	0.449**	0.167	
	(0.505)	(0.532)	(-2.142)	(-1.005)	
A-level	-2.059	0.107	0.292	0.057	
	(-0.334)	(0.038)	(-1.387)	(-0.336)	
GCSE	1.628	-0.977	0.394*	-0.019	
	(0.268)	(-0.338)	(-1.886)	(-0.106)	
Other Qualification	2.803	-2.835	0.329**	-0.11	
	(0.640)	(-1.037)	(-1.98)	(-0.696)	
Individual FEs	Included	Included	Included	Included	Included
Year FEs	Included	Included	Included	Included	Included
N	18405	8828	16,452	8,163	8524
R2_adj	0.501	0.649	0.714	0.797	

Note: *** p < 0.1, ** p < 0.05, *** p < 0.01. Coefficients are reported with t-statistics in parentheses for columns (1) to (4) and z-statistics in parentheses for column (5).
Source: author's calculations

Introducing weekly working hours as an alternative outcome variable is particularly relevant in the UK context because the British labour market is characterised by exceptionally high rates of female part-time employment following motherhood. Recent

evidence suggests that many British mothers respond to childcare responsibilities by reducing weekly hours rather than fully exiting employment, especially during the years immediately after childbirth. Compared with several continental European countries, the UK combines relatively flexible part-time employment opportunities with comparatively high childcare costs, encouraging many mothers to adjust labour supply margins after childbirth (OECD, 2023).

Using working hours as an alternative dependent variable also addresses an important methodological concern in the motherhood-penalty literature. Observed wage declines following childbirth may partly arise mechanically from reductions in hours worked rather than from changes in hourly pay or productivity. Previous studies therefore emphasise the importance of separately analysing labour supply responses when interpreting post-birth earnings trajectories (Adda, Dustmann & Stevens, 2017). If childbirth leads women to substantially reduce working hours, the observed earnings penalty may reflect both reduced labour-market attachment and slower wage progression.

Moreover, UK labour market institutions make working-time adjustments particularly important after childbirth. Flexible and part-time employment arrangements are widespread among British mothers, but these arrangements are often associated with lower promotion opportunities, reduced training access, and weaker long-term wage growth (Manning & Petrongolo, 2008; Chung & Booker, 2023). As a result, reductions in weekly working hours may constitute one of the main mechanisms through which motherhood generates persistent wage penalties over time.

The results are reported in Columns (1) and (2) of Table 7. Similar to the wage specifications, the coefficients in the pre-birth periods remain statistically insignificant for both first and second childbirths, indicating no clear evidence of differential labour supply trends prior to fertility transitions. This again supports the identifying assumption of the event-study framework.

Following childbirth, however, women's weekly working hours decline sharply and persistently. For first childbirth, working hours decrease by approximately 4 hours in the year of birth and fall further to around 7.6 hours one year later. Although the magnitude narrows slightly in subsequent periods, mothers still work approximately 7 fewer hours per week up to three years after childbirth. The results therefore suggest that first motherhood generates a substantial and sustained withdrawal from labour supply.

Weekly hours decline by approximately 2 hours in the year of second birth and remain between 4.2 and 4.5 hours lower during the following three years. Compared with

first childbirth, the reduction in labour supply after second childbirth is less severe, mirroring the smaller wage penalties observed in the baseline regressions.

The persistence of lower working hours after childbirth indicates that earnings losses are closely linked to long-term changes in mothers' labour market attachment rather than temporary short-run disruptions alone. The consistency between the wage and labour-supply specifications further strengthens the robustness of the main findings.

7.2. In-time placebo tests

A further way to assess the robustness of the event-study models is through placebo tests. The purpose of these tests is to examine whether the estimated wage penalties are genuinely driven by childbirth events rather than by pre-existing earnings trends or spurious correlations. Following recent event-study literature on fertility and labour market outcomes, placebo treatments are generated by artificially shifting the timing of childbirth forward in time and re-estimating the baseline specifications using these fictitious birth years (Kleven et al., 2019a; Andresen & Nix, 2022). If the identification strategy is valid, the placebo coefficients should fluctuate around zero and remain statistically insignificant, since no actual childbirth transition occurs during the placebo period.

For the first-child placebo test, the sample is restricted to women who transition from childlessness to one child. The placebo specification artificially reassigns the timing of childbirth to three years before the actual birth year. For example, if a woman's true first birth occurred in 2015, the placebo event is instead assumed to occur in 2012. Wage trajectories are then re-estimated relative to this fictitious childbirth timing. Because the placebo event is shifted three years earlier, the estimation window is restricted to five years before and two years after the placebo event so that the placebo post-treatment period does not overlap with the woman's actual childbirth year. The regression specification otherwise remains identical to the baseline model, including the same control variables, age fixed effects, and year fixed effects. A parallel placebo exercise is conducted for second childbirth.

Figures 5 plot the estimated wage effects around these placebo events. In both cases, the estimated effects fluctuate closely around zero, with no visible patterns or statistically significant post-event dummies. The absence of wage responses reinforces confidence that the results reflect the impact of childbirth rather than spurious wage shocks.

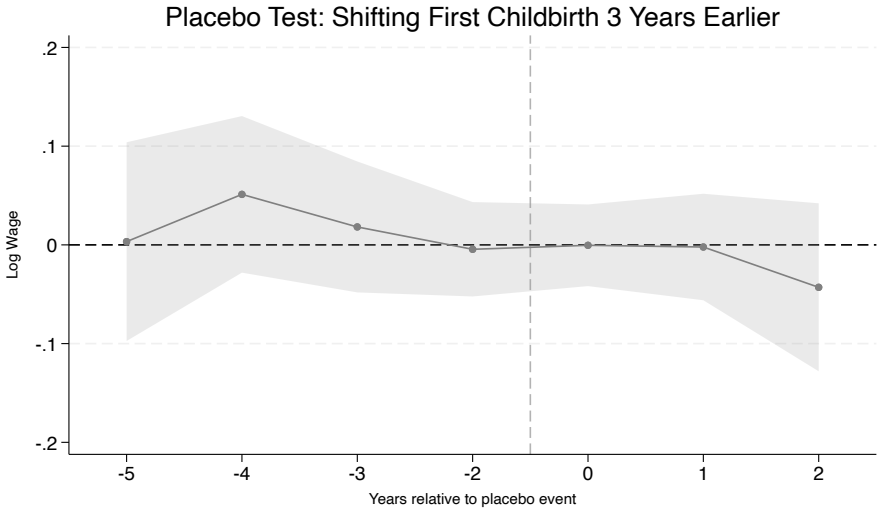

Figure 5(a). In-time Placebo Test for the First Child

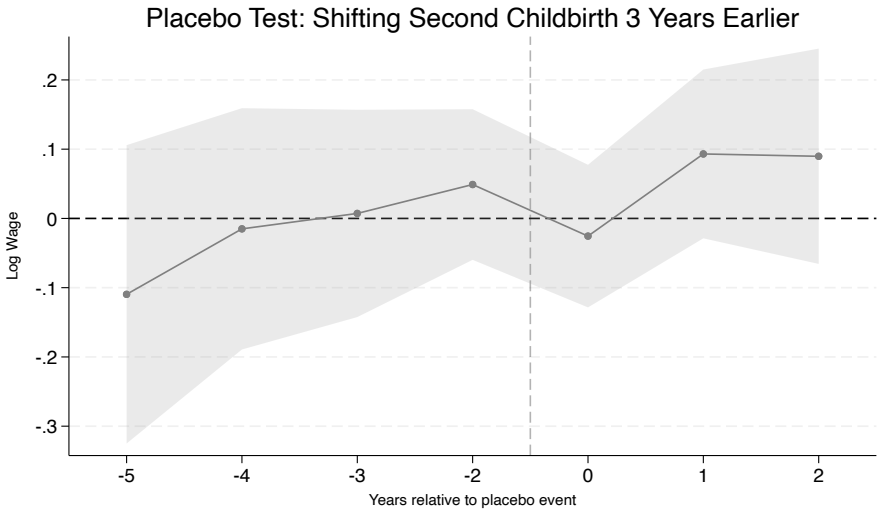

Figure 5(b). In-time Placebo Test for the Second Child

Note: For visual clarity, the placebo plot excludes the actual year of childbirth (pseudo t=3), as the placebo event is defined at t=0 and t=3 would represent three years after the placebo event. The in-time placebo tests are conducted only among women who experienced both first and second childbirths. Restricting the sample to mothers with observed fertility transitions substantially reduces the available number of panel observations. To preserve sufficient sample size for dynamic estimation, the minimum observation requirement was therefore relaxed from six to four observations per individual in the placebo specification.

Source: compiled by the author

7.3. Sensitivity to sample selection

To examine whether the estimated motherhood wage penalties are sensitive to labour-market attachment and employment composition, another robustness analysis restricts the sample to women working full-time only. This specification is important because labour supply adjustments after childbirth often occur through transitions from full-time to part-time employment rather than complete labour-market exit (Connolly & Gregory, 2008). In the United Kingdom, part-time employment is particularly common among mothers and represents one of the main mechanisms through which childbirth affects women's long-term earnings trajectories (Blundell et al., 2016). Consequently, baseline estimates using all employed women may partly capture reductions in working hours and changes in employment intensity rather than wage penalties among continuously full-time workers.

Restricting the sample to full-time employed women therefore provides a stricter test of whether childbirth generates wage penalties even among mothers maintaining relatively strong labour-market attachment. Previous studies argue that full-time employed mothers often represent a positively selected group with higher levels of human capital, stronger career orientation, and greater employer attachment (Budig & Hodges, 2010; Kleven et al., 2019a). If substantial wage penalties remain visible within this group, the results are less likely to be driven solely by labour-force withdrawal or part-time transitions.

The results indicate that the main findings remain broadly robust after restricting the sample to full-time workers. For first births, wage penalties remain negative and statistically significant in the post-birth periods, although the estimated magnitudes are somewhat smaller than in the baseline specification. The largest decline occurs immediately after childbirth, with wages falling by approximately 24 per cent in the birth year. Persistent negative effects are also observed during the subsequent post-birth periods. These findings suggest that motherhood penalties in the UK are not entirely explained by transitions into part-time employment, but also reflect slower wage progression and career disruption among women who remain continuously attached to full-time employment.

The second-birth estimates similarly show substantial post-birth wage declines among full-time employed mothers. The coefficients remain negative throughout the post-birth periods and are statistically significant, indicating that additional fertility transitions continue to affect women's earnings even among highly attached workers. This finding is consistent with recent research suggesting that cumulative childcare responsibilities may weaken wage growth and promotion opportunities even when mothers maintain continuous employment (Goldin, 2021).

At the same time, the attenuation of some coefficients relative to the baseline results suggests that labour-supply adjustment remains an important mechanism underlying the motherhood wage penalty. British mothers frequently reduce working hours after childbirth because of high childcare costs and limited compatibility between professional careers and caregiving responsibilities (OECD, 2023). Excluding part-time workers therefore removes an important channel through which childbirth affects women's earnings trajectories. Overall, however, the persistence of significant post-birth wage declines within the full-time sample strengthens confidence that the main findings are not driven purely by sample composition or labour-force withdrawal.

7.4. Robustness check with staggered DID

To assess the robustness of the baseline two-way fixed-effects (TWFE) event-study estimates, this study additionally applies the staggered difference-in-differences estimator proposed by Callaway and Sant'Anna (2021). Recent methodological research has shown that conventional TWFE estimators may generate biased treatment effects in settings with staggered treatment timing and heterogeneous treatment effects across cohorts (Goodman-Bacon, 2021; Sun & Abraham, 2021). TWFE specifications may assign negative weights to already-treated groups, potentially distorting dynamic event-study estimates when treatment timing differs across individuals. Since second childbirth occurs at different points in women's life courses, the staggered treatment framework is particularly relevant in the present analysis.

The Callaway and Sant'Anna estimator address these concerns by estimating cohort-specific average treatment effects and aggregating them without relying on inappropriate comparisons between already-treated individuals and later-treated groups. This approach has increasingly become standard in recent labour-economics research examining dynamic policy and fertility effects (Baker, Larcker & Wang, 2022; de Chaisemartin & D'Haultfoeuille, 2020).

Importantly, the second-birth specification allows the analysis to focus on the additional wage consequences associated with progressing from one child to two children, rather than the broader transition into motherhood itself. Since both the treatment and control groups consist of women who have already experienced first childbirth, the estimated effects capture the incremental labour-market adjustments associated with second births under relatively comparable family and employment conditions. To assess the robustness of the baseline TWFE estimates, the analysis additionally applies the staggered difference-in-differences estimator proposed by Callaway and Sant'Anna (2021), which is specifically

designed to account for treatment-effect heterogeneity in settings with staggered treatment timing. The resulting dynamic ATT estimates remain negative and statistically significant throughout the post-birth periods, providing further evidence that second childbirth generates persistent wage reductions.

As shown in Column (3) of Table 7, the estimated dynamic treatment effects strongly support the validity of the main findings. The average pre-treatment effect remains small (-0.0136) and statistically insignificant ($p = 0.608$), while all individual pre-treatment coefficients remain close to zero and statistically insignificant. These results provide strong evidence in favour of the parallel-trends assumption and suggest that women who eventually progress to a second birth did not exhibit systematically different wage trajectories prior to childbirth. This finding strengthens the causal interpretation of the estimated post-birth wage penalties.

Following second childbirth, substantial and statistically significant wage declines emerge immediately. The estimated wage penalty reaches approximately 27.6 per cent in the year of childbirth and remains persistently negative throughout the subsequent post-birth periods. Although the magnitude of the penalty gradually declines over time, the post-treatment coefficients remain economically large and statistically significant up to three years after childbirth. The overall post-treatment average effect is estimated at approximately 23.8 per cent. These findings closely mirror the baseline TWFE event-study results, indicating that the main conclusions are not driven by potential biases associated with heterogeneous treatment timing.

Figure 6. Event-Study Estimates of the Effect of Second Birth on Wages (Callaway–Sant'Anna)

Notes. The csdid estimator normalises all coefficients relative to the omitted pre-treatment reference period (t=−1). Because the event-study window is specified as [−5,3], the first displayed pre-treatment coefficient in the figure corresponds to t=−5, although it is labelled as −4 in the default csdid plotting output. Similarly, the displayed coefficient labelled −1 corresponds to the actual event time t=−2. This reflects the internal indexing procedure of the csdid estimator and does not affect the interpretation of the estimated dynamic treatment effects.
Source: compiled by the author

8. Conclusion and discussion

This study examined how childbirth affects women's wage trajectories in the UK, with particular attention to differences between first and second births and the extent to which these effects vary across workplace-size, ethnic and institutional contexts. Using longitudinal UKHLS data and an event-study framework with individual and year fixed effects, the analysis traced women's wage dynamics before and after childbirth while accounting for age profiles and time-varying labour market characteristics. Unlike much of the earlier UK literature, which often treats motherhood as a single transition, this study distinguished between first and second births in order to capture the sequential nature of fertility behaviour and the possibility that different births may reshape women's labour market trajectories in distinct ways. The findings indicate that childbirth generates substantial and persistent wage penalties for women in the UK, but that these penalties are highly uneven across birth order, institutional period, and ethnic groups. The transition to first motherhood produces the largest and most statistically robust decline in wages, whereas the effects associated with second births are generally smaller and less precisely estimated. The results further suggest that institutional changes, including the broader policy environment surrounding Shared Parental Leave (SPL) may have moderated second-birth penalties to some extent. The workplace heterogeneity analysis further shows that motherhood penalties differ across organisational settings. Women employed in smaller firms generally experience larger and more persistent post-birth wage declines than those working in larger organisations, suggesting that access to formalised family-friendly policies, internal flexibility, and stronger institutional support within large firms may partially mitigate the long-term economic consequences of childbirth. In addition, the ethnicity analysis indicates that White women experience clearer and more statistically significant post-birth wage declines than minority women, although this does not necessarily imply more favourable labour market outcomes for minority mothers overall.

Overall, the findings strongly support the broader international literature arguing that childbirth remains one of the central drivers of gender inequality in labour market outcomes. Consistent with Kleven, Landais and Søgaard (2019a), Angelov, Johansson and Lindahl (2016), and Andresen and Nix (2022), the results show that women's wage trajectories diverge sharply after childbirth and that these effects persist well beyond the immediate post-birth period. The evidence therefore reinforces the argument that motherhood penalties are not short-term disruptions but long-term processes that reshape women's labour market attachment and earnings growth. The results are also broadly consistent with UK-based evidence showing that women's career progression slows substantially after childbirth due to reductions in working hours, occupational mobility, and changes in employment continuity (Adda, Dustmann & Stevens, 2017; Dias, Joyce & Parodi, 2020). The robustness analysis using weekly working hours further supports this interpretation. Women's labour supply declines substantially after childbirth, particularly following first births, indicating that post-birth wage losses are closely linked to enduring reductions in labour market attachment rather than temporary earnings shocks alone.

However, this study contributes to the literature by showing that motherhood penalties are not uniform across fertility transitions. Existing international research often emphasises first births as the decisive turning point in women's careers, arguing that the majority of lifetime child penalties emerge immediately after the first child (Angelov et al., 2016; Kleven et al., 2019a). The present findings largely support this interpretation. First births generate the largest and most persistent wage declines, suggesting that the initial transition into motherhood fundamentally alters women's labour market trajectories. Yet the analysis also demonstrates that second births remain economically important. This finding complicates the assumption that second births merely represent small marginal extensions of already-established family roles. Instead, the evidence suggests that second births continue to influence labour supply and earnings trajectories, although their effects are shaped by women's prior adjustments after first childbirth.

The ethnicity findings also contribute to ongoing debates regarding intersectionality and labour market inequality. Contrary to conventional assumptions that minority women necessarily experience larger motherhood penalties, the analysis shows that White women often exhibit clearer and statistically stronger post-birth wage declines. This result is broadly consistent with recent UK studies suggesting that minority women may display smaller marginal wage penalties after childbirth because they already face flatter wage trajectories, occupational segregation, or constrained promotion opportunities prior to motherhood (Forth,

Theodoropoulos and Bryson, 2023). In other words, childbirth may generate a smaller additional decline where pre-existing labour market disadvantage is already substantial. This interpretation supports intersectional perspectives arguing that gender and ethnicity interact in complex ways rather than producing additive forms of disadvantage (Collins & Bilge, 2020).

Nevertheless, the findings should not be interpreted as evidence that minority women experience more equal labour market outcomes overall. A smaller estimated motherhood penalty may instead reflect lower pre-birth earnings growth, concentration in lower-mobility occupations, or weaker attachment to high-promotion career tracks. The results therefore reinforce recent arguments that motherhood penalties must be interpreted relative to women's pre-existing labour market position rather than solely through post-birth wage changes. In the UK context, where ethnic occupational segregation remains substantial and labour market experiences differ widely across minority communities, the interaction between ethnicity and motherhood is likely to operate through multiple channels simultaneously, including occupational sorting, public-sector employment, family norms, and discrimination.

Several findings also diverge from parts of the existing literature and therefore require further interpretation. First, some previous studies suggest that higher-order births should intensify cumulative labour market disadvantage because childcare responsibilities increase with family size. While this study finds persistent reductions in working hours after second births, the wage penalties themselves are not consistently larger than those observed after first births. One possible explanation is that UK mothers may undertake substantial occupational restructuring immediately after first childbirth, thereby reducing the marginal labour market disruption associated with later births. Another explanation may relate to institutional timing. Since many second births in the later sample occur after the expansion of flexible work and post-pandemic hybrid employment arrangements, mothers may have greater capacity to maintain labour market attachment following later births than was previously possible.

The findings additionally imply that policy interventions targeting gender inequality cannot focus exclusively on maternity protection alone. Policies that encourage paternal caregiving participation, expand affordable childcare, and reduce the career penalties associated with flexible work may be particularly important for limiting long-term earnings inequality. The evidence from second births suggests that household adaptation and workplace flexibility may matter increasingly over time. However, unless workplace cultures themselves become less dependent on ideal-worker norms and constant availability, formal flexibility rights may continue to coexist with substantial career penalties for mothers.

Several limitations should nevertheless be acknowledged. First, although the UKHLS provides rich longitudinal information, sample sizes become considerably smaller when distinguishing between first and second births and conducting subgroup analyses by ethnicity and institutional period. This limits statistical precision, particularly for minority women and later-event periods. Second, the ethnicity analysis necessarily aggregates highly heterogeneous minority groups into a single category due to sample constraints. This approach captures broad structural differences between White and minority women but cannot fully identify variation across specific ethnic communities. Third, although the event-study design strengthens causal interpretation by examining pre-trends and individual fixed effects, unobserved time-varying factors such as changing household preferences, employer selection, or fertility timing decisions may still influence estimated effects.

Future research could extend this analysis in several directions. More detailed examination of occupational trajectories, sectoral mobility, and employer characteristics could clarify how workplace structures mediate childbirth penalties across different career paths. Additional research could also explore heterogeneity across specific ethnic communities, migration backgrounds, and partnership arrangements. Finally, future work should examine whether post-pandemic hybrid working arrangements generate durable reductions in motherhood penalties or instead reproduce gender inequality through new forms of unequal unpaid labour allocation within households.

Overall, this study demonstrates that motherhood continues to exert a profound influence on women's wage trajectories in the UK labour market. The transition to first motherhood remains the most consequential turning point, but second births also shape labour supply and earnings dynamics in important ways. The findings further show that motherhood penalties are conditioned by institutional change, workplace organisation, and pre-existing labour market inequalities rather than arising solely from individual labour supply decisions. Understanding how childbirth reshapes women's economic trajectories therefore remains central to explaining the persistence of gender inequality in contemporary labour markets.

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Resümee

ESIMESE JA TEISE SÜNNIGA KAASNEVAD DÜNAAMILISED MÕJUD PALGALE ÜHENDKUNINGRIIGIS

Lu Dong

Käesolev uurimus käsitleb emadusega seotud palgakaotust Ühendkuningriigis, analüüsides, kuidas naiste palgad muutuvad pärast esimese ja teise lapse sündi. Uuring kasutab Ühendkuningriigi Leibkondade Longituuduuringu (UK Household Longitudinal Study, UKHLS) paneelandmeid. Esmalt rakendatakse fikseeritud efektidega (TWFE) baasmudelit, et tuvastada emadusega seotud palgakaotuse olemasolu Ühendkuningriigi tööturul. Seejärel kasutatakse peamises analüüsis sündmusuuringu (event-study) meetodit, et hinnata naiste palgatrajektoore enne ja pärast sünnitust. Lisaks uuritakse palgakaotuse heterogeensust ettevõtte suuruse, etnilise tausta ning erineva perepoliitika (Shared Parental Leave'i) lõikes.

Tulemused näitavad, et sünnitus põhjustab Ühendkuningriigi naistele märkimisväärseid ja püsivaid palgakaotusi, kusjuures esimese lapse sünd toob kaasa kõige suurema ja pikaajalisema sissetulekute languse. Palgakaotused on eriti väljendunud esimestel aastatel pärast esimese lapse sündi, mis viitab sellele, et emaks saamine kujutab endast olulist pöördepunkti naiste tööturuteekonnas. Kuigi ka teise lapse sünd vähendab naiste sissetulekuid, on selle mõju üldiselt väiksem. Tulemused näitavad samuti, et suuremates ettevõtetes töötavad naised kogevad suhteliselt väiksemat palgakaotust, samas kui valgenahalistel naistel on sünnitusjärgne palgalangus tugevam kui vähemusrahvustest naistel. Lisaks viitavad tulemused sellele, et Shared Parental Leave'i poliitikamuudatused aitavad vähendada teise lapse sünniga seotud palgakaristust. Üldiselt näitab uurimus, kuidas laste sünnijärjekord mõjutab naiste pikaajalisi sissetulekute trajektoore, ning pakub empiirilist tõendusmaterjali tööturu- ja perepoliitika arutelude jaoks, mille eesmärk on toetada emade tööhõivet.

Märksõnad: emadusega seotud palgakaotus; laste sünnijärjekord; sündmusuuringu analüüs; Ühendkuningriigi tööturg; Shared Parental Leave (SPL).

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