Women Employment and Health

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Declarations

I can confirm that no part of this thesis has been submitted for another award and that the research presented in the empirical chapters is my own work. No part of the thesis has been published yet.

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Summary

The primary aim, as set out in the Introduction, is to explore women's specific difficulties regarding labour market outcomes in the first decade of the 21st century, related to their dual role as mothers and labour force participants. The overarching context of the thesis is a contemporary profile of the working woman in Great Britain who is struggling to balance motherhood and paid work successfully, with the consequences this might have for her mental health. This thesis contains three empirical chapters exploring women's employment and health interactions, through the consequences of the 2008/9 economic crisis on the UK gender wage gap, the effects of postpartum depression on maternal employment after childbirth, and the potential long-term impacts of postpartum depression on children's emotional health and cognitive developmental outcomes.

Specifically, this thesis seeks to address the following research questions: Did the great recession affect the wage gender gap? Does postpartum depression affect employment? Does postpartum depression predict emotional and cognitive difficulties in 11 year olds?

Recent estimates reveal that 1 in 10 children aged 5-16 years have a diagnosable mental health problem and 1 in 5 mothers suffer from perinatal mental disorders, which highlight how widespread mental health problems are and how important the promotion of good mental health and prevention is at crucial stages in development. The results of the three empirical chapters of the thesis point to the need for an innovative and comprehensive approach to the distinct problems faced by different groups and sub-categories within the population.

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Abstract

This thesis contains three empirical chapters exploring women's employment and health interactions, through the consequences of the 2008-2009 economic crisis on the UK gender wage gap, the effects of postpartum depression on maternal employment after childbirth, and the potential long-term impacts of postpartum depression on children's emotional health and cognitive developmental outcomes.

The primary aim, as set out in the Introduction/Chapter 1, is to explore women's specific difficulties regarding labour market outcomes in the first decade of the 21st century, while the overarching context of the thesis is a contemporary profile of the working woman in Great Britain who is struggling to balance motherhood and paid work successfully, with the consequences this might have for her mental health.

In Chapter 2, using Labour Force Survey Data from 2002-2010, we explore gender equality at work through the impact of the 2008 great recession on the gender wage gap in the UK; specifically the impact of the recession on women's earnings. The response of the labour market to this economic downturn is of special significance for policy makers who are interested in promoting gender equality, economic growth and social cohesion, particularly as this recession takes place after the adoption of a number of reforms introduced since 1996, designed to facilitate female labour market participation.

In Chapter 3, we evaluate the role of postpartum depression on maternal employment outcomes, using data from the Millennium Cohort Study. The growing number of young mothers who choose to return to employment after childbirth indicates the central role work plays in the lives of contemporary women and how vital mental health is for personal and professional development. Indications that postpartum depression appears to affect women's long-term employability trajectories through its strong association with mental and physical

health problems 11 years after the birth is a finding that has serious implications for policies designed to promote women's health and wellbeing, which are vital for maintaining a presence in the labour market.

In Chapter 4, using data from the Millennium Cohort Study, we explore the specific role and influence of mothers' postpartum depression (PPD) on children's socio-emotional and cognitive outcomes at age 11 (a significant period of transition to early adolescence) through multiple evidence provided by mothers, teachers and children. Increasing evidence shows that depression is common in the postpartum period and that maternal postpartum depression is associated with developmental problems in children. The analysis of the results obtained in this chapter shows no effect of PPD on children's cognitive outcomes, while it indicates a strong association with children's emotional difficulties at age 11 when these are reported by the mother. Apart from the possibility of mother-reporting measurement issues, these findings point to diverse pictures of the same child in different contexts.

In Chapter 5/Conclusion, we present a summary of the main findings of the three empirical chapters of the thesis with emphasis on implications for future policies as well as suggestions for future research.

Chapter 1 Introduction

In contemporary societies work plays an important role in the lives of both men and women. On an individual level, employment is not only the main source of income, but constitutes a dominant experience and a major influence on people's lives which is associated with social status and quality of life (McDaid et al., 2008). At the societal level, employment is considered a major contributor to the national economy, productivity and competiveness. High levels of employment also have implications for the sustainability of a country's social welfare system (McDaid et al., 2008). In most western industrialised nations, economic growth increased labour market demands and helped draw married women, including those with dependent children, into the labour force (Scott, 2008). In the United Kingdom the female employment rate in 2013 reached 67%, with over 42% in part-time employment, whereas the percentage for men fell from 92% in 1971 to 76% in 2013, with 12% in part-time work.[1] In the same period, the percentage of mothers with dependent children in work increased from 67% in 1996 to 72% in 2013 (ONS, 2013). Thus a greater number of women are nowadays participating in the formal labour market, balancing paid work and caring responsibilities.

The spectacular rise in female employment in the second half of the 20th century was accompanied by major social and economic changes, particularly regarding gender relationships in the labour market. As reported in many studies, the change from the male breadwinner system to a dual-earner family system and single-parent households, led to women assuming increased responsibilities, specifically the responsibilities of motherhood and of labour market participants. These dual responsibilities had a variety of impacts on women's lives, including impacts on maternal health and wellbeing, particularly for a

[1] Office for National Statistics (ONS): employment rates for men and women aged 16-64, April to June 2013

considerable percentage of mothers – estimated between 8-15% in most studies (O'Hara, 1997) – who are also exposed to postpartum depression following childbirth.

In this thesis, we focus on the specific difficulties women face in the UK labour market in the first decade of the 21st century, with emphasis on maternal mental health and its influence on women's dual role as labour force participants and as primary child caregivers – investigating issues related to parenthood, the mother-infant relationship and the potential impact of maternal depression on the child, as well as issues related to gender equality and economic disparities faced by women at work.

The link between maternal mental health and child outcomes has been extensively explored in the literature (Sinclair and Murray, 1998; Essex et al., 2003; Hay et al., 2008; Kiernan and Huerta 2008; Pawlby et al., 2008; Goodman et al., 2011; Agnafors et al., 2013) whereas the long-term impact of postpartum depression on maternal employment outcomes appears not to be in the focus of research despite significant health and social implications involved. The present thesis aims to fill this significant gap by exploring in its three empirical chapters the following parameters regarding the importance of maternal mental health and women's employment outcomes:

- Gender equality at work explored through the consequences of the 2008/9 economic crisis on the UK gender wage gap
- The role of postpartum depression on maternal employment outcomes - evaluation of its long-term effect on women's employability.
- The potential influence of mothers' postpartum depression on children's socio-emotional and cognitive outcomes 11 years after the birth.

Aims and Objectives

The primary aim of this thesis is to explore women's specific difficulties regarding labour market outcomes in the first decade of the 21st century, with emphasis on maternal mental health in the postpartum period. We begin by examining the wage gender gap in respect of the great recession of 2008 to determine whether women's position in the labour market has changed during the period from 2002 to 2010. Following this, we examine maternal employment outcomes after childbirth in relation to maternal mental health (postpartum depression), a factor impeding women's health and employment. Finally, we examine the potential long-term impacts of postpartum depression on children's emotional and developmental outcomes. The overarching objective of the thesis is to evaluate the interconnections between women's employment outcomes and mental health in the postpartum period and the implications for the mother, the child and society. Each of the three empirical chapters has individual objectives. The combining results from these chapters enables us to synthesize a comprehensive picture on the overarching theme of the thesis: women, employment, and health.

Despite the significant societal implications involved, the long-term impact of postpartum depression on maternal employment outcomes appears not to be in the focus of research. To fill this gap, the present thesis explores the effect of postpartum depression on maternal employment outcomes and highlights the association between maternal mental health and market outcomes within the broader context of the consequences of mental disorders on the UK economy and the workplace. Apart from contributing to this field, the present thesis indicates a new direction for future research on maternal mental health and market outcomes. The research carried out demonstrates the long-term impact of postpartum depression on women's employment outcomes, mediated through mental and physical health 11 years after the birth. Additionally, the thesis provides further empirical support to earlier evidence indicating that maternal mental health is highly important for children's

developmental outcomes, particularly at critical stages of development. Age 11 represents in this thesis an important stage as it marks the transition from childhood to early adolescence. Only three clinical works (Hay et al., 2001; Hay et al., 2003 and Pawlby et al., 2008) have focused their research specifically on the outcomes of 11-year-old children in relation to maternal mental health in the postpartum period.

The choice to start with gender equality at work (explored through the impact of the first recession of the 21st century on the gender wage gap) is a conscious decision on my part. Nowadays, the workplace has become "the defining element in the lives of women as it has always been for men" (Casper, 1998, p. xiii). As indicated by statistical evidence (ONS and Eurostat) and a large body of empirical research on economic inequality, women have not yet achieved parity with men in the labour market despite the widely acknowledged significant strides made in terms of levels of educational attainment and work experience/skills accumulation. On the same line, our findings regarding the UK gender wage gap in Chapter 2 of the thesis reveal that women still earn significantly less than men in the labour market.

In the remainder of this chapter we discuss: a) recessionary effects and labour market inequalities, b) the main characteristics of the UK market in relation to female employment rates and the specific difficulties encountered by women as regards employment and pay, c) postpartum health after childbirth with emphasis on the potential consequences for maternal mental health and children's development and d) relevant policies, the main legal framework and government initiatives.

Recessions and labour market inequalities

The time-frame of the present thesis (2002 to 2012) is divided into a period of economic stability and growth (2002-2007), followed by an economic downturn (2008/09). It is well

known that in recessionary times the economy contracts, resulting in negative impacts on living standards. Productivity, employment rates, investment activity, household incomes and business output usually experience a fall, whereas unemployment rates and redundancies experience a rise. Given the strong female presence in some sectors of the economy and particularly in part-time employment, recessions and their effects have significant implications for policy makers as business cycles are reported to influence part-time and full-time employment in the short-to-medium term in different ways (Buddelmeyer et al., 2008). Estimates by Bell and Blanchflower (2010b) regarding the effects of the 2008/9 recession, demonstrate this difference in influence as full-time employment declined from 22 million in 2008 to 21 million in 2010, while temporary and part-time employment increased by 200,000 and 400,000 respectively. Research evidence also indicates that flexibility and control of working time is easier with part-time workers who can be used as a buffer against downturns (Anderton and Mayhew, 1994). Despite the global origins of the latest recession, findings by Muriel and Sibieta (2009) show that its impacts were similar to those of previous downturns affecting mostly low-skilled, low-educated individuals and young people. This indicates that some vulnerable groups in the population are disproportionately affected by economic downturns. According to the literature, recessions have gender-specific employment patterns, with male employment rates decreasing sharply in contrast to women's rates which experience milder falls (Jacobsen, 2007; Gregg and Wadsworth, 2010). Evaluating the effects of the latest recession, Bell and Blanchflower (2010a) find marked differences in employment and unemployment rates between male and female workers. The impact of the economic crisis on gender equality has wider implications related to women's unequal position in the formal labour market and the effectiveness of the UK legal framework and relevant policies (Gregg and Wadsworth, 2010; Rubery and Rafferty, 2013). The economic determinants of the UK gender equality policy agenda are examined by Annesley and Gains (2013), who point out that in adverse economic conditions proposals for further progress towards gender equality are not encouraged due to the cost involved. Therefore, they suggest that advocacy for policy issues

which have economic consequences would be easier when the economy is growing, unemployment is low and there is no public concern about the course of the economy.

According to the literature, economic conditions can impact on the life of individuals in a variety of ways, with many people experiencing not only financial but also health issues. The relationship between economic fluctuations and health has been the focus of considerable research.[2] The association is examined through the study of health behaviours, such as alcohol consumption, cigarette smoking, substance use and obesity during economic fluctuations, as well as the association between unemployment and mental health problems and also the link between mortality rates and economic decline. Evidence in Ruhm (2000, p.617) indicates that, contrary to the common belief that health worsens when the economy declines, in fact "health *improves*" during downturns. Total mortality show a pro-cyclical fluctuation with the exception of suicides, smoking and obesity increase in times of expansion, but physical activity decreases and diets become less healthy (Ruhm, 2000). However, examining the effects on mortality over the period 1976-2010, Ruhm (2015) finds that the total mortality shifted from being strongly pro-cyclical to being unaffected by macroeconomic conditions, but deaths from cardiovascular disease and transport accidents remain pro-cyclical, whereas deaths from cancer and external causes (e.g. accidental poisonings) show a countercyclical pattern. The effects of wages and working hours on the health behaviours of low-educated persons were examined by Xu and Kaestner (2010). Their findings indicate that increases in working hours are associated with an increase in cigarette smoking, and a reduction in both physical activity and doctor visits. The impact of unemployment on maternal health was the focus of a study by Currie et al. (2014) which investigates physical and mental health outcomes, as well as health behaviours in women with children. The findings show that increases in the unemployment rate decrease self-reported health status and increase smoking and drug use.

[2] Studies examining business cycles and mortality/ health behaviours (Ruhm, 1995; Freeman, 1999; Ruhm, 2000; Ruhm, 2005; Xu and Kaestner, 2010; Ruhm, 2015)

Regarding the consequences of the latest recession on people's health in the UK, Bell and Blanchflower (2010b, p.R4) emphasise that individuals who lose their jobs not only face financial difficulties, but also have low levels of happiness, and are at risk of suffering from depression, while unemployment "creates permanent scars" for young people. In a UK study on the labour market and health, Clark (2011) finds that workers' wellbeing is pro-cyclical, improving in boom times, whereas satisfaction with the work itself and overall job satisfaction are both counter-cyclical, increasing during economic downturns. The association between economic fluctuations and health behaviours is an interesting avenue of research. However, it is a parameter beyond the scope of the present thesis. The overarching objective of the thesis is to evaluate the interconnections between women's employment outcomes and mental health in the postpartum period and the implications for the mother, the child and society.

Labour market and female employment

In the UK, structural and institutional changes in the 1980s greatly facilitated female labour market participation. There was a decline in the manufacturing and agricultural sectors and an expansion in the services sector (Green, 2005; Jenkins, 2013). Additionally, Margaret Thatcher's industrial reforms led to a decline in trade union activity and power. These changes, it is argued, led to a labour market with more flexibility, allowing for part-time and temporary work but also led progressively to the removal of job and wages protection (Wallace, 2003). The shift away from manufacturing and agriculture led to a decline in the employment rate for men between 1971 and 1991, whereas women's employment rate increased, with the presence of young mothers in the workforce experiencing a particularly dramatic rise (ONS, 2013).

However, despite 40 years of increasing female participation in the labour market, widespread evidence indicates that women continue to be under-represented in managerial roles and positions of authority relative to men (Smith 2002). A characteristic example is the low proportion of women on boards of FTSE-100 companies which stands at 26.1%, according to the first review of Lord Davies report entitled *Women on Boards, 2011,* and also the percentage of women in senior management roles which is around 35% (Jenkins, 2013 citing Eurostat figures Oct.-Dec. 2012; Azmat, 2015 citing LFS 2014: quarter 2).[3] The percentage of women employed in lower-middle skilled roles was 46%, according to 2013 estimates, compared to 24% of men (Jenkins, 2013). The above evidence indicates that women on average are employed in less prestigious jobs than men and are mostly concentrated in low-paying and part-time positions.

Human capital theory

Despite various possible theoretical explanations there is no agreement as to the real causes of the difference in pay between the sexes. Two common arguments used to explain this difference in pay are related to human capital and socialisation theories. The development of human capital theory (Becker 1962; Mincer 1962; Shultz 1963 cited in Hoffman and Averett, 2010) contributed towards understanding earnings and skill development, since education and work experience (both general and firm-specific human capital) are among the most important factors used by economists to explain differences in wages between individuals (Hoffman and Averett, 2010). According to Becker's theory, individual incomes can vary depending on the amount of education invested in human capital. In western countries, general human capital is mostly provided through formal education whereas specific human capital is developed on the job through training and experience which is largely provided by employers.

[3] Women on Boards, 2011, first review. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/482059/BIS-15-585-women-on-boards-davies-review-5-year-summary-october-2015.pdf

Due to constant changes in technology, employees need to keep upgrading their capital stock and skills in order to be competitive (Jacobsen, 2007). Thus, loss of specific human capital as a result of unemployment, long spells away from the market, or a change in occupation, might impact negatively on an employee's future wage prospects. Among women, motherhood and family responsibilities often lead to lower human capital accumulation (or more rapid skills depreciation) – a factor influencing not only their future career progression but also widening the gender pay gap. Long breaks away from the labour market diminish future prospects and earnings, as experienced by many women who take time off to raise their children (Fawcett Society, 2012). According to research evidence (Smith, 2002; Scott, 2008; Clisby and Holdsworth, 2014) motherhood and family responsibilities have a negative influence on women's employment trajectories. As pointed out by McRae (2008, p.185) "childbirth is the biggest single cause of vertical downward occupational mobility for women".

Socialisation theory

Socialisation theory on the other hand, argues that different preferences, interests, and aspirations in men and women created by a process of cultural transmission lead them to choose different courses of study and different career paths (England, 2005). Statistical discrimination reinforces traditional perceptions of women's abilities and productivity. It is also argued that employers tend to treat male and female applicants differently, whether consciously or unconsciously, contributing into maintaining occupational segregation (England, 2005). It is also argued that the segregation of jobs and women's childbearing responsibilities are two factors linked to the pay gap because predominantly female jobs pay less, on average, than predominantly male jobs (England, 2005; Azmat, 2015).

Employment post-childbirth

The arrival of a child often has long-term implications for women's employment and economic outcomes. Women often change from full-time work to part-time employment after childbirth, which can lead to a loss in human capital since time away from the labour market affects skill development and the accumulation of experience (see review of studies by Crosby and Hawkes, 2008). Therefore, employment continuity following childbirth is considered beneficial for women's future career progression, and subsequent earnings (McRae, 2008). Fagan and Norman (2012) also stress the need for employment continuity, pointing out that non-employment reduces the likelihood of subsequent integration. The tendency among British women with dependent children is to combine paid employment with time away from the labour market. In this way women can maintain a presence in the labour market while taking care of their families (McRae, 2008).

Technological advances have brought about huge changes in women's lives and careers. With reliable contraception available, women can now take control of their fertility by delaying motherhood – choosing the age at which they wish to have children. The mean age of first time mothers, according to 2010 estimates, was 29.5 years (Clisby and Holdsworth, 2014 citing ONS and OECD 2011 figures). Economic growth during the 1970s and 1980s led to an increased demand for women's labour in western industrial nations. As reported, this increase coincided with a change in social attitudes towards women and their role as regards paid work, marriage and family life. The shift in social attitudes was reflected in the women's movement, legislation, and the numerous policies adopted to promote equal opportunities and equal treatment in the labour market. Referring to the changes in family life, Scott (2008) underlines the significant increase in cohabitation, the tendency to marry late and have fewer children. Studies have consistently found that despite the increased presence of married women in the labour force, men's and women's roles in the family have not changed much over the last four decades. In Britain, as McRae (2008) observes, most of

the housework and childcare responsibilities are still undertaken by mothers, even when they are working full-time.

Apart from inequalities in skills and human capital which are strongly linked to inequalities in earnings and to social disadvantage, inequalities in health are another important determinant of economic growth and wellbeing. The health problems and difficulties faced by a significant percentage of mothers as a result of postpartum depression – an illness impacting on women's capacity to function adequately in their dual role as primary carers to their infants and market participants – constitute both a disadvantage and an inequality. Postpartum depression is an illness affecting women at a time of high sensitivity and vulnerability. According to Glavin et al. (2009, p.705), "pregnancy and birth are especially vulnerable periods in a woman's life".

Postpartum health

The postpartum time is a period characterised by change and transition and, as research evidence indicates, postpartum depression is often associated with ongoing maternal difficulties (Beck, 2006; O'Hara, 2009; Evertsson, 2012; Spiteri and Xuereb, 2012). For instance, Grigoriadis (2006, p.284) observes that the physical changes and "the combination of new and multiple demands in all aspects of life postpartum can be overwhelming to many women", with dire consequences for their health because some women develop psychiatric illness for the first time whereas others experience a recurrence of illness. This means that a considerable percentage of women "are struggling with depression and the demands of motherhood at the same time" (Hammen, 1997 cited in Hans, 2006, p.311).

Given that women's successful return to work after childbirth and their subsequent employment integration are of vital importance for their future career progression and wages, long breaks away from the labour market diminish future prospects (Fawcett

Society, 2012) and often lead to lower human capital accumulation and skill depreciation. However, "the transition to parenthood is a life-changing event that places new and challenging demands on those experiencing it" (Deutch et al., 1998 cited in Evertsson, 2012, p.139). Drawing on the transitional theory and *The Rites of Passage* by van Gennep, a Maltese context-study by Spiteri and Xuereb (2012), describes returning to paid employment after motherhood as a period of increased vulnerability characterised by a three-stage process starting from childbirth until the mother's transition back into the workforce. For a significant number of mothers who are battling postpartum depression, the transition back to paid employment after childbirth is an issue with significant implications for the individual and society.

The gender difference in depression and the female propensity for depressive disorders are issues which have been widely explored and debated in the literature. As Kessler (2006, p.31) points out, depression "is a problem of enormous importance among women", while Garber (2006, p.105) observes that "being female is associated with an increased risk for depression". Research evidence also indicates that women, relative to men, are at greater risk of developing depressive disorders during their childbearing years (Burke, 2003). Other studies emphasise the economic cost and heavy burden for both the individual and society (Sobocki et al., 2006; Mental Health Taskforce, 2016). In fact, the annual cost of mental health problems to the economy was recently estimated at £105 billion (Mental Health Taskforce, 2016, p.4).

Postpartum disorder categories

Despite the debate on whether or not postpartum psychiatric disorders constitute distinct entities, most researchers categorize the mood disturbances of this period into postpartum blues, postpartum (non-psychotic) depression (PPD), and postpartum psychosis. Miller (2002, p.762), for example, characterises postpartum blues as "a transient state of

heightened emotional reactivity", that occurs 3 to 5 days after delivery; postpartum non-psychotic depression "as a major depression that occurs within 6 months of delivery"; whereas postpartum psychotic depression is described as a disorder "manifested by delusions, hallucinations, or both occurring within 3 weeks of birth, whether for the first time or as part of a recurrent illness" (Miller 2002, p.763).

This categorization is not reflected in the nosology of the Diagnostic and Statistical Manual of Mental Disorders (2013), 5th edition, (DSM V), although a reference to "peripartum onset" is included under specifiers for depressive disorders. It can be inferred that the non-categorisation of postpartum disorders as distinct entities might be partly attributed to the absence of policies and strategies specifically designed to help postpartum depressed mothers overcome their illness and return to active employment and to their mothering responsibilities in the first or second year following childbirth. As discussed earlier, postpartum depression constitutes a common complication of childbirth affecting around 15% of women with serious consequences for their mental health and employment outcomes, but is also associated with outcomes for children and negative consequences for their socio-emotional and cognitive development.

Although it is regarded as a treatable disorder, depression often goes undiagnosed because, according to Garber (2006, p.105), it has a "complex, multifactorial causal structure", and this means that no single risk factor will explain its development. For postpartum depression, Robertson et al. (2003) for example, identify 5 strong to moderate predictors: prenatal depression; prenatal anxiety; life stress; lack of social support (actual or perceived); and history of previous depression. Thus the early detection and identification of depression (vital for the health of the mother and her offspring's wellbeing) presents a significant challenge.

Impacts on mother and offspring

Most research findings indicate that postpartum depression is an issue critical to the health of women and their infants, as depressive episodes can become chronic or recurrent and lead to significant impairments in the ability of the mother to handle daily responsibilities (Beck, 2006; O'Hara, 2009). It has also been demonstrated that impaired maternal mental health as a consequence of postpartum depression may affect the quality of parenting with long lasting deleterious effects on the child's development, including poor cognitive outcomes (Hay et al., 2001) and increased behavioural disturbances (Kiernan and Mensah, 2009). Some studies have explored the impact of maternal depression at any point in time on child outcomes and at different stages of development (Garber, 2006; Goodman et al., 2011), whereas other studies focused on postpartum depression and its effects on children's developmental outcomes in terms of cognitive and behavioural development (Cogill et al., 1986; Sharp et al., 1995; Grace et al., 2003). As demonstrated by a large number of studies, the consequences of postpartum depression pose unique challenges for the mother, the child, and society. Grigoriadis (2006) argues that maternal psychiatric illness affects mother-infant bonding and early interaction by impacting on the mother-infant dyad, thus directly affecting the infant's immediate wellbeing and longer-term growth and development. The importance of bonding between mother and infant for the child's future development has been the focus of much research reflecting attachment theory perceptions. As Campbell and Cohen (1997) note, Bowlby's (1969) theory posits that early mother-infant interaction, especially maternal sensitivity and responsiveness during the first 12-month period, is of great significance for the child's future mental health because of the consolidation of the attachment relationship between the dyad.

Other studies place emphasis on the timing and chronicity of depression. In a critical review of literature, Grace et al. (2003) found that chronic or recurrent maternal depression, rather than postpartum period depression per se, might be associated with later effects on the child,

whereas the adverse effects of PPD on child development seem to be mediated through maternal behaviour and the sex of the infant. As pointed out by Kessler et al. (2001), unlike other categories of illness, mood disorders often begin in childhood or adolescence and thus may have a stronger impact on social development and adversely affect educational attainment. On the same line, Hay et al. (2001) find that adverse experiences in infancy predict cognitive ability and academic performance 10 years later, with boys more affected than girls (lower IQ scores, attentional problems, difficulties in mathematical reasoning, and special educational needs).

Another parameter with serious implications concerns the bidirectional influences between maternal depression and offspring disorder. Reviewing prior evidence, Birmaher et al. (1996) and Halligan et al. (2007) point out that depressed children may generate conflicts that will contribute to the maintenance of their parents' and their own depression. Mensah and Kiernan (2010) explain that these processes may become cyclical, because parental mental health can influence children's development, and children's difficulties and conduct can be a source of distress to parents.

Mental health, according to the World Health Organization (2011, p.1) constitutes "an indivisible part of public health" and should be viewed "as a resource supporting overall wellbeing and productivity". It is well documented that, compared to other categories of illness, mental health disorders have a greater impact on people's ability to work and function at full capacity (Mental Health and Work, 2008). The research conducted in the present thesis highlights the importance of maternal mental health as a determinant of maternal employment outcomes, as well as the crucial role of maternal mental health in the health and development of future generations (Alstveit et al., 2015).

As the analysis of the results in Chapter 3 of this thesis reveal, childbearing can put women at risk of suffering from depression in the postpartum period with potential long-term

consequences for the mother's ability to succeed in her dual capacity as primary caregiver and market participant. For the working mother, apart from the increased responsibilities of motherhood, childbearing might lead to employment interruption, reduction of prospects for career advancement, and even unemployment, because depression linked to childbirth can recur or develop into severe episodes of depression following future pregnancies or life difficulties, as indicated by a growing body of research evidence (Burke, 2003; Garber, 2006; O'Hara, 2009). Thus inequalities in pay and employment are often associated with the family factor or the role of women in child-bearing and child-rearing. Motherhood is associated with significant economic penalties for women with negative impacts on earnings and career trajectories and is considered a critical factor in accounting for the gender wage gap (McRae, 2008; Clisby and Holdsworth, 2014). Chichilnisky (2008) argues that the coupling of the family and the market lead to a disproportionate amount of household responsibilities falling upon women and, at the same time, to lower earnings in the labour market, and thus the interaction between the two distinct institutions may provide an explanation for the unequal position of women and the difficulty in overcoming the gender gap.

As demonstrated by the findings in Chapter 4 of the thesis, exposure to maternal postpartum depression can affect children's socio-emotional outcomes 11 years after the birth. As discussed earlier, age 11 represents a critical stage of transition from childhood to adolescence, with potential consequences for educational attainment and employment prospects. The difference in impacts observed in Chapter 4 of the thesis between the emotional and cognitive outcomes for 11-year-old children, can be interpreted as an indication of the complex interactions and multiple ways through which postpartum depression can impact on children's outcomes at different stages of the life cycle. The findings are in line with prior research and are of significance as regards intervention policies, indicating that key stages in children's lives are presenting different and specific problems and this must be borne in mind by policy makers.

Legislation and Policies

International bodies such as the International Labour Office (ILO) and the European Union (EU), as well as national governments, recognise women's dual role as mothers and labour market participants, and have introduced numerous policies and regulations and adopted equality and antidiscrimination legislation to facilitate women's employment opportunities, and their uninterrupted participation in the labour market. The right to equal pay between men and women is a fundamental right enshrined in the Treaty of Rome (1957) while the promotion of gender equality remains a strategic priority for the EU (European Commission, 2016).

In the United Kingdom, the Equal Pay and the Sex Discrimination Acts were introduced back in the 1970s, before the country's entry into the European Economic Community, followed by the Human Rights Act (1998) and the Equality Act in 2010. Equal pay between men and women was promoted by the Equal Pay Act (1970) which prohibited any unfavourable treatment in terms of pay, the Sex Discrimination Act (1975) which promoted equality between men and women, while the Employment Protection Act (1975) introduced statutory maternity provision and made it illegal to dismiss a woman due to pregnancy (Jenkins, 2013). The National Minimum Wage law (1999) contributed to the reduction of the gender wage gap by facilitating women's employment and the employment of other vulnerable groups within the population (Azmat, 2015). Another important step was the introduction of the Part-Time Workers Regulations in 2000 which aimed at strengthening the employment rights of women, in particular, who constitute the majority of workers in part-time employment (Azmat, 2015). Other pieces of legislation that might have influenced women's employment rate, according to Jenkins (2013), are changes in Lone Parent Income Support and the Increase in State Pension Age for women, introduced in 2008 and in 2010 respectively. Furthermore, the Equality Act (2010) calls for the reduction of socio-economic

inequalities and increase of equality of opportunity. It requests companies with more than 250 employees to publish information on gender pay differences.

Additionally, the state facilitates women's participation in the labour market through policies or regulations which take the form of maternity and childcare benefits, extended maternity leave, and the right to request flexible working. In the 1990s the Labour government initiated a set of work-family reconciliation measures and improved childcare services in an attempt to increase maternal employment. Maternity leave was extended to 52 weeks, whereas paid paternity leave, unpaid parental leave and the right for an employee to request reduced or flexible hours to accommodate childcare and other responsibilities were also introduced (Fagan and Norman, 2012).

The right to request flexible working was extended to all employees in 2013. According to the government, this measure is aimed at enriching the labour market through more diverse working patterns.[4] The introduction of paid paternity leave and unpaid parental leave is designed to encourage men to share some of the child-rearing responsibilities often borne by the mother and, at the same time, facilitate the transition of the mother into paid work by reducing her caring responsibilities (Finch, 2008). Since 2011, fathers have been entitled to up to 26 weeks of additional paid paternity leave if the mother returns to work, but the reported low rate of men taking up paternity leave has raised concerns about the success of this policy (Azmat, 2015). According to the European Commission (2016), women are predominantly the ones who make use of available measures, while men show the opposite tendency.

It is widely reported that childcare provision is a factor that plays a major role in the decision of women to continue in full-time employment and is also associated with gender wage differentials. Gregory (2009, p.304) characterised the subsidization of good quality

[4] Available at: https://www.gov.uk/government/news/shared-parental-leave

childcare as "a strong incentive to both women's employment and fertility". In the UK, childcare costs are still largely borne by the parents because the childcare provision sector is only partially state-funded (Finch, 2008). The aim of government policy is to increase care provision by making childcare more accessible and affordable through childcare Tax Credits. For example, the Working Tax Credit introduced in 2003 is designed to help working parents meet the cost of registered and approved childcare (Finch, 2008) and the Working Families Tax Credit is regarded as having facilitated employment, particularly for single mothers (Azmat, 2014 cited in Azmat 2015).

Mental health care

The rights of people with mental disorders are set out in the Mental Health Act 1983 (in England and Wales) regarding assessment and treatment in hospital, treatment in the community, and pathways into hospital, which can be civil or criminal. The Equality Act 2010, the Mental Capacity Act 2005, and the Human Rights Act 1998 are considered as key pieces of legislation containing articles relevant to the rights of people with mental health problems or aimed at protecting them from discrimination. In the case of children's mental health, guidance on managing depression is given by the National Institute for Health and Care Excellence (NICE) document *Depression in children and young people* (NICE 2005). The Children Act, 1989, the Mental Health Act, 2007, and the Mental Capacity Act, 2005, are considered relevant pieces of legislation, although with the exception of the first Act, the other two do not contain specific provisions relating to children (only reference to the age of patients under 18 and under 16). To enable better co-ordination all services that work with children and young people who face difficulties with their emotional or behavioural wellbeing, come under CAMHS (Child and Adolescent Mental Health Services) and Specialist CAMHS. In 2015 the National Health Service (NHS) England and the Department of Health published a report called *Future in Mind* offering advice and guidance on how children and young people can access high quality mental health care (Mental

Health Taskforce, 2016). As regards peripartum care, in 2007 NICE published a set of guidelines for the clinical management of antepartum and postpartum mental health for women.[5] These guidelines (updated in 2014) established a clinical pathway for health professionals aimed at detection and prevention of the condition (see Chapter 3 for details).

Primary care services take the lead role in detecting and treating mental health problems. However, there are concerns regarding the low rates of detection and treatment. For instance, the Mental Health and Work (2008) report revealed that only about half of the cases of people with mental disorders who turned to their GPs are detected and that detection rates are even lower for people presenting a mixture of physical illness and mental health problems. Similar concerns over the ineffectiveness of NHS services are also expressed in the Mental Health Taskforce (2016) report.

According to perinatal mental healthcare recommendations (Annex B of Mental Health Taskforce 2016), comprehensive and high quality NHS services are to be set up across England so that at least 30,000 more women each year can access specialist mental health care during the perinatal period. Upgrading perinatal mental healthcare is essential given that 1 in 5 mothers suffers from depression, anxiety or even psychosis during pregnancy or in the first year postpartum (Mental Health Taskforce, 2016). However, there is no specific long-term government scheme or provision targeted at mothers affected by postpartum depression and their children, such as helping the mother overcome the problems and consequences resulting from her illness with the aim of enabling her to resume her dual responsibilities (motherhood and the market place) and providing specialised care to the children of postpartum depressed mothers at every critical stage of childhood. It is well-documented in the literature, (Beck 2006; Halligan et al., 2007; Goodman and Brand 2009; O'Hara, 2009) that maternal depression in the postpartum period is associated with ongoing

[5] NICE guidelines 2007 (CG45) were updated and replaced by CG192 in 2014. Available at: https:// www.nice.org.uk/guidance/cg192

maternal difficulties and the development of child disorders. Children born to postpartum-affected mothers are considered more at risk of developing socio-emotional problems and are likely to start their lives at a disadvantage compared to children born to non-affected mothers (findings in Chapter 4 of this thesis). These children must be given equal opportunities and provided with the tools to succeed in life in accordance with the Equality Act 2010 and the United Nations Convention on the Rights of the Child (UNCRC). As Finch (2008) points out, the UK ratified the UNCRC in 1992 and articles 27 and 4 of this legislation guarantee an adequate standard of living and a child's economic rights, respectively.

The responsibility lies with the state, or rather with society more widely, to intervene and rectify "the brute luck results" (Dworkin, 1981 cited in Roemer, 2009, p.29). Early detection followed by effective treatment of maternal depression is likely to reduce disruptions to parenting and caregiving, thus enabling both mother and child to reap the benefits (Beck, 1998). One parameter that must be taken into account is the child's age since each key developmental stage (infancy, toddlerhood, and childhood) requires an appropriate, targeted, approach. In this thesis, age 11 represents a significant stage in children's development as it marks the end of childhood and the beginning of puberty and adolescence which is associated with the gender difference in depression and with greater difficulties for girls (Hankin et al., 2007).

Given the increased female presence in the labour market, women's successful transition into employment is of vital importance. Studies underpin the importance of health as a determinant of employment outcomes and the consequences of impaired mental health on the capacity to work. Because of the early age of onset, mental disorders in childhood are reported to have a strong impact on educational attainment (Kessler et al., 2001) and consequently might compromise children's future prospects. Recent estimates (Mental Health Taskforce, 2016) reveal that 1 in 10 children aged 5-16 have a diagnosable mental

health problem and 1 in 5 mothers suffer from perinatal mental disorders. These reported estimates highlight how widespread mental health problems are and the importance of promoting good mental health and prevention at crucial stages of development.

The results of the three empirical chapters of the thesis in combination with the findings and observations from prior studies reviewed in this section, point to the need for an innovative and comprehensive approach to the distinct problems faced by different groups and sub-categories within the population. The absence of policies and strategies specifically designed to help postpartum depressed mothers overcome their illness and return to active employment and to their mothering responsibilities, as well as the absence of a specialised NHS service to coordinate between all health professionals, nurses, GPs, paediatricians and specialists involved in the care and treatment of the depressed mother and her child, can be interpreted as a significant liability.

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Chapter 2 Did the recession affect the gender wage gap? Evidence from the UK.

Introduction

Wage inequality between men and women is a complex issue and always on the agenda of policy makers. In times of recession wage inequality assumes greater significance since periods of overall decline in economic activity result in unemployment and under-employment and if these are unequally distributed across the population then the consequences are income disparities and widening inequality in society. Sharp falls in employment are also likely to affect the gender wage gap which is a widely used indicator of progress towards gender equality in the labour market (New JNCHES, 2011). Issues of gender inequality in the labour market are addressed by a vast body of research, focusing mainly on how inequality emerges in terms of wage differentials, social roles, poverty, and social change.[1]

The spectacular rise in female employment in the second half of the 20th century led to major social and economic changes, particularly as regards gender relations in the labour market.[2] Research evidence show that women's experiences at work have distinct characteristics reflected in long career breaks following childbirth and extensive part-time employment with large penalties in terms of pay (Connelly and Gregory, 2009). The persistence of the pay gap indicates that women's position in the labour market is still vulnerable relative to men and that gender differentials in the labour market remain, as Altonji and Blank (1999, p. 3144) observe, "stubbornly persistent".

[1] See for example, Korpi and Palme (1998), Beutel and Axinn (2002), Blau and Kahn (2003), Newman and Oaxaca (2004), Del Bono and Vuri (2006), Gangl and Ziefle (2009), and Christophides and Vrachimis (2011).
[2] See labour market and female employment section, Chapter 1

The 2008/9 downturn and its effects on the UK labour market has been the focus of a number of studies (Bell and Blanchflower, 2009; Chamberlin, 2010; Gregg and Wadsworth, 2010; Jenkins, 2010; Harkness and Evans, 2011; Taylor, 2011; Rubery and Rafferty, 2013). Findings indicate that there were variations across the population, industrial sectors and regions of the UK regarding the impact of the recent recession (Jenkins, 2010) and marked differences were observed in employment and unemployment rates between male and female workers (Bell and Blanchflower, 2010a).[3] Large declines in employment in the manufacturing and construction sectors and falling output in business and financial services were a particular feature of the 2008/9 recession (Chamberlin, 2010). It was estimated that the total number of jobs lost was 856,000, with the biggest fall in manufacturing, whereas 338,000 jobs were lost in the services industries, a female-dominated sector (Jenkins, 2010). As pointed out by Rubery and Rafferty (2013, p.415), the gendered impact of a recession will not be the same across time and space, since "variable outcomes can be expected, reflecting both the characteristics of the particular recession but also the variable but evolving pattern of gender differences".

The focus in this chapter is on gender equality and economic disparities faced by women at work in the first decade of the 21st century, examined through the effect of the 2008/9 recession on the UK gender wage gap. The impact of the economic crisis on the gender wage gap presents wider implications for policy makers as it touches on broader issues related to women's unequal position in the formal labour market and the effectiveness of the UK legal framework and relevant policies. Our analysis covers the time-period from 2002 to 2010, which is divided into a period of stability and economic growth (2002-2007), followed by an economic downturn (2008-2009), and stagnation (2010 onwards). As well as analysing trends among the working population as a whole, we also consider the wage gap between men and women aged under 30 – a subgroup concentrated at the lower end of the

[3] The recession also affected subgroups in the population to different degrees. For example, it is estimated that 74% of the decline in employment was among the young - 44% of the decline was among young men and 30% among young women (Bell and Blanchflower 2010b).

wage distribution – whose labour market outcomes are more sensitive to the prevailing economic climate (Lambert, 2010). To allow for the predominance of women in part-time work, separate analyses for full-time and part-time employees are also presented.

As underlined in earlier studies, the recent economic downturn is the worst recession the UK has experienced since World War II, the deepest for several decades, and the most substantial shock to UK output since the Great Depression (Bell and Blanchflower, 2010b; Gregg and Wadsworth, 2010; Jenkins, 2010). However, the impact of this recession on the gender wage gap in the UK has not been explored in an extensive and systematic way. Most previous studies have focused on gender-specific trends in employment and unemployment.[4] Our aim is to help fill this gap, and contribute to the policy discussion of gender equality at work and what parameters are affecting it. Within this context we explore trends in female labour force participation, and the main factors identified by previous research as contributing to the gender pay gap, specifically the response of the labour market to this prolonged downturn – the first of the 21st century.

The empirical results of this study indicate that the overall impact of the recession on the gender wage gap in the working age sample is small. However, further analysis indicates variations regarding the impacts of the recession on the gender wage gap among subgroups of the population; for example, we find that the recession had an impact on the gender wage gap for A-Level holders and for those with other qualifications. Additionally, the recession also had an impact on the gender wage gap in the banking sector. In the case of young workers under 30 years of age, the recession had no impact on the gender wage gap, although the recession had a weak effect on the gender wage gap for full-time young

[4] Some studies which, in addition to employment, have also examined wages and earnings are: Swaffield, (2011) examines gender issues in the labour market using ASHE and LFS data; Harkness (2013) explores women's employment and earnings using LFS, NOMIS, and HBAI data; and Azmat (2015) explores the unadjusted gaps regarding employment, hours worked and wages using LFS data.

workers. In all other subgroups (working age sample/young workers sample) we find no impact of the recession on the gender wage gap.

A broad evaluation of the empirical results of our analysis, and drawing on prior research evidence, we can interpret the weak impact of the recession on the wage gap as an indication of the growing importance of women's role in the economy and women's stronger attachment to the labour market, as well as to the resilience of the labour market, mostly due to its flexibility. It appears that equal pay and anti-discrimination legislation that has been in place since the 1970s and the range of positive measures introduced in the decade leading up to the recession that aimed to promote female integration in the workforce, have played a positive role. We expect that our findings will contribute to the policy discussion of gender equality at work and the parameters affecting it, taking into account the roles of the sexes in the labour market, the differential impacts of the recession on full-time employment and part-time employment and the pattern of sex segregation widely discussed in prior research.

Literature Review

In this section we present a brief background to the UK gender wage gap in conjunction with developments in employment (reforms and policy changes) which are generally considered to have impacted on female labour market outcomes over recent decades, before exploring earlier evidence on the impact of the 2008/9 recession.

The gender wage gap in the UK

Research findings reveal that, despite increasing gender equality in terms of employment in the UK, women still earn significantly less than men in the labour market. However, the gender wage gap has narrowed considerably in recent decades (Olsen et al. 2010; Perfect, 2011; Azmat, 2015) at least partly due to the adoption and implementation of the Equal Pay

and Sex Discrimination Acts in the 1970s (Blau and Kahn, 1999; Mumford and Smith, 2007).[5] The impact of these two laws, as Swaffield (2011) stressed, was fundamental in significantly reducing the gender wage gap in the British labour market. However, 40 years after the implementation of the first equal pay legislation and a set of additional laws and policies that followed, the pay gap remains a key aspect of the inequalities women face in the labour market (O'Reilly et al., 2015). For example, findings by Perfect (2011) show that the difference in pay between men and women working full-time fell from 36.2% in 1970 to 28.2% in 1980, and continued to fall to 20.2% in 2000 and 15.5% in 2010 whereas the part-time women's pay gap in 2010 was 34.5% from 48.5% in 1970. Looking at the narrowing trends of the two gaps in the period 1970 to 2010 the fall in the full-time gender pay gap relative to the part-time gap was higher to around 20 percentage points compared to around 14 percentage points (Perfect, 2011). The size of the full-time gender pay gap often varies considerably across occupational groups. For example, among the nine major occupational groups, the gap was widest in both mean and median hourly earnings for managers and senior officials and for skilled trades (24% for mean earnings and 20 to 26% for median earnings).[6] The narrowest gaps were for sales and customer service and professional occupations. Dias et al. (2016) plotting the gender wage gap for two decades (1993-2013) for the three different education groups, find that the wage gap among the lowest-educated individuals has being falling steadily, whereas the gap for A-Level holders and degree holders is approximately the same as two decades ago. This indicates that the fall in the overall gender wage gap over the past 20 years has been driven by the lowest-educated individuals, and by an increase in the number of women who are highly educated. The gender wage gap is now highest among the mid-educated group – those with A-Levels (Dias et al., 2016).

[5] The Equal Pay Act was passed in 1970 and the Sex Discrimination Act in 1975.
[6] Nine occupational groups: Managers and senior officials; professional occupation; associate professional and technical; skilled trades; personal service; sales and customer service; process, plant and machine operatives, elementary.

Although wage inequality between men and women is always on the agenda of policy makers and in the focus of considerable research interest, there is no consensus as regards the real causes of the difference in pay between the sexes. As discussed in Chapter 1 (human capital theory section), human capital theory and socialisation theory are often used to explain this difference in pay. The former maintains that individual incomes can vary according to the amount of general education and accumulation of specific job experience an individual has, while the latter supports that different preferences, interests, and aspirations in men and women lead them to choose different courses of study and different career paths (England, 2005). It is also argued that women earn less as a result of discrimination. Statistical discrimination, for example, reinforces traditional perceptions about women's abilities and productivity, while employers' tendency to treat male and female applicants differently, whether consciously or unconsciously, contributes to maintaining occupational segregation (England, 2005; Hoffman and Averett, 2010). For some researchers gender inequalities in the labour market might be related to differences in productivity or preferences between men and women. It is also argued that employer behaviours and organizational policies are more important than women's attitudes and behaviours in explaining the gender gap in authority in the workplace (Smith, 2002). Regarding gender discrimination, a significant proportion of the gender wage gap cannot be explained by reference to observable variables such as level of education, job experience, age, or skills included in many econometric decomposition methods (Olsen et al., 2010). The portion of the gap that is unexplained is often referred to as evidence of labour market discrimination (New JNCHES, 2010). Regarding the persistence of the unexplained gender wage gap, Blau and Kahn (2016, p.50) support that its persistence suggests (though it does not prove) "that labor market discrimination continues to contribute to the gender wage gap".

Female employment

Research on economic inequality indicates that women have not achieved parity with men in the labour market despite the significant strides achieved in the last 40 years as regards female employment rates. As widely reported female labour participation in the UK has been facilitated by a number of structural changes and industrial reforms that took place in the 1980s particularly by the expansion of the services sector and the decline in the manufacturing and agriculture sectors. The shrinking of the manufacturing and agriculture sectors between 1971-1991 had a negative influence on male employment rates which fell from 92% in 1971 to 76% in 2013 compared to female employment rates which increased from 53% to 67% during the same period (Jenkins, 2013). The expansion of the service sector has been associated with the creation of jobs particularly suited to women's skills and preferences (Olivetti and Petrongolo, 2016). Additionally, the Thatcher industrial reforms led to a decline in trade union activity and power. It is argued that these reforms led to a labour market with more flexibility allowing for part-time and temporary work (see Chapter 1).

The spectacular rise in female employment was accompanied by major social and economic changes particularly as regards gender relationships in the labour market. Most importantly, there was a change from the male breadwinner system to a dual-earner family system and single-parent household. Additionally, there was a change in social attitudes towards women and their role as regards paid work, marriage and family life. The main changes in family life include: increase in cohabitation, tendency to marry late and have a smaller number of children (Scott, 2008). The change from the male breadwinner system to a dual-earner family system and single-parent household led to women assuming increased responsibilities: specifically the responsibilities of motherhood and the responsibilities of labour market participant.

Despite the increased female participation rates the wage gap remains a key aspect of inequality women still face in the labour market. Research findings indicate that overall motherhood and family responsibilities have a negative influence on women's employment trajectories and economic outcomes (Scott, 2008; Olsen et al., 2010; Fawcett Society, 2012; Blau and Kahn, 2016). According to evidence women in the UK often change from full-time work to part-time employment after childbirth. The unequal division of unpaid labour in the home is another important factor that shapes women's progress in the workplace (working hours and promotion). Harkness and Waldfogel (1999) point to the family gap in pay which as they observe, is larger in the UK than in other countries because of the tendency of British mothers to work in low-paid part-time jobs. Looking at trends in the gender wage gap in the USA and also in other economically advanced countries, Blau and Khan (2016) noted that current research continues to find evidence of a motherhood penalty for women and a marriage premium for men. As Dias et al. (2016) underlined, after the birth of first child there is a gradual widening of the gender wage gap and by the time the child is 12 years old, women's hourly wages are a third below those of men. Thus women who pursue career breaks to take care of children are likely to have lower wages relative to men (Olsen et al., 2010).

Sex segregation is another influencing factor for differences in male and female earnings. Most findings show that men have consistently higher employment rates relative to women, tend to work in the professional occupations associated with higher levels of pay, and are likely to be employed in more highly skilled jobs and managerial positions, whereas women dominate employment within the caring and leisure occupations, administration and customer services (Jenkins, 2013). According to the existing literature, women on average hold less prestigious jobs than men and are mostly concentrated in low-paying and part-time positions, despite their widely acknowledged achievements in educational attainment and

work experience accumulation.[7] Furthermore, it seems that women find it harder than men to advance through the ranks or reach top management positions, perhaps due to the glass ceiling phenomenon (Dolton et al., 1996). Most research findings support the premise that the over-representation of women in certain sectors of the economy and the prevalence of part-time employment are key factors influencing the gender wage gap (see employment structure and educational attainment section).

Part-time employment

An important factor influencing the gender wage gap in the UK is part-time employment. Nearly half of all women employed in the UK are in part-time jobs. In 2008, for example, 41.8% of women were employed part-time, compared to 11.3% of men (Eurostat, 2009). Part-time employment is commonly associated with occupational downgrading and underutilisation of human capital, particularly when an individual moves from full-time to part-time employment. Often part-time jobs are lower paid than full-time jobs and are disproportionately concentrated in low-skilled, low-wage sectors with a strong female presence. However, the flexibility which it offers in terms of working hours has facilitated part-time employment amongst women by allowing them to combine work with home and family responsibilities (Connelly and Gregory, 2008). As Rubery and Rafferty (2014) point out, after childbirth mothers are likely to move into part-time work because of the low childcare support, the long working hours expected from full-time employees, and the increasingly deregulated UK labour market.[8] In 2009, for instance, almost two thirds of women with children aged 2-4 worked part-time, compared with about a quarter of women with no dependent children and 7% of (all) men (Azmat, 2015). Research indicates that part-time jobs tend to have lower skill profiles than full-time jobs and are less likely to be permanent or unionised (Olsen et al., 2010).

[7] According to a Higher Education Policy Institute report (2009) female students' participation rate stood at 49% compared with 38% for male students (www.hepi.ac.uk). ONS (2013) estimates show that the percentage of female graduates in work in 2013 was 44%, compared to 38% of men holding a degree or higher education qualification.

[8] Margaret Thatcher's industrial reforms let to a decline in trade union activity and power (Wallace, 2003).

Recent legislation and measures

The growing differences between part-time and full-time workers have led the UK government to introduce a number of policies to improve the status of those working part-time. Two such policies are the National Minimum Wage introduced in 1999, and the Prevention of Less Favourable Treatment Rules in 2000. These were introduced by the Labour government mainly in response to EU Directives on working time and aimed at providing security and protection to part-time workers against the de-regulatory policies of the 1980s and early 1990s (Wallace, 2003). Although Dickens and Manning (2004) find that the effect of the National Minimum Wage on overall wage inequality is small, Machin (2011) claims that the National Minimum Wage plays a role in bringing up the lower part of the wage distribution, while Swaffield (2011) and Azmat (2015) find that this law has had a positive impact on women's outcomes in the labour market. The latter also sees a contribution to the reduction of the gender gap in earnings. The Prevention of Less Favourable Treatment Rules (mandating the same hourly rates of pay and the same entitlements to pensions, leave, sick pay, and training as full-time workers) are believed to have contributed to raising the status of part-time work and strengthening the employment rights of part-time workers, the majority of whom are female (Swaffield, 2011).

Other pieces of legislation that influenced female employment during the decade leading up to the recent economic crisis include the Working Families Tax Credits Scheme (1999), the right to request flexible working (2003), the lone parent income support changes (2008), and the changes to the state pension age for women (2010). [9] Furthermore, a number of measures within the government's broader anti-poverty strategy aimed at making childcare more accessible and more affordable are also considered to have benefitted maternal employment – in particular the national childcare strategy launched in 1998 primarily targeting children from poor families (Finch, 2008). Brewer et al. (2014) estimate that 12,000 more mothers joined the workforce in England as a result of the extension of free

[9] For more detailed discussion on legislation and relevant policies see Chapter 1.

part-time pre-school education for three year olds. Most importantly, maternity leave was extended and the government introduced paid paternity leave and unpaid parental leave (Fagan and Norman, 2012). However, as some researchers indicate, the family policies introduced to enable women to combine careers and motherhood might backfire or turn into "a long-term hindrance to women's careers" due to the loss of work experience and the higher costs to employers when hiring women of childbearing age (Olivetti and Petrongolo, 2017, p.206). Changes to the rules regarding lone parent income support (lowering the age of the child initially from 12 to 7 and then to 5), are considered by some researchers to have had large effects on the labour supply of single women with dependent children, for others these changes are seen as a stringent approach to the issue of lone parent households (Swaffield, 2011; Rubery and Rafferty, 2014; TUC, 2015).

The persistence of the gender wage gap has led some researchers to conclude that equal pay legislation in Britain has not been fully effective in reducing pay differentials between men and women (e.g. Mumford and Smith, 2009). For other researchers gender pay equality becomes more complex nowadays due to the fragmented and decentralised wage setting environment, the diminishing role of trade unions, and the newly emerging pay inequalities between and within different groups of workers (Rubery and Grimshaw, 2014; O'Reilly et al., 2015) mostly due to educational attainment and technological change (see employment structure and educational attainment section).

Recession 2008-2009

The UK economy went into recession in the second quarter of 2008 – GDP fell for six consecutive quarters, recording a total peak to trough fall of 6.4 per cent (Jenkins, 2010). [10] This was the most substantial shock to UK output since the Great Depression (Bell and Blanchflower, 2010b). However, the fall in employment and rise in unemployment were smaller than in the previous two recessions of the 1980s and 1990s. Using Labour Force

[10] Although there is no universally accepted definition of a recession, a technical definition based on two successive quarters of falling GDP has gained some broad appeal (Chamberlin 2010).

Survey data, Bell and Blanchflower (2010b) estimate that employment fell by 580,000 between the beginning of 2008 and early 2010 – not a large decline compared to the fall of 1.6 million in the 1980s recession and of 1.7 million in the 1990s recession. The decline in employment was more concentrated among men. Male employment fell by 3%, while female employment fell by 0.7%. Additionally, full-time employment declined from 22 million in 2008 to 21 million in 2010, while self-employment rose by 91,000 and temporary and part-time employment increased by 200,000 and 400,000 respectively. Young people suffered the most: 74% of the decline in employment occurred among those aged 16 to 24, with 44% of the decline among young men and 30% among young women (Bell and Blanchflower, 2010b). Some sub-groups in the population such as the less educated, single people, lone parents, and low skilled individuals were disproportionally affected (Muriel and Sibieta, 2009). According to Chamberlin (2010) large declines in employment in the manufacturing and construction sectors and falling output in business and financial services were a particular feature of the 2008/9 recession.

Two clear trends that have emerged from the latest recession as Coulter (2016) observed, are the significant fall in real wages in the UK and the accompanying fall in labour productivity. The falling of real wages in the UK is the focus of research by Gregg and Machin (2012) who draw attention to the relationship between unemployment and real wages, noting that the current period of stagnant real wages growth represents a distinct break of trend that predates the start of 2008 recession. According to Blanchflower and Machin (2014) in previous economic downturns median real wage growth could slow down or stall but did not fall. Another characteristic this time was the evenly spread of falling real wages across the distribution with the exception of those at the top. Analysing the behaviour of the labour market during and after the recession, Greg et al. (2014) attributed the falling of real wages to a larger downward pressure being exerted by unemployment on wages than in previous recessions, to firms' tendency to meet demand by hiring more workers rather than investing in labour saving technologies and that wages of typical

workers are no longer keeping up with productivity gains. As regards the third factor they observed that apart from supporting pensions a disproportionate share of the gains from productivity goes to the highest paid at the top at the expense of ordinary workers. One possible explanation for the fall in real wages, according to Coulter (2016) might be related to the changing structure of the labour market that have favoured lower paying sectors at the expense of higher paying sectors (e.g. the long-term shift in jobs from the relatively high paying manufacturing sector to lower paying services) is likely to have been accelerated by the recession.

Employment structure and educational attainment

Exploring the response of the labour market to the great recession it is important to place its impacts in a broader context looking at issues such as how employment has changed on the basis of skill levels and the role of educational attainment in the context of wage inequality.

Education is an important parameter. According to Machin (2011) education has become more highly valued in the labour market and that this is one of the key features of rising wage inequality.[11] There is often a link between the qualifications required to do a job and the skill level of a job, with higher skilled jobs requiring a higher level of qualification. Emphasis is also given to the role of technological change in the workplace and the changing structure of tasks (Machin, 2011; Greg and Machin, 2012; Lindley and Machin, 2013) in relation to rising inequality and shifts in relative demand for skills. According to Machin (2011) the SBTC hypothesis (Skill-Biased Technology Change) supports that new technologies lead to higher productivity. The shift in demand for highly educated and highly skilled workers raises wages at the expense of less skilled workers (Machin, 2011). It is thus argued that the changing structures of employment and qualification attainment lead to new forms of inequalities in pay. Furthermore, emerging novel forms of work may lead to

[11] Machin (2011) states that three are the key drivers of rising wage inequality- education, skill-biased technology change, and institutional change (see recent legislation and measures for the effect of National Minimum Wage).

inequalities between and within different groups of workers but also to new gender inequalities particularly among the highly qualified and highly paid (O'Reilly et al., 2015). It is estimated that in Britain the graduate share of employment doubled between 1996 and 2009, rising from 14.5% to 29%, whereas the postgraduate share during the same period jumped from 4% to 11%. However, not all categories of degrees have the same returns. It is estimated that the returns to degrees in science, engineering and technology are substantial, along with some social science subjects and professions such as law and medicine whereas degrees in arts and humanities are often associated with a relatively low return (Machin and McNally, 2007). There are also differences in the rewards for men's and women's investment in higher levels of education. In the UK male doctoral graduates, for example, receive markedly higher pay than all of the other groups of graduates whereas female doctoral graduates working outside academia are less likely to receive the same high wage rates awarded to their male equivalents (O'Reilly et al., 2015).

Looking at high skilled jobs in relation to educational attainment Jenkins (2013) finds that 38% of men and 44% of women in work were graduates who had achieved a qualification above an A-Level standard. Focusing on graduates, aged 22 and above, 53% of men and 49% of women were in high skill jobs. At the bottom of the skill scale, there were very few graduates in low skill jobs; just 4% of men and 3% of women, while in the second highest skill category of upper middle, 31% of men and 21% of women were employed whereas in the lower middle skill category 27% were women against 13% of men. Regarding the non-graduate workers, estimates by ONS (2011) show that in 2010 about two-thirds of workers educated to the GCSE or equivalent level were employed in the two lowest skill groups, and about 14 % were employed in the highest skill group whereas about 44% of workers educated at the A-Level or equivalent level were employed in the two lowest skill groups. Occupations can be grouped by skill level into four categories: high, low, lower-middle, and

upper-middle (ONS, 2011).[12] When grouping the occupations into job skill level, men are more likely to be employed in higher skilled jobs than women (Jenkins, 2013). In the lowest skill category, consisting of the elementary occupations, both sexes shared a similar percentage. The main differences between men and women were in the two middle skilled groups of upper middle and lower middle. According to Jenkins (2013) 37% of men were employed in the upper middle skilled roles compared with 18% of women and conversely 46% of women were employed in lower middle skilled roles compared with 24% of men.

According to research evidence, the 2008/9 recession has followed a long-time trend in the UK labour market with high-skilled jobs and low-skilled jobs expanding their share of employment whereas middle-skilled jobs declined (Harkness, 2013; Plunkett and Pessoa, 2013; Coulter, 2016). Findings by Coulter (2016) show that employment growth during the recession has been concentrated in high-skilled occupations, experiencing a 10% increase, whereas medium-skilled occupations experienced a slight growth (1.6 %) and low-skilled occupations a decline of 2.4%. Plunkett and Pessoa (2013) examining the impacts of the recent recession on the UK and the US labour markets, found that low and high-skilled jobs expanded their share of employment from 2008 to 2012 while middle-skilled jobs saw a relative decline. They also found that occupations responded differently to the downturn depending on the tasks involved, for example, employment in non-routine occupations rose through 2008 to 2012, while employment in routine occupations experienced a strong fall.

As Harkness (2013) observed women's underrepresentation in the middle of the job quality distribution has protected their employment rates over the course of the recession. More

[12] (1) Low: competence acquired through compulsory education and may be acquired through a short period of training. Occupations include postal workers, hotel porters, cleaners and catering assistants. (2) Lower-middle: competence acquired through compulsory education, but involves a longer period of work-related training and experience. Occupations include machine operation, driving, caring occupations, retailing, and clerical and secretarial occupations. (3) Upper-middle: competence acquired through post-compulsory education but not to degree level. Occupations include catering managers, building inspectors, nurses, police officers (sergeant and below), electricians and plumbers. (4) High: competence acquired through a degree or an equivalent period of work experience. Occupations are generally termed 'professional' or managerial positions, and include senior government officials, financial managers, scientists, engineers, medical doctors, teachers and accountants.

specifically, the occupations which suffered the biggest job losses between 2007 and 2010 were almost all male dominated and that the number of jobs lost in these occupations ranged between 18% and 30% and that women accounted for around 2% and one third of the workforce.[13] According to Harkness (2013) the only exceptions were administrative occupations in government and related sectors where women occupied 71% of the workforce and where employment declined by 38%, as well as sales occupations where women make up half the workforce and employment decrased by 18%. Looking at the unemployment growth, Muriel and Sibieta (2009) found that the recession hit harder low-skilled elementary occupations (shelf fillers and cleaners) and process, plant and machine operatives with an increase in unemployment around 5%. Skilled trades (such as plumbers and motor mechanics) also saw their unemployment rates increase by 4%, whereas for managers and senior officials unemployment increased by only 1% and for white collar professional unemployment by 0.7%. Johnson (2013) observes that compared to previous downturns, employment levels during the 2008/9 recession have remained relatively high and unemployment has grown much less than was initially expected, whereas temporary and part-time employment and self-employment rates increased.

Labour market resilience

The rise in part-time relative to full-time employment during the 2008/9 recession is interpreted by Jenkins (2010) as evidence that jobs may have been protected by a greater capacity to adjust working hours than in previous downturns. As Anderton and Mayhew (1994) observe, flexibility and control of working time is easier with part-time workers who can be used as a buffer against downturns. In recessionary times employers have the flexibility to vary hours rather than jobs. Lambert (2010) points out that in the recent recession labour costs had to be decreased either by reducing hours or wages, or by job losses. Within this context, Jenkins (2010) finds that in the recent recession total hours fell

[13] As pointed out by Harkness (2013) the largest job losses were in the following occupations: process operatives; elementary plant process operatives; assemblers and routine operatives; plant and machine operatives; elementary construction occupations and textile and garment trades.

by 4.1 per cent compared to an employment fall of 1.9 per cent, whereas in the 1980s recession, total hours decreased by 5.3 per cent and employment by 2.4 per cent, and in the 1990s the drop in hours was 5.2 per cent while employment declined by 3.4 per cent. Thus by varying hours and not jobs firms gain on productivity and training expenses whereas the workers avoid redundancy and keep their specific human capital.

Gregg and Wadsworth (2010) attribute the employment resilience to the effectiveness of labour market policies introduced since 1996. They argue that these policies succeeded in keeping individuals in the labour market while maintaining job search effectiveness. Coulter (2016) confirms this line of argument adding that the slight re-regulation of the labour market since 1997 was responsible for the UK labour market's good performance particularly the enactment of a number of policies aiming at increasing the employability of low-skilled workers and improving mechanisms for job search (see recent legislation and measures section). For their part, Harkness and Evans (2011) point to the female role in dual earning households in relation to male unemployment. Their findings indicate that the employment reforms and transfer programmes introduced since 1999 had an impact across households and particularly affected women's decisions to remain in employment if their partner lost his job, suggesting fewer jobless couple households in the 2008/09 recession, relative to previous downturns. Evaluating the impact of the latest recession in an EU study, Smith (2009) underlines that nowadays women are significantly more integrated into the labour market and their attachment is considered stronger than in previous downturns. It is also pointed out that women now account for a much greater proportion of the labour market and the growth of dual earning families reflects the rising importance of women's earnings to household income (Rubery and Rafferty, 2014).

The literature review indicates that the recent downturn has had differential effects on men and women and other subgroups of the population and hence its impact on the gender wage

gap is a matter for empirical investigation. We explore this in the remaining sections of the chapter.

Data

To identify patterns in the gender wage gap that might be attributed to the recent recession, we investigate the socio-economic determinants of wages for men and women based on microeconomic data covering the period from 2002 to 2010 using the UK Labour Force Survey (LFS).

The LFS is a comprehensive source of information on the labour market status and wages of individuals in the UK and collects data on employment, unemployment and economic inactivity as well as occupation, training, hours of work, and personal characteristics of household members aged 16 years and over. The survey is conducted by the Office of National Statistics. It was established in 1973 and, since March 1992, it has collected quarterly data with a sample size of approximately 60,000 responding households. The sample is national and is representative of all persons who live in private households in Great Britain. Detailed questions on wages are also included in each quarter. The LFS has a panel structure whereby individuals stay in the survey for 5 consecutive quarters and one fifth of the sample is replaced each quarter. From spring 1997 onwards questions on earnings are asked in waves (quarters) 1 and 5 and hence selecting individuals with wage information on an annual basis and constricting to individuals at wave 1, makes the dataset used in the analysis cross-sectional. In subsequent analysis, the LFS data have been regressed using the most recent population estimates, based on the most recent Census.

Sample selection

We use data from the LFS for the period from 2002 to 2010. Wage information for all quarters of the LFS is available from 2002 onwards and quarterly datasets for each year

were appended to construct annual datasets of approximately 30,000 employed individuals of working age each year. Individuals that fell within the extreme tails (the top and bottom 1%) of the wage distributions in each year were excluded and wages were deflated to 2010 prices using the CPI.[14] The sample consists of employed individuals (employees and those on a government scheme), covering the age range from 16 to 65. Self-employed individuals (around 8% each year) and those with missing wage data were excluded from the sample (around 25% each year). Also, in the construction of the sample, observations with missing data on any variables used in the analysis were dropped.[15] Additionally, individuals who answered 'don't know' to the question about the highest qualification obtained were excluded from the sample (around 1.2% each year). Individuals who live in Northern Ireland were excluded, as its labour market has a different structure from the rest of the UK (around 3% each year). This leaves us with 254,373 individuals in the observation period (2002-2010) for the working age sample and 57,349 individuals in the young workers' subgroup. Summary statistics are presented in Appendix I, Tables 1-2.

Initial findings of raw wage gap

We start with a brief description of the raw (unconditional) gender wage gap in the UK for the period 2002-2010 before focusing on the adjusted (conditional) gender wage gap. We discuss trends in the average wages of men and women and the raw and relative wage gap to identify any trends that occur over time.

To estimate the raw and relative wage gap between men and women we use two measures, commonly used in the literature. The first measure ΔW_t is the absolute difference in average

[14] This is in accordance with Vol.3 of the LFS (available at: http://www.esds.ac.uk/doc/6727/mrdoc/pdf/lfs_vol3_variable details2007.pdf). Exclusion of individuals with extreme wage data in each year (top/ bottom 1% of the wage distribution) using the Stata package winsor2. Available at: http://fmwww.bc.edu/repec/bocode/w/winsor2.ado.

[15] Hours of work (full-time/part-time status) are self-assessed. We have missing information for 21 out of 254,373 individuals in the observation period (2002-2010) for the working age sample and 7 out of 57,349 individuals for the young workers' sample. We include them in the category of 'all workers' but exclude them from full/part-time models. We expect this not to affect our results.

deflated wages between men and women at a particular point in time. This can be expressed as follows:

$$\Delta W_t = W_{M,t} - W_{F,t} \quad (1)$$

The first term on the right hand side $W_{M,t}$ is the average of men's hourly wages and the second term $W_{F,t}$ represents the average of women's hourly wages. Both terms are adjusted to 2010 prices, while t denotes the relevant year. The relative wage gap defines the difference as a proportion of men's average wages, and can be expressed as:

$$\Delta \widetilde{W}_t = \frac{\Delta W_t}{W_{M,t}} \quad (2)$$

Table 1: Average wages for men and women, raw and relative wage gap, all workers

Year	Hourly wage		Absolute wage gap	Relative wage gap	Women's wage % of men's	Change in relative wage gap (ppt.)
	Men	Women				
2002	12.40	9.77	2.63	21.22%	78.78%	
2003	12.72	10.01	2.71	21.34%	78.66%	0.11
2004	12.88	10.32	2.56	19.87%	80.13%	-1.47
2005	13.33	10.74	2.59	19.44%	80.56%	-0.43
2006	13.57	10.88	2.69	19.80%	80.20%	0.36
2007	13.71	11.11	2.59	18.93%	81.07%	-0.88
2008	13.82	11.03	2.79	20.17%	79.83%	1.25
2009	13.74	11.11	2.64	19.18%	80.82%	-0.99
2010	13.46	11.12	2.34	17.40%	82.60%	-1.78

Note: Author's calculations based on LFS 2002-2010. Hourly wages and the absolute wage gap measured in pounds, deflated to 2010 prices. Abbreviations: ppt., percentage points.

Table 1 summarizes average hourly wages as well as the absolute and relative gender wage gaps of all employed men and women in the sample (combining full-time and part-time employees). The table shows that in 2002, men had average wages of £12.40 per hour compared with £9.77 for women. This represents an absolute wage gap of £2.63 and a relative wage gap of 21.22%. Hence, women had average wages that were 21.22% lower

than those of men. The table indicates that the absolute wage gap fluctuated over the period and was largest in 2008 and smallest in 2010. Between 2002 and 2007 average wages among men increased each year, to a high of £13.82 in 2008, but from then onwards they fell to £13.46. Women's wages increased each year between 2002 and 2007, from £9.77 to £11.11, but since then they remained relatively constant at about £11.11 (with the exception of 2008 when women's average wages fell).

Hence, from 2008 onwards the wage gap declined because men's wages fell while women's wages remained relatively constant. This is initial evidence that the recession and subsequent economic stagnation had different effects on the wages of men and women.

During the recession period there was a decline in the wage gap mainly due to the fall in men's wages (from £13.82 in 2008 to £13.46 in 2010) while those of women remained constant (at £11.11, with the exception of 2008). In 2008 the average wage for employed men was at its highest level of £13.82, compared with £11.03 for women. This represents a raw wage gap of £2.79 (or 20.17% in relative terms). In 2010 the average wage for employed men was £13.46, compared with £11.12 for women. This represents a raw wage gap £2.34, or 17.40% in relative terms.

The overall trend indicates that men's wages increased each year until 2008 and then fell, while women's wages increased until 2007 and then remained relatively constant with the exception of 2008. The absolute wage gap fluctuated until 2008 and then declined for the next two consecutive years, mainly due to the fall in men's wages. The relative wage gap fell in each year except 2003, 2006 and 2008.

Table 2: Average wages for men and women aged under 30, raw and relative wage gap

Year	Hourly wage		Absolute wage gap	Relative wage gap	Women's wage % of men's	Change in relative wage gap (ppt.)
	Men	Women				
2002	9.08	8.30	0.78	8.61%	91.39%	
2003	8.97	8.42	0.55	6.08%	93.92%	-2.52
2004	9.10	8.66	0.44	4.81%	95.19%	-1.28
2005	9.52	8.98	0.53	5.60%	94.40%	0.80
2006	9.26	8.87	0.39	4.24%	95.76%	-1.36
2007	9.55	9.05	0.50	5.27%	94.73%	1.03
2008	9.52	8.88	0.64	6.75%	93.25%	1.48
2009	9.35	8.91	0.44	4.70%	95.30%	-2.04
2010	9.12	8.63	0.48	5.32%	94.68%	0.61

Note: Author's calculations based on LFS 2002-2010. Hourly wages and the absolute wage gap measured in pounds, deflated to 2010 prices. Abbreviations: ppt., percentage points.

Table 2 summarizes the average hourly wages of employed men and women aged under 30 and hence focuses on young people who are most affected by the recent and previous recessions (Lambert 2010). It illustrates different patterns compared to those previously discussed for the working age sample employees. This may be partly due to cohort effects since these young people are the first cohort to grow up in the new flexible labour market.[16]

In 2002, young employed men had average wages of £9.08 per hour compared with £8.30 for young women. This represents an absolute wage gap of £0.78, and a relative wage gap of 8.61%. Young women were therefore earning wages that were 91.39% of those of young men. Hence, the raw gender wage gap is considerably smaller for young workers than for all workers. The absolute wage gap was largest in 2002 (at 0.78) and smallest in 2006 (at 0.39). In 2010 the average wage for young employed men was £9.12, compared with £8.63 for women, representing a raw wage gap of around £0.48 (or 5.32%). In the period leading up to the recession, from 2002 to 2007, men's average wages fluctuated while women's average wages increased each year (with the exception of 2006 where women's average wages fell). During the recession and post-recession period, the wage gap decreased from £0.64 in 2008 to £0.44 in 2009, and increased to £0.48 in 2010. Over this same period men's average wages fell by £0.17 and £0.23 each year while women's wages remained constant from 2008 to 2009 and fell by £0.28 in 2010.

[16] Following the Thatcher Reforms and the policies adopted in 1999 and 2000 (see Literature Review).

Table 3: Average wages for men and women in full-time employment, raw and relative wage gap

Year	Hourly wage		Absolute wage gap	Relative wage gap	Women's wage % of men's	Change in relative wage gap (ppt.)
	Men	Women				
2002	12.81	10.92	1.89	14.72%	85.28%	
2003	13.15	11.15	2.00	15.19%	84.81%	0.47
2004	13.27	11.40	1.87	14.12%	85.88%	-1.07
2005	13.72	11.87	1.85	13.47%	86.53%	-0.66
2006	13.99	12.01	1.98	14.13%	85.87%	0.67
2007	14.14	12.16	1.98	14.03%	85.97%	-0.10
2008	14.25	12.13	2.12	14.87%	85.13%	0.83
2009	14.25	12.24	2.01	14.13%	85.87%	-0.74
2010	13.97	12.17	1.80	12.89%	87.11%	-1.23

Note: Author's calculations based on LFS 2002-2010. Hourly wages and the absolute wage gap are measured in pounds, deflated to 2010 prices. Abbreviations: ppt., percentage points.

Table 3 summarizes average hourly wages, as well as the absolute and relative gender wage gaps, of men and women who are full-time employees. The table indicates a similar trend for the absolute wage gap as for all employees (Table 1). In particular, in 2002, men in full-time jobs had average wages of £12.81 per hour compared with £10.92 for women. This represents an absolute wage gap of £1.89 and a relative wage gap of 14.72%. Hence, women had average wages that were 14.72% lower than those of men. The absolute wage gap for full-time workers fluctuated throughout the period with the largest gap occurring in 2008 (at £2.12) and the smallest in 2010 (at £1.80).

For the period leading up to the recession, from 2003 to 2008, average wages among men increased each year, to a high of £14.25 in 2008. From then onwards they stagnated and fell to £13.97. Women's average wages increased each year between 2002 and 2007, from £10.92 to £12.16, and since then they have fluctuated. More specifically, women's wages fell to £12.13 in 2008, increased to £12.24 in 2009, and decreased again to £12.17 in 2010.

Consequently, from 2002 to 2008 the wage gap fluctuated due to the different rates of increases in the wage rates of men and women, while from 2008 it fell from 14.87% in 2008

to 12.89% in 2010 because men's wages stagnated and then dropped from £14.25 in 2008 to £13.97 in 2010 while women's wages fluctuated.

Table 4: Average wages for men and women in part-time employment, raw and relative wage gap

Year	Hourly wage		Absolute wage gap	Relative wage gap	Women's wage % of men's	Change in relative wage gap (ppt.)
	Men	Women				
2002	7.65	8.26	-0.62	-8.05%	108.05%	
2003	7.86	8.58	-0.72	-9.20%	109.20%	-1.16
2004	8.44	8.91	-0.47	-5.55%	105.55%	3.65
2005	8.75	9.17	-0.42	-4.84%	104.84%	0.71
2006	8.82	9.33	-0.51	-5.73%	105.73%	-0.89
2007	8.91	9.60	-0.69	-7.71%	107.71%	-1.98
2008	9.13	9.42	-0.29	-3.12%	103.12%	4.58
2009	8.87	9.52	-0.66	-7.40%	107.40%	-4.28
2010	8.85	9.66	-0.81	-9.13%	109.13%	-1.73

Note: Author's calculations based on LFS 2002-2010. Hourly wages and the absolute wage gap measured in pounds, deflated to 2010 prices. Abbreviations: ppt., percentage points.

Table 4 summarizes average hourly wages as well as the absolute and relative gender wage gaps of part-time employed men and women in the sample. This indicates a different trend in the absolute wage gap for part-time workers than for full-time workers. In particular, it shows that women who are employed part-time earn higher wages on average than similarly employed men and that this difference increased over the period.

For example, Table 4 shows that in 2002, men in part-time jobs had average wages of £7.65 per hour compared with £8.26 for women in part-time jobs. This represents an absolute wage gap of -£0.62 (women's average hourly wages are higher than those of men) and a relative wage gap of -8.05% (indicating a wage premium for women). Hence, women had average wages that were 8.05% higher than those of men. In the period preceding the recession, from 2003 to 2008, average hourly wages among men increased (from £7.86 in 2003 to £9.13 in 2008) and in 2010 stood at £8.85. However, women's average real wages increased each year (except 2008), from £9.42 to £9.66 per hour. During the recession period the wage gap increased to £0.81 in 2010, due to the decrease in men's average wages and the increase in women's average wages during that period.

The trends observed in the raw gender wage gap among these population subgroups are summarised in Figure 1 below.

Figure 1: Wage gap of working age and young people aged under 30

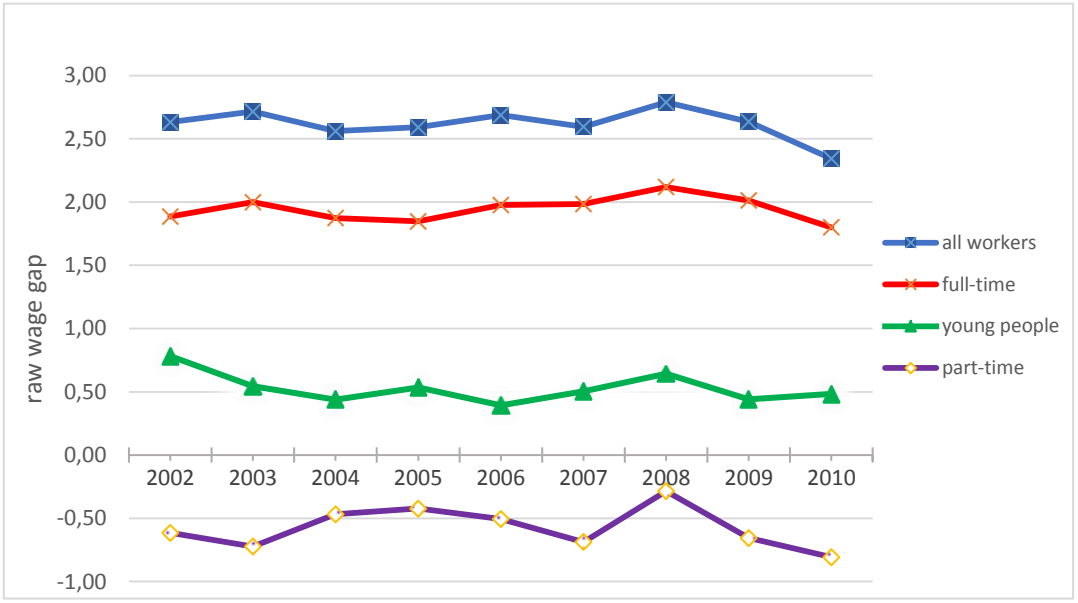

Figure 1 shows that the trends for the full-time and working age samples are similar with the exception of the recession period, where the gender wage gap for working age employees falls more sharply. However, among young people, fluctuations in the wage gap are apparent in the period leading up to the recession, whereas from 2009 onwards the wage gap remains relatively constant (although the gender wage gap for the under 30s is substantially smaller). This could be attributed to young people occupying early career positions that are relatively equally remunerated – due to the absence of diversity in terms of early career opportunities and early career remuneration – with respect to market changes, in contrast with the working age sample which is more skilled and specialised and also more heterogeneous (combining full-time and part-time employees). Regarding trends observed for the wage gap of part-time workers (negative values for the gender wage gap indicate a wage premium for women), it appears to narrow until 2005 and then fluctuates, while from 2008 onwards the gender wage gap increased in favour of women. Having discussed

patterns observed in the raw gender wage gap in the pre-recession, recession and post-recession periods for several population subsamples, we next describe an estimation approach to identify whether, and how, the recession affected the gender wage gap.

Methodology

First, we investigate patterns in the gender wage gap in a multivariate setting, controlling for differences in observed characteristics between men and women. We then proceed with a pooled model that directly identifies trends in the wage gap since the recession.

Interaction model

In order to determine whether the recession had an impact on the gender wage gap, we estimate an OLS wage regression pooling observations across years and including dummy variables for each year and an interaction term between gender and the recession years (defined as 2008-2010). The interaction model helps us to directly identify the impact of the recession on the wages of women relative to men (or how much the wage gender gap deviated from its average), using an increased number of observations which results in more precise estimates.

The equation estimated can be written as follows:

$$\mathrm{Y_{it}} = \beta_0 + \beta_1 \mathrm{X}_{it} + \beta_2 \mathrm{Gender}_i + \beta_3 \mathrm{Year}_{it} + \beta_4 (\mathrm{Gender}_i \times \mathrm{Recession}) + \mathrm{u}_{it} \quad (3)$$

where $\mathrm{Y_{it}}$ is the log gross hourly wage, X_{it} is a vector of socio-economic characteristics, (see below), gender is a binary variable which takes the value of 1 if female and 0 if male, year is a categorical variable indicating a year within the observation period (2002-2010), and the interaction term (gender × recession) takes the value of 1 if the individual is female and is observed in the recession years (2008-2010).

The set of variables included in (X_i) are: age; ethnicity; highest educational qualification obtained (university degree, higher education qualifications, A-Level, GCSEs, other qualifications); and region.[17] 'Age' and 'age squared' are used as a proxy of experience (general human capital) while 'highest qualification obtained' also captures human capital. The regional variables control for local wage fluctuations (Drolet 2002).[18]

Sample Selection

Estimation of this model is complicated by the fact that we only observe wages for those who are in employment. If the selection of workers (and women in particular) into the labour market and into employment is non-random, then resulting estimates will be biased. The problem of non-random selection into employment is typically more serious for women than men as non-employment rates are typically higher among women (Beblo et al., 2003). In particular, workers who would be most likely to receive low wages if they had a job choose not to work and so the sample of those in work is a non-random sample of the population. We follow the common strategy for overcoming this selection bias by adopting the Heckman correction procedure (Heckman 1979; Christofides and Vrachimis 2011) which involves adding a term (the Inverse Mills Ratio) into the OLS wage equation to correct for the non-random selection in employment. The selection into work is determined by the following:

[17] Ethnicity variables used in the model: Mixed, Asian, Chinese, Other Ethnicity, Black. Omitted variable - White. Highest educational qualification obtained refers to the highest qualification obtained or equivalent. Variables used are: university degree; higher education; A-level; GCSEs–grades A-C; other qualifications. Omitted variable - no qualifications. Region refers to government office regions. Variables used are: Tyne and Wear; North; Manchester; Merseyside; York; Midlands; East; South West; Wales; Scotland. Omitted variable - London/ South East.

[18] In this specification we do not include occupation because it is highly correlated with education (which we control for) and additionally, occupational coding is notoriously unreliable and prone to measurement error, while education and industry are far more robust.

$$P_i^* = Z_i\gamma + u_i \ (4)$$

Where P_i^* is an individual's unobserved propensity to be in employment, Z is a vector of observable exogenous variables (including the year variable for the interaction model), γ is a vector of constant parameters and u is the residual term. We do not observe P_i^*, but instead observe an individual's actual employment status P_i which is determined as follows:

$$P_i = \begin{cases} = 1, & P_i^* > 0 \text{ with probability } F(Z_i\gamma) \\ = 0, & P_i^* \leq 0 \text{ with probability } 1 - \mathrm{F}(Z_i\gamma) \end{cases}$$

F (.) is the standard normal distribution function. The selection equation (4) can be estimated using a probit model and the Inverse Mills Ratio can be retrieved as:

$$\lambda_i = \varphi(Z\hat{\gamma})/F(Z\hat{\gamma})$$

where $\varphi(.)$ denotes the probability density function and F (.) denotes the standard normal distribution function. The Inverse Mills Ratio is then added into the log wage equation as a correction term. We adjust for the addition of the correction term by bootstrapping with 50 replications to obtain correct standard errors.[19] A positive Inverse Mills Ratio coefficient suggests unobserved variables that increase both the probability of being employed and earning a higher than average wage. A negative Inverse Mills Ratio suggests unobserved variables that increase the probability of being employed and the probability of earning a lower than average wage.

Identification of the wage equation is achieved by including variables in Z_i that are not in X_i. The identifying variables for equation (4) are 'marital status' and 'the presence of

[19] Non parametric bootstrap is a statistical technique that uses resampling with replacement to obtain statistical measurements (in this case standard errors), see Greene (2003).

children'. Thus, these variables are assumed to determine whether or not women work, but not their wages conditional on working. We assume no selection effects for men as we could not find an exclusion variable in this context (see Rabe and Taylor, 2012). We acknowledge that this is a strong assumption to make and that women might choose to work but, for example, not put themselves forward for promotion, which in turn affects their wages.

Quasi complete separation

Quasi complete separation occurs when the dependent variable of a non-linear model separates an independent variable to some degree. When faced with quasi complete separation of the predictors in the probit model we collapse the right hand side variables into larger categorical variables, assuming homogeneity in the larger categorical variables. For example, we collapse Tyne and Wear into the Northern region. Although a statistical package exists for dealing with quasi complete separation in non-linear models, it only applies to logit models and hence cannot be used in this analysis.[20]

Results

In this section we present estimates from year-specific OLS estimates which generate indications of the conditional gender wage gap over the period under examination. We then directly explore the extent to which the gender wage gap has been affected by the recession using the pooled interaction model. This is estimated for various subgroups of the population to identify any heterogeneous effects. The above estimates are presented firstly without correcting for selection and then with selection correction in order to identify whether changes in selection into employment affect trends observed in the wage gap.

[20] Stata package FIRTHLOGIT. Available at: http://fmwww.bc.edu/repec/bocode/f/firthlogit.ado

Year-specific OLS equations

The OLS estimates from year-specific wage equations are presented in Table 5. The model adopted relates the log of gross hourly wage to age, and age squared, with all other socio-economic variables entered as binary indicators to show the proportional change in the gross hourly wage associated with the presence of the characteristic. The specification includes controls for education, ethnicity, and region of residence. The model R^2s vary between 0.31 and 0.41 which indicates that the specified models explain more than a third of the total observed variation in wages across individuals.

Table 5: Yearly estimates for working age sample (not selectivity corrected), LFS 2002-2010

	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Female	-0.214**	-0.213**	-0.213**	-0.209**	-0.205**	-0.199**	-0.211**	-0.201**	-0.188**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
N	30611	29806	28759	28191	27736	28977	28317	26328	25648
R^2	0.411	0.412	0.311	0.312	0.401	0.385	0.388	0.384	0.373

Note: Estimates from OLS log hourly wage equations, wages deflated to 2010 prices. All models also control for other socio-economic characteristics. Full estimates are presented in Appendix II, Table 1. Statistical significance: *p<0.05; **p<0.01. Standard errors in parentheses. Dependent variable: log hourly real wage.

The main coefficient of interest is that of the gender indicator which identifies the conditional gender wage gap in each year. A negative coefficient of the female indicator identifies a wage penalty for women relative to an otherwise similar man, while a positive coefficient indicates a wage premium.

The estimates in Table 5 show the difference in log points of women's wages relative to men's, in real terms, with all other characteristics remaining the same. In 2002, for example, the estimated coefficient on the female indicator is negative and statistically significant, taking a value of -0.214. This suggests that on average women received wages that were 21.4% less than for a man with the same observed characteristics.[21] Figure 2 plots estimates

[21] Note that in this section we comment on yearly estimates and trends and we do not examine whether the differences between the yearly estimates are statistically significant.

of the conditional gender gap across the period and shows that it remains relatively stable at about 21% until 2005, and then reduces in the period 2005-2010, with the exception of 2008. The biggest decrease occurred between 2009 and 2010. In 2009 a woman earned 20.1% less than a man with similar characteristics, while in 2010 a woman earned 18.8% less than a man with similar characteristics. Thus, there is some evidence of a gradual fall in the gender wage gap over the time period, consistent with the long term trend. This decline may have been accelerated by the onset of the recession in 2008/9.

In addition to estimating these year-specific wage regressions for all employed workers, we also estimate them for sub-groups of workers as a first step towards identifying heterogeneous effects of the recession on the gender wage gap. Figure 3 shows the conditional wage gap for men and women aged under 30. Yearly estimates for young workers are presented in Appendix II, Table 2. The conditional wage gap for this subgroup of young workers is significantly smaller than for all workers, ranging from 6% in 2005 to 9% in 2002. This is likely to reflect the relevant homogeneity of this group (see Appendix I, Table 2). However we note that the conditional wage gap fluctuates more than the corresponding one for all workers (Figure 2). However, in contrast to the all workers sample, the largest year on year decline in the conditional wage gap occurred between the years 2002 to 2003, which indicates a wage gain of 2.3% for women.

Figure 4 shows the estimated conditional differences in wages for men and women in full-time jobs. Yearly estimates for full-time workers are presented in Appendix II, Table 3. This pattern is similar to that for all workers, with the exception of 2005, although the gender wage gap is consistently smaller among full-time employees (ranging from 13.9% in 2005 to 16.2% in 2008). For the all workers sample, there is a decline in the gender wage gap (of 0.7 percentage points) among full-time employees during the recession period (2008-2010). Specifically, during the recession period, the wage penalty for female full-time employees decreased from 16.2% to 15.5% in 2009, and then from 15.5% to 14.8% in 2010.

Figure 2: Difference in log points of women's wages relative to men's

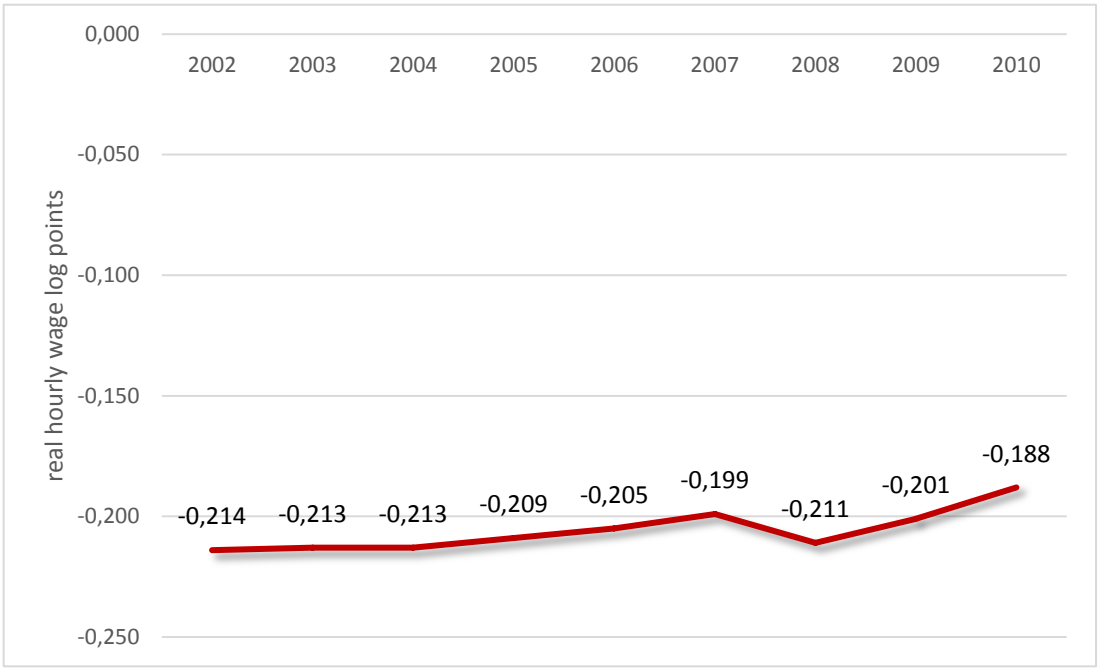

Figure 3: Difference in log points of women's wages relative to men's, young workers

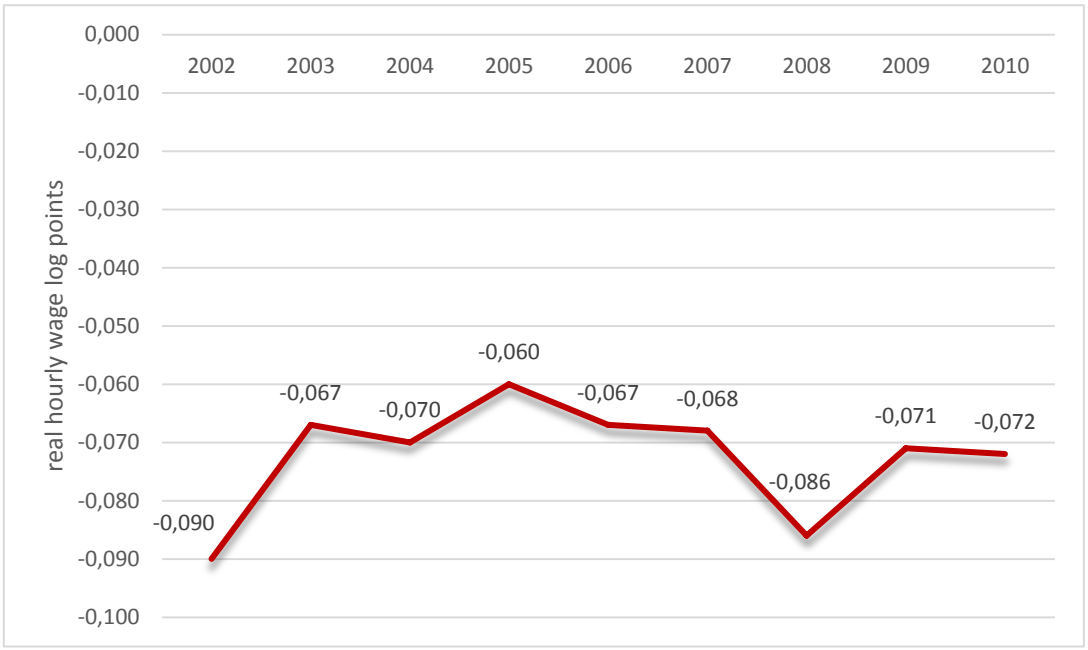

Figure 4: Difference in log points of women's wages relative to men's, full-time workers

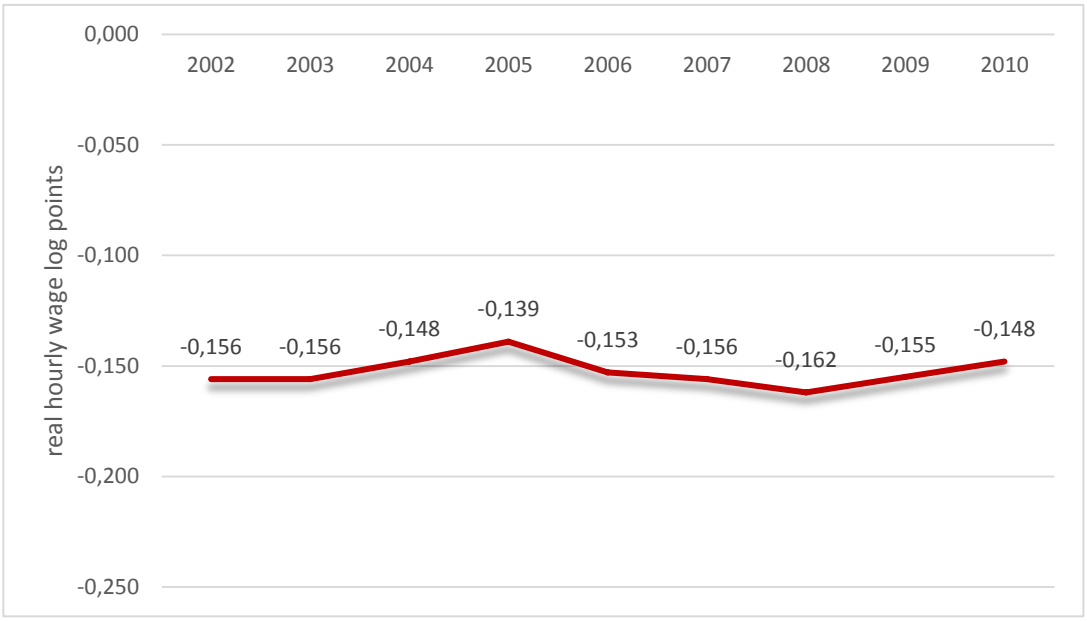

Figure 5: Difference in log points of women's wages relative to men's, part-time workers

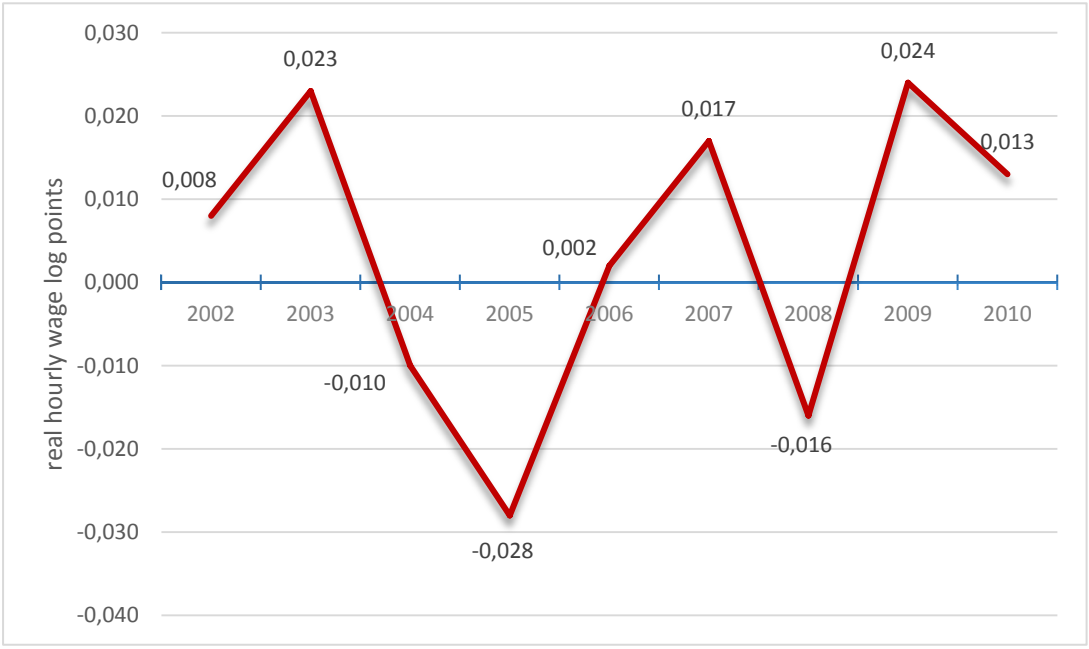

Figure 5 presents estimates of the conditional gender wage gap among part-time workers. Yearly estimates for part-time workers are presented in Appendix II, Table 4. This indicates that in most years women working part-time earn higher wages than otherwise similar men

working part-time, although this premium is only statistically significant at the 10% level in 2003 and 2009, while the wage penalty is only statistically significant – at the 10% level – in 2005. The biggest drop occurs between the years 2007 and 2008 where the wage premium falls from 1.7% to a wage penalty of 1.6% which indicates that in 2007 a female in part-time employment earned 1.7% more than a male part-time employee with the same characteristics, while in 2008 a female part-time employee earned 1.6% less than her male counterpart with the same characteristics. During the recession period, the wage premium for female part-time employees increased sharply in 2009 from 1.6% (a wage penalty) to 2.4%, and then fell from 2.4% to 1.3% in 2010. Overall, there is a very small if any gender difference in wages among part-time employees. However, there is evidence of a large wage penalty for women among full-time workers. During the recession the wage penalty fell, particularly from 2009 to 2010.

Interaction effects

We next investigate more directly the impact of the recession on the gender wage gap by estimating models pooling data over the years and adding variables indicating year in the observation period (2002-2010) and an interaction of the recession years (2008-2010) with gender. These models show how the recession affected women compared to men, controlling for a range of demographic characteristics including educational attainment, ethnicity, and regional residence. As well as estimating average effects, we also estimate a series of models for specific population subgroups, as well as for different educational levels, those in the banking sector (which was hit particularly hard by the recession), full- and part-time employees, and those in the private sector. These were chosen as the groups most likely to be affected by the recession (Muriel and Sibieta, 2008; Chamberlin, 2010; Lambert, 2010). Moreover, drawing from the literature review (see employment structure and educational attainment section) and considering the association between educational levels and occupational skills we could also interpret the effect of the recession on the wage gap by grouping the educational qualifications into the 4 skill levels as follows: high skill –

degree and higher educational qualifications; upper middle skill – A-Level; low middle skilled – GCSE and other qualifications.

Table 6(a): Estimates of the impact of the recession on the gender wage gap: LFS 2002-2010

	All	FT	PT	Degree	Higher QF	A-Level	GCSE	Other QF	Banking	Private
Woman	-0.209**	-0.150**	0.002	-0.145**	-0.209**	-0.218**	-0.226**	-0.212**	-0.198**	-0.232**
	(0.002)	(0.002)	(0.006)	(0.005)	(0.007)	(0.004)	(0.004)	(0.006)	(0.006)	(0.002)
Woman in recession	0.007*	-0.006	0.004	-0.006	-0.005	-0.019*	0.008	0.023*	0.033**	0.005
	(0.004)	(0.004)	(0.009)	(0.008)	(0.011)	(0.007)	(0.007)	(0.010)	(0.010)	(0.004)
2002	-0.016**	-0.017**	-0.023**	-0.017*	-0.005	-0.022**	-0.002	-0.023**	-0.020*	-0.014**
	(0.003)	(0.004)	(0.006)	(0.008)	(0.011)	(0.007)	(0.007)	(0.009)	(0.009)	(0.004)
2004	0.082**	0.075**	0.086**	-0.011	0.034**	0.040**	0.032**	0.033**	0.077**	0.072**
	(0.003)	(0.004)	(0.007)	(0.009)	(0.011)	(0.007)	(0.007)	(0.010)	(0.010)	(0.004)
2005	0.108**	0.102**	0.100**	0.025**	0.052**	0.051**	0.056**	0.052**	0.112**	0.099**
	(0.003)	(0.004)	(0.007)	(0.009)	(0.012)	(0.007)	(0.007)	(0.010)	(0.010)	(0.004)
2006	0.053**	0.047**	0.063**	0.033**	0.039**	0.055**	0.054**	0.057**	0.044**	0.053**
	(0.003)	(0.004)	(0.007)	(0.008)	(0.011)	(0.007)	(0.007)	(0.009)	(0.010)	(0.004)
2007	0.064**	0.054**	0.077**	0.030**	0.047**	0.081**	0.063**	0.063**	0.058**	0.064**
	(0.003)	(0.004)	(0.007)	(0.008)	(0.011)	(0.007)	(0.007)	(0.009)	(0.010)	(0.004)
2008	0.057**	0.057**	0.060**	0.034**	0.049**	0.082**	0.049**	0.043**	0.050**	0.060**
	(0.004)	(0.004)	(0.010)	(0.009)	(0.013)	(0.008)	(0.008)	(0.011)	(0.011)	(0.005)
2009	0.049**	0.053**	0.054**	0.021*	0.027*	0.079**	0.040**	0.051**	0.008	0.052**
	(0.004)	(0.004)	(0.010)	(0.009)	(0.013)	(0.008)	(0.008)	(0.011)	(0.011)	(0.005)
2010	0.025**	0.025**	0.046**	-0.005	0.020	0.034**	0.022**	0.029**	-0.016	0.018**
	(0.004)	(0.004)	(0.010)	(0.009)	(0.013)	(0.008)	(0.008)	(0.011)	(0.011)	(0.005)
Observations	254373	188133	66219	52974	25251	54198	55406	27895	37014	178759
R^2	0.372	0.358	0.293	0.199	0.171	0.261	0.240	0.154	0.345	0.370

Note: Estimates from OLS hourly wage equations, wages deflated to 2010 prices. See text for details. All models also control for other socio-economic characteristics. Standard errors in parentheses. Full estimates are presented in Appendix III, Table 1. **, *, # indicates statistical significance at the 1%, 5% and 10% level respectively. Dependent variable: log hourly real wage. Abbreviations: FT, full-time; PT, part-time; QF, qualification.

Table 6(b): Estimates of the impact of the recession on the gender wage gap, young workers: LFS 2002-2010

	All	FT	PT	Degree	Higher QF	A-Level	GCSE	Other QF	Private
Woman	-0.070**	-0.053**	0.012	-0.047**	-0.105**	-0.103**	-0.056**	-0.085**	-0.086**
	(0.003)	(0.004)	(0.008)	(0.008)	(0.014)	(0.007)	(0.006)	(0.012)	(0.004)
Woman in recession	-0.005	-0.014#	0.003	0.016	0.036	-0.011	-0.016	0.011	-0.005
	(0.006)	(0.007)	(0.013)	(0.014)	(0.026)	(0.011)	(0.011)	(0.021)	(0.007)
2002	-0.010#	-0.005	-0.030**	-0.004	-0.017	-0.011	-0.004	-0.042*	-0.005
	(0.006)	(0.007)	(0.011)	(0.014)	(0.023)	(0.010)	(0.010)	(0.020)	(0.007)
2004	0.047**	0.043**	0.057**	-0.021	0.060*	0.036**	0.030**	0.008	0.041**
	(0.006)	(0.007)	(0.012)	(0.015)	(0.025)	(0.012)	(0.011)	(0.022)	(0.007)
2005	0.077**	0.072**	0.073**	0.008	0.063*	0.048**	0.056**	0.053*	0.073**
	(0.006)	(0.007)	(0.012)	(0.015)	(0.026)	(0.012)	(0.012)	(0.022)	(0.007)
2006	0.037**	0.032**	0.044**	-0.001	0.048#	0.041**	0.052**	0.020	0.034**
	(0.006)	(0.007)	(0.012)	(0.014)	(0.024)	(0.011)	(0.011)	(0.020)	(0.007)
2007	0.054**	0.046**	0.065**	0.022	0.078**	0.071**	0.066**	0.008	0.051**
	(0.006)	(0.007)	(0.012)	(0.014)	(0.024)	(0.011)	(0.011)	(0.020)	(0.007)
2008	0.041**	0.043**	0.039**	-0.000	0.026	0.059**	0.055**	-0.011	0.043**
	(0.007)	(0.008)	(0.015)	(0.016)	(0.029)	(0.012)	(0.012)	(0.022)	(0.008)
2009	0.026**	0.029**	0.035*	-0.024	0.013	0.049**	0.050**	-0.040#	0.022**
	(0.007)	(0.008)	(0.015)	(0.016)	(0.030)	(0.013)	(0.013)	(0.023)	(0.008)
2010	-0.011	-0.011	0.021	-0.069**	-0.042	0.008	0.020	-0.042#	-0.015#
	(0.007)	(0.008)	(0.015)	(0.016)	(0.029)	(0.013)	(0.013)	(0.023)	(0.008)
Observations	57349	42259	15083	12515	3640	15473	14478	5152	46756
R^2	0.401	0.398	0.193	0.231	0.230	0.280	0.306	0.214	0.391

Note: Estimates from OLS hourly wage equations, wages deflated to 2010 prices. See text for details. All models also control for other socio-economic characteristics. Standard errors in parentheses. Banking estimates are not presented due to quasi complete separation in the collapsed categorical variables. Full estimates are presented in Appendix III, Table 2. **, *, # indicates statistical significance at the 1%, 5% and 10% level respectively. Dependent variable: log hourly real wage. Abbreviations: FT, full-time; PT, part-time; QF, qualification.

In Table 6(a) we present estimates from the key coefficients of interest in these models, the gender indicator, year dummies and the interaction between gender and the recession period (2008-2010). A full set of estimates is presented in Appendix III.

The first column in Table 6(a) presents the estimates from a model that includes all employees (both full-time and part-time, from all sectors, and all ages). These indicate that, on average across the observation period, women received wages that were 20.9% lower than an observationally equivalent man. The key variable in these models is the interaction term, capturing the wages of women during the recession period, which indicates the extent to which the gender wage gap deviated from its average across the observation period. The estimate for this variable is positive (0.007), indicating that the gender wage gap fell by 0.7 percentage points in the recession period (i.e. women's wages increased relative to men's). Hence, on average the recession had an impact on the gender wage gap.

Additionally, it is well-documented that the recession affected particular subgroups of workers more than others. For example, young workers in low skilled occupations, in the private sector and in the banking sector were affected the most (Muriel and Sibieta, 2008; Bell and Blanchflower, 2010b; Chamberlin, 2010). We therefore estimate separate models, focusing on particular subgroups of workers, to identify whether the recession had a heterogeneous impact on the gender wage gap. Estimates from these models are presented in the subsequent columns of Table 6(a). We first estimate separate models by hours of work, and distinguish between full-time and part-time employees. As our previous analysis indicated, we find that the extent of the gender wage gap differs in relation to hours of work, with women in full-time jobs experiencing a wage penalty of 15% relative to otherwise similar men, while those in part-time jobs earn wages that are similar to men's. The estimated coefficient on the female indicator is positive, but is small and not significantly different from zero. However, we find that the recession had similar impacts on the gender wage gap for full- and part-time workers. In particular, the gender wage gap among full-

time and part-time workers was not affected by the recession: the estimate on the interaction term is positive for part-time workers (indicating that the differences in wages between men and women narrowed during the recession) and negative for full-time workers (indicating that the differences in wages between men and women widened during the recession), but both estimates are very small and statistically insignificant.

Next, we present estimates for levels of educational attainment, and distinguish between employees who gained only GCSEs, employees with A-Levels, employees with only a higher education qualification, employees who possess only other qualifications, and employees that gained a degree. We observe that the gender wage gap is lower among more highly educated groups, with the exception of employees with other qualifications; in particular, women having gained only GCSEs experienced a wage penalty of 22.6% relative to otherwise similar men, while women with a degree experienced a wage penalty of 14.5% relative to otherwise similar men. The recession had differential impacts on the gender wage gap among workers with different educational qualifications. Our estimates indicate a reduction in the wage gap for women with low educational attainment and an increase for women with higher educational attainment (A-Levels). However, for women having the highest educational qualifications (degree and higher educational qualifications), the estimates on the interaction term are very small and statistically insignificant. During the recession, women who gained only A-Levels (upper middle skilled) experienced a wage penalty of 1.9% relative to otherwise similar men, while women with other qualifications (low middle skilled) experienced a wage premium of 2.3%. If we focus only on workers in the private sector we observe that women experience a wage penalty of 23.2%. The gender wage gap fell by 0.5% since the recession, although it is not statistically different from zero. In the banking sector, women experienced a wage penalty of 19.8% relative to otherwise similar men. As expected, the recession had a large effect on these workers, with women gaining relative to men during the recession (women experienced a wage premium of 3.3%).

Regarding wage growth in Table 6(a) the estimates indicate that the time variables are positive in all years, indicating an average wage growth over the observation period in relation to 2003 (omitted variable). Generally, we observe that the rate of wage growth increases each year until 2005, whereas from 2006 onwards the rate of wage growth decreases year upon year, with the exception of 2007. This trend is similar for all models with the exception of degree and higher qualification holders which indicate no wage growth in 2010 (the estimates are statistically insignificant) and the banking sector which indicates no wage growth in 2009 and 2010.

Table 6(b) presents the estimates from analogous models that focus on young employees aged under 30. Again we estimate a range of models focusing on specific population subgroups. The first column indicates that, on average across the observation period, young women received wages that were 7% lower than an observationally equivalent man. The key variable is the interaction term capturing the wages of women during the recession period, which indicates the extent to which the gender wage gap deviated from its average during the recession. The estimate on this variable is negative (0.005), indicating that the gender wage gap increased by 0.5 percentage points in the recession period. However, this effect is small and is not statistically significant. Hence on average the recession had little impact on the gender wage gap. Estimates of the gender wage gap in terms of hours of work (full-time and part-time young workers) indicate that full-time young working women experienced a wage penalty of 5.3% across the observation period. For part-time young workers, the estimated coefficient on the female indicator is positive, but it is small and not significantly different from zero. During the recession period, in the case of full-time young workers, young women experienced a wage loss of 1.4% relative to observationally equal men, while the gender wage gap among part-time workers was not affected by the recession. The effect of the recession on the wage gap remains the same in all other models, and the interaction term is statistically insignificant, indicating that the wage gap was not affected by the recession.

In Table 6(b) regarding wage growth from analogous models on young employees aged under 30 the estimates indicate that in the first three models (all employees, full-time, part-time) the rate of wage growth increases each year until 2005, whereas from 2006 onwards it falls year upon year (with the exception of 2007) to the point that in 2010 is not statistically significant. As regards estimates for different levels of educational attainment for young workers, the pattern of wage growth follows the previous three models with the exception of degree holders where it fluctuates. However, for degree holders the estimates are statistically insignificant indicating no wage growth until 2009 (relative to 2003) and a negative wage growth in 2010. Although young higher qualification holders experience the same wage growth pattern as previous models, from 2008 onwards we find no wage growth (relative to 2003). As stated above, we find that A-Level and GCSE holders experienced a similar pattern of wage growth in the observational period as all employees, full-time, part-time workers. In contrast, we find no wage growth for other qualification holder in all years except 2005, and a negative wage growth in 2009 and 2010. Finally, young workers in the private sector follow the same wage growth pattern as the first three models.

Selectivity corrected estimates

In this section we present estimates corrected for non-random selection into work for women.[22] In Table 7(a) we present selection corrected estimates from the key coefficients of interest in these models, while in Appendix III we present the full sets of estimates. In particular, we present estimated coefficients of the gender indicator, and the interaction between gender and the recession period (2008-2010).

[22] We re-examined the interaction wage models (without correcting for selectivity bias) by including dependent children in the wage equations. In Appendix IV, Tables 1-2, we present the key coefficients of interest: the gender indicator, and the interaction between gender and the recession period. We find no marked differences in our estimates.

Table 7(a): Estimates of the impact of the recession on the gender wage gap, selectivity corrected: LFS 2002-2010

	All	FT	PT	Degree	Higher QF	A-Level	GCSE	Other QF	Banking	Private
Woman	-0.193**	-0.148**	-0.021	-0.095**	-0.227**	-0.230**	-0.206**	-0.216**	-0.164**	-0.197**
	(0.003)	(0.003)	(0.013)	(0.008)	(0.013)	(0.009)	(0.006)	(0.012)	(0.006)	(0.003)
Woman in recession	0.009**	-0.006	0.006	0.001	-0.010	-0.020**	0.011	0.022*	0.030**	0.002
	(0.003)	(0.004)	(0.011)	(0.008)	(0.013)	(0.008)	(0.007)	(0.010)	(0.010)	(0.004)
Mills ratio	-0.035**	-0.431	0.616*	-0.176**	0.060#	0.028#	-0.042**	0.007	-2.421**	-1.952**
	(0.007)	(0.638)	(0.297)	(0.026)	(0.036)	(0.016)	(0.010)	(0.019)	(0.257)	(0.129)
2002	-0.016**	-0.017**	-0.024**	-0.016#	-0.004	-0.023**	-0.002	-0.023*	-0.024**	-0.016**
	(0.004)	(0.004)	(0.006)	(0.009)	(0.010)	(0.007)	(0.007)	(0.010)	(0.009)	(0.004)
2004	0.081**	0.075**	0.082**	-0.012	0.035**	0.040**	0.033**	0.033**	0.080**	0.072**
	(0.003)	(0.003)	(0.005)	(0.008)	(0.012)	(0.009)	(0.007)	(0.010)	(0.010)	(0.005)
2005	0.107**	0.102**	0.100**	0.023**	0.052**	0.052**	0.056**	0.052**	0.108**	0.097**
	(0.003)	(0.003)	(0.006)	(0.008)	(0.010)	(0.006)	(0.007)	(0.009)	(0.010)	(0.004)
2006	0.053**	0.047**	0.064**	0.033**	0.039**	0.055**	0.054**	0.057**	0.039**	0.048**
	(0.003)	(0.004)	(0.005)	(0.007)	(0.011)	(0.006)	(0.007)	(0.009)	(0.010)	(0.004)
2007	0.063**	0.054**	0.073**	0.028**	0.047**	0.081**	0.064**	0.063**	0.053**	0.063**
	(0.004)	(0.004)	(0.006)	(0.008)	(0.010)	(0.006)	(0.006)	(0.010)	(0.008)	(0.004)
2008	0.057**	0.057**	0.057**	0.032**	0.050**	0.083**	0.048**	0.043**	0.049**	0.058**
	(0.004)	(0.004)	(0.013)	(0.008)	(0.009)	(0.009)	(0.008)	(0.012)	(0.011)	(0.005)
2009	0.050**	0.053**	0.052**	0.020*	0.027*	0.079**	0.040**	0.051**	0.003	0.050**
	(0.003)	(0.004)	(0.011)	(0.010)	(0.013)	(0.008)	(0.008)	(0.013)	(0.011)	(0.005)
2010	0.026**	0.024**	0.046**	-0.005	0.021#	0.034**	0.023**	0.029**	-0.026*	0.014**
	(0.004)	(0.005)	(0.011)	(0.009)	(0.012)	(0.007)	(0.008)	(0.011)	(0.010)	(0.004)
Observations	254373	188133	66219	52974	25251	54198	55406	27895	37014	178759
R^2	0.372	0.358	0.293	0.199	0.171	0.261	0.240	0.154	0.346	0.371

Note: Estimates from OLS hourly wage equations, wages deflated to 2010 prices. See text for details. All models also control for other socio-economic characteristics. Standard errors in parentheses. Bootstrapped standard errors (50 replications). Full estimates are presented in Appendix III, Table 3. **, *, # indicates statistical significance at the 1%, 5% and 10% level respectively. Dependent variable: log hourly real wage. Abbreviations: FT, full-time; PT, part-time; QF, qualification.

We observe that, even when adjusting for selection, the coefficient of interest (the interaction between gender and the recession period) remains relatively the same in all the models, as do the non-selectivity adjusted coefficients of interest. Additionally, the IMR does not have the same sign, nor is it significant in all our models. We present the selection adjusted estimates and discuss the differences in detail, with the non-adjusted estimates, from all models in the remainder of this section.

The first column in Table 7(a) presents the estimates from a model that includes all employees. These indicate that, on average across the observation period after adjusting for selection, the wage gap was reduced by 1.6 percentage points (Table 6(a)), meaning that women received wages that were 19.3% lower than an observationally equivalent man. Regarding the estimates of the interaction term, capturing the wages of women during the recession period, they increased by 0.2 percentage points after adjusting for selection (Table 6(a)), which indicates that the recession had a small impact on the gender wage gap.

However the same cannot be said for the rest of the models. As in Table 6(a), separate models are estimated focusing on particular subgroups of workers to identify whether the recession had a heterogeneous impact on the gender wage gap. Full-time female employees experienced a 14.8% wage penalty relative to similar male full-time employees, compared with a 15% wage penalty when not adjusted for selectivity. Adjusting for selection bias had similar impacts on full-time employees as in previous estimates, regarding the impact of the recession on the gender gap (statistically insignificant, indicating no effect on the wage gap). In the case of part-time employees we find that, after adjusting for selection, we have a 2.1% wage loss for women relative to otherwise similar men in the observation period, contrary to previous estimates that showed a 0.2% wage premium for women. However, both estimates are statistically insignificant, indicating similar wages for men and women. Additionally, the selection corrected estimates for the impact of the recession on the wage

gender gap remain broadly similar to previous estimates which were statistically insignificant (Table 6(a)).

Next, we present estimates for different levels of educational attainment, and distinguish between employees who gained only GCSEs, A-Levels, higher education qualifications, other qualifications, and those who gained only a degree. In contrast to non-selectivity corrected estimates we observe that the gender wage gap fluctuates as the level of educational qualifications rises. For example, we observe a wage penalty ranging from 23% for women with only A-Levels relative to otherwise similar men, to a wage penalty of 9.5% (14.5% in non-selectivity corrected estimates) for women who gained a degree relative to otherwise similar men. Regarding the lower educational attainment categories of other qualifications and GCSEs, women face a wage penalty of around 21.6% and 20.6% respectively, relative to otherwise similar men in the observational period (while in non-selectivity corrected estimates, the wage penalties for women employees in the lower educational attainment categories were 21.2% and 22.6% respectively). Similarly to previous non-selectivity adjusted estimates for workers with different educational qualifications, the estimates of the interaction term in most models are small and statistically insignificant. However, the recession had an impact on the gender wage gap for some educational attainment categories. For women who gained only A-Levels (upper middle skilled) the interaction term is negative, indicating a wage penalty of 2% for women (compared to a 1.9% wage penalty in the non-adjusted estimates) relative to otherwise similar men, during the recession period. For women who gained only other qualifications (low middle skilled) the interaction term is positive, indicating a wage premium of 2.2% for women (compared to a 2.3% wage premium in the non-adjusted estimates) relative to otherwise similar men, during the recession period.

Regarding the private sector, when corrected for selectivity bias, the estimates show that women experienced a wage penalty of 19.7% compared to 23.2% according to non-

selectivity corrected estimates. However, the selectivity corrected estimates regarding the gender wage gap during the recession remain broadly similar, relative to non-selectivity corrected estimates, and in both cases the estimates are small and not statistically significant. In the banking sector, selectivity adjusted estimates indicate that over the observation period women experienced a wage penalty of 16.4% relative to otherwise similar men (a reduction of 3.4 percentage points to the non-selectivity adjusted estimates), while the gender wage gap during the recession indicates a wage premium of 3% for women (compared to a 3.3% wage premium for the non-selectivity adjusted estimates).

Regarding wage growth in Table 7(a) we observe the same pattern as in Table 6(a) that the rate of wage growth increases each year until 2005, whereas from 2006 onwards the rate of wage growth decreases year upon year- with the exception of 2007. This is true for all models with the exception of degree qualification holders which indicate no wage growth in 2004 and 2010 (as opposed to degree and higher qualification holders in Table 6(a)) and the banking sector which indicates no wage growth in 2009 and negative wage growth in 2010 (as opposed to no wage growth in 2009 and 2010 in Table 6(a)).

Table 7(b): Estimates of the impact of the recession on the gender wage gap, young workers, selectivity corrected: LFS 2002-2010

	All	FT	PT	Degree	Higher QF	A-Level	GCSE	Other QF	Private
Woman	-0.037**	-0.056**	-0.000	-0.021#	-0.068**	-0.157**	-0.017#	0.029	-0.071**
	(0.005)	(0.004)	(0.013)	(0.012)	(0.022)	(0.013)	(0.010)	(0.020)	(0.004)
Woman in recession	-0.003	-0.012	0.007	0.020	0.043*	-0.016	-0.010	0.020	-0.011
	(0.005)	(0.009)	(0.015)	(0.015)	(0.021)	(0.011)	(0.013)	(0.025)	(0.007)
Mills ratio	-0.063**	1.627*	0.299	-0.109**	-0.127**	0.105**	-0.068**	-0.168**	-2.029**
	(0.008)	(0.827)	(0.255)	(0.035)	(0.045)	(0.021)	(0.014)	(0.027)	(0.399)
2002	-0.010	-0.005	-0.030**	-0.003	-0.018	-0.012	-0.006	-0.039	-0.005
	(0.006)	(0.007)	(0.010)	(0.015)	(0.024)	(0.010)	(0.011)	(0.024)	(0.007)
2004	0.046**	0.043**	0.049**	-0.020	0.056*	0.036**	0.031*	0.016	0.049**
	(0.005)	(0.008)	(0.014)	(0.013)	(0.023)	(0.011)	(0.014)	(0.023)	(0.008)
2005	0.076**	0.072**	0.072**	0.008	0.066**	0.047**	0.057**	0.059*	0.077**
	(0.007)	(0.008)	(0.012)	(0.014)	(0.023)	(0.011)	(0.012)	(0.027)	(0.007)
2006	0.037**	0.033**	0.044**	-0.001	0.049#	0.040**	0.053**	0.026	0.036**
	(0.005)	(0.008)	(0.013)	(0.014)	(0.025)	(0.009)	(0.009)	(0.022)	(0.008)
2007	0.055**	0.046**	0.061**	0.021#	0.081**	0.070**	0.068**	0.014	0.054**
	(0.006)	(0.008)	(0.013)	(0.012)	(0.022)	(0.011)	(0.011)	(0.022)	(0.006)
2008	0.041**	0.043**	0.035*	-0.002	0.024	0.060**	0.054**	-0.006	0.048**
	(0.006)	(0.006)	(0.015)	(0.017)	(0.026)	(0.013)	(0.011)	(0.024)	(0.007)
2009	0.027**	0.029**	0.033#	-0.024	0.011	0.048**	0.051**	-0.037	0.025**
	(0.006)	(0.007)	(0.018)	(0.017)	(0.032)	(0.015)	(0.014)	(0.026)	(0.007)
2010	-0.008	-0.011	0.018	-0.067**	-0.042	0.005	0.025#	-0.032	-0.014
	(0.006)	(0.008)	(0.017)	(0.015)	(0.026)	(0.014)	(0.015)	(0.028)	(0.009)
Observations	57349	42259	15083	12515	3640	15473	14478	5152	46756
R^2	0.401	0.398	0.193	0.231	0.231	0.282	0.308	0.220	0.391

Note: Estimates from OLS hourly wage equations, wages deflated to 2010 prices. See text for details. All models also control for other socio-economic characteristics. Standard errors in parentheses. Bootstrapped standard errors (50 replications). Banking estimates are not presented due to quasi complete separation in the collapsed categorical variables. Full estimates are presented in Appendix III, Table 4. **, *, # indicates statistical significance at the 1%, 5% and 10% level respectively. Dependent variable: log hourly real wage. Abbreviations: FT, full-time; PT, part-time; QF, qualification.

Table 7(b) presents the estimates from the model that includes all young employees under 30 years of age (both full-time and part-time, from all sectors) corrected for selectivity. The estimates indicate that, on average across the observation period, women received wages that were 3.7% lower than an observationally equivalent man. This indicates that the wage gap for young workers decreased by 3.3 percentage points after being corrected for selectivity. The interaction term capturing the wages of women during the recession period, which indicates the extent to which the gender wage gap deviated from its average across the observation period, is small and is not statistically significant, similar to the estimates in Table 6(b). Hence, on average, the recession had little impact on the gender wage gap for young employees. As regards full-time young workers, the selectivity adjusted and non-selectivity adjusted wage gender gap estimates are similar (0.3 percentage point increase in the selectivity adjusted wage gender gap in the observation period). Contrary to the non-selectivity adjusted estimates in Table 6(b) we observe no statistical significance regarding the impact of the recession on the wage gender gap for young full-time workers. Contrary to the non-selectivity estimates presented in Table 6(b), we observe that in the other qualifications category the wage gap is not statistically significant. The recession appears to have had no impact on the wage gender gap in the different educational attainment categories, except in the higher education category where young women experienced a wage premium of 4.3% during the recession. Young women in the private sector faced a wage penalty of 7.1% relative to otherwise similar men (a reduction of 1.5 percentage points from the non-selectivity adjusted estimates in the observation period). However, the selection adjusted estimates regarding the impact of the recession on the gender wage gap remain statistically insignificant, as was the case for the non-selectivity corrected estimates (Table 6(b)).

In Table 7(b) regarding wage growth from analogous models on young employees aged under 30 the estimates indicate that in the first three models (all employees, full-time, part-time) the rate of wage growth increases each year until 2005, whereas from 2006 onwards it

falls year upon year (with the exception of 2007) to the point that in 2010 is not statistically significant. As regards estimates for different levels of educational attainment for young workers, the pattern of wage growth follows the previous three models with the exception of degree holders where it fluctuates. However, for young workers we find no wage growth for degree holders - with the exception of 2007- and a negative wage growth in 2010 (relative to 2003). Young higher qualification holders experience the same wage growth pattern as previous models although, from 2008 onwards we observe no wage growth similar with the non-selectivity estimates in Table 6(b). As stated above, we find that A-Level and GCSE holders experienced a similar pattern of wage growth in the observational period as previous models. However, we find that GCSE holders experience a weak wage growth in 2010 in contrast with non-selectivity estimates presented in Table 6(b), where we find no wage growth in 2010. As with the non-selectivity estimates in Table 6(b), we find no wage growth for other qualification holders in all years except 2005. Finally, young workers in the private sector follow the same wage growth pattern as all employees (first column in Table 7(b)).

Conclusion and policy implications

Gender equality at work is the focus of the present study, which explores the gender wage gap in the UK during the recent recession. The gender pay gap is a widely used indicator of progress as regards pay equality in the labour market and the workplace, while the 2008/9 recession hit the UK after several reforms which made the labour market more flexible. Thus, the results of the study are of special significance for policy makers who are interested in promoting gender equality, economic growth and social cohesion.

The empirical results of this study indicate a small reduction in the gender wage gap during the period under review. However, there are variations among subgroups of the population with different impacts of the recession on the gender wage gap. More specifically, in the working age sample there is some evidence of a gradual fall in the gender wage gap over the

recession period, from 21.1% in 2008, to 20.1% in 2009, and 18.8% in 2010. This decline may have been accelerated by the onset of the recession in 2008/9. For full-time employees there is some evidence of a gradual fall in the gender wage gap over the recession period, consistent with the long-term trend, from 16.2% in 2008, to 15.5% in 2009, and 14.8% in 2010.

The sharp decline in the wage penalty for female workers could be attributed to the loss of jobs for men. The fall in male employment is consistent with previous findings, for example Bell and Blanchflower (2010b) using LFS data find that male employment fell by 3% while female employment fell by 0.7%. In addition, recessions have gender-specific employment patterns, with male employment rates declining sharply whereas female employment rates experience only a minor fall (Gregg and Wadsworth, 2010).

Our analysis indicates that part-time female employees face a premium relative to part-time male workers in the recession. These findings show the important influence part-time employment appears to have on the gender wage gap in the UK, as about half of all women employed in the UK work in part-time jobs, because the flexibility in hours facilitates employment amongst women of all ages (Connelly and Gregory, 2008). Another important point to be considered is the legal framework and the effectiveness of equality policies introduced by the government to improve the status of part-time employees, mainly the national minimum wage and the prevention of less favourable treatment rules. The absolute gender wage gap for part-time employees is negative in all the years, meaning that on average women in part-time jobs earn more than men.

Although the empirical results of the present study must be considered as indicative, they are broadly in line with findings of previous research which reveal that women earn significantly less than men in the labour market and that the gender wage gap persists, although it has been narrowing over time (Perfect, 2011; Azmat, 2015). However, there is

no consensus about the real causes of the difference in pay between the sexes. Research evidence points to the influence of a range of factors – personal, institutional and structural – and suggests that a large part of the gender wage gap remains unexplained when controlling for differences in observable characteristics and productivity-related factors (Drolet, 2002). The remainder of the gap is usually attributed to unobservable characteristics or believed to result from the choices made by the workers themselves (job preferences, career choices) or, alternatively, from discrimination. It is also argued that these preferences or choices made by men and women may be a consequence of their different roles within the structure of society. Another factor is the tendency among employers to treat male and female applicants differently, a phenomenon that might contribute to maintaining occupational segregation. It is also argued that segregation of jobs and women's childbearing responsibilities are two factors linked to the pay gap because predominantly female jobs pay less, on average, than predominantly male jobs (England, 2005; Azmat, 2015; Fawcett Society, 2015). Other researchers emphasise the structural elements of the labour market rather than the differences in the characteristics of men and women (New JNCHES, 2011).

Our estimates also suggest that on average the recession had a small effect on the gender wage gap for the working age sample. However, we find that this hides different impacts across particular population subgroups. For instance, the recession had no effect on the gender wage gap for the full-time working age sample. The recession also had differential impacts on the gender wage gap among workers with different educational qualifications. We find that the recession had an impact on the gender wage gap for A-Level holders and for those with other qualifications, whereas for all other educational qualifications it had no effect on the gender wage gap. In the banking sector the recession also had an impact on the gender wage gap, indicating a wage premium of around 3% for women. This is a point that needs further investigation. Regarding young workers under 30 years of age, we find no effect of the recession on the gender wage gap, though the recession had a weak effect on

the gender wage gap for full-time young workers. In all other specifications we find no effect of the recession on the gender wage gap.

The empirical results of the present study indicate that the small reduction in the gender wage gap during the 2008/9 recession appears to be due to the reduction in men's wages (see Table 1). However wage inequality between men and women is a complex issue. Given that the recession affected men more than women, one might have expected a larger reduction in the gender wage gap. Drawing on prior research evidence other factors should be taken into consideration. Firstly, the resilience of the market, mostly due to its flexibility. As Gregg and Wadsworth (2010, p.50) observe, "the labour market and the welfare system have performed well" in the 2008/9 recession. Other factors to be taken into consideration include the role of segregation, leading to differential effects on sectors and occupations, and the over-representation of women in part-time jobs and in the public sector. As discussed earlier, part-time work responds differently to business cycle effects relative to full-time employment. In contrast to men's falling employment rates, which is a long-standing trend, women's comparative advantage in services increased their participation rates in the labour market. The introduction of the national minimum wage is another factor considered to have had a positive impact on women's outcomes in the labour market (Swaffield, 2011) and might have contributed to the reduction of the gender gap in pay (Azmat, 2015). To achieve a smaller wage gap would entail wider changes involving, according to Swaffield (2011), a change in women's choices of occupations, upgrading rewards for jobs in feminized sectors, and creating quality part-time jobs.

Regarding gender equality policies and future prospects, concerns have been expressed over the possibility of governments using the economic crisis as an excuse to slow down progress on equality policies (Smith, 2009). There are also concerns regarding the tendency to view gender equality as a human right rather than as a political issue (Aseskog, 2015), while the TUC (2015, p14) sees "a more hostile political climate" developing following the 2008/9

economic downturn. Apart from the negative impacts on living standards, employment rates and national productivity, recessions can be viewed as a 'test' of labour market policies introduced since 1996 (Gregg and Wadsworth, 2010). Thus the differential effects of the 2008/9 recession on the labour market have significant implications for policy makers. According to the evidence gathered in this study, the recent recession has influenced various subgroups in the population to different extents. Comparisons between the working age and under 30s samples, as well as between full-time and part-time employees, indicate that women's wages relative to men's were affected to a different degree. Future policies and strategies should study these variations, and the different influences of the recent economic crisis on the wages of specific groups within society, considering the main trends, strengths and issues that emerged as a result of the shock of the recent recession and its different level impacts. Viewed in a broader context, we believe the results of the present study also have wider implications not only for policies and strategies promoting gender equality at work, but are related to significant issues regarding the debate on social roles, social cohesion, market inequalities, poverty and state intervention theories.

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Appendix I Descriptive statistics

Table 1: Descriptive statistics for working age sample (2002-2010)

	Males		Females	
	Mean	Standard deviation	Mean	Standard deviation
Age	40.204	12.330	40.045	12.001
Age^2	1768.412	1005.168	1747.661	966.689
Regions				
Tyne and Wear	0.022	0.146	0.022	0.145
North	0.080	0.272	0.081	0.273
Manchester	0.043	0.204	0.044	0.205
Merseyside	0.018	0.134	0.019	0.138
York	0.101	0.302	0.101	0.301
Midlands	0.171	0.377	0.167	0.373
East	0.090	0.287	0.088	0.283
South West	0.088	0.283	0.091	0.287
Wales	0.045	0.208	0.047	0.213
Scotland	0.096	0.294	0.099	0.298
Ethnicity				
Mixed	0.005	0.073	0.006	0.080
Asian	0.038	0.191	0.029	0.168
Chinese	0.003	0.055	0.003	0.059
Other	0.010	0.100	0.008	0.092
Black	0.016	0.125	0.018	0.135
Highest qualification achieved				
Degree	0.212	0.409	0.204	0.403
Higher QF	0.086	0.281	0.111	0.314
A-level	0.260	0.439	0.170	0.375
GCSE	0.177	0.382	0.255	0.436
Other QF	0.116	0.321	0.104	0.305
FT	0.916	0.277	0.578	0.494
Banking	0.148	0.355	0.143	0.350
Private	0.795	0.403	0.619	0.485
Observations	121,755		132,618	

Note: Labour Force Survey 2002-2010. Abbreviations: QF, qualification; FT, full-time.

Table 2: Descriptive statistics for young workers sample (2002-2010)

	Males		Females	
	Mean	Standard deviation	Mean	Standard deviation
Age	23.581	3.812	23.633	3.822
Age^2	570.613	176.115	573.131	176.353
Regions				
Tyne and Wear	0.025	0.155	0.023	0.148
North	0.078	0.268	0.080	0.271
Manchester	0.047	0.212	0.047	0.211
Merseyside	0.019	0.136	0.018	0.133
York	0.103	0.304	0.105	0.307
Midlands	0.162	0.368	0.160	0.367
East	0.089	0.284	0.088	0.283
South West	0.084	0.278	0.089	0.284
Wales	0.045	0.208	0.050	0.217
Scotland	0.094	0.292	0.095	0.293
Ethnicity				
Mixed	0.010	0.098	0.012	0.107
Asian	0.049	0.215	0.040	0.195
Chinese	0.005	0.068	0.004	0.066
Other	0.012	0.110	0.010	0.099
Black	0.014	0.119	0.017	0.129
Highest qualification achieved				
Degree	0.196	0.397	0.239	0.427
Higher QF	0.057	0.232	0.069	0.254
A-level	0.277	0.448	0.263	0.440
GCSE	0.248	0.432	0.256	0.437
Other QF	0.106	0.308	0.075	0.263
FT	0.826	0.379	0.654	0.475
Banking	0.161	0.367	0.169	0.374
Private	0.872	0.334	0.766	0.423
Observations	27,484		29,865	

Note: Labour Force Survey 2002-2010. Abbreviations: QF, qualification; FT, full-time.

Appendix II Yearly estimates

Table 1: Yearly estimates for all workers (not selectivity corrected), LFS 2002-2010

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Female	-0.214**	-0.213**	-0.213**	-0.209**	-0.205**	-0.199**	-0.211**	-0.201**	-0.188**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Age	0.071**	0.070**	0.075**	0.074**	0.068**	0.069**	0.067**	0.065**	0.070**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ethnicity									
Mixed	-0.017	0.044	-0.070*	0.037	-0.011	-0.066*	0.013	-0.003	0.027
	(0.035)	(0.031)	(0.032)	(0.035)	(0.030)	(0.031)	(0.030)	(0.030)	(0.032)
Asian	-0.099**	-0.072**	-0.100**	-0.107**	-0.063**	-0.116**	-0.108**	-0.078**	-0.112**
	(0.014)	(0.014)	(0.015)	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)
Chinese	-0.181**	-0.105*	0.015	-0.077#	-0.142**	-0.181**	-0.115**	-0.119**	-0.132**
	(0.043)	(0.045)	(0.046)	(0.043)	(0.043)	(0.039)	(0.040)	(0.043)	(0.043)
Other	-0.063*	-0.048#	-0.079**	-0.100**	-0.136**	-0.136**	-0.095**	-0.130**	-0.125**
	(0.030)	(0.028)	(0.030)	(0.027)	(0.023)	(0.024)	(0.022)	(0.025)	(0.025)
Black	-0.042*	-0.081**	-0.133**	-0.110**	-0.099**	-0.122**	-0.116**	-0.151**	-0.126**
	(0.019)	(0.019)	(0.020)	(0.020)	(0.018)	(0.017)	(0.018)	(0.019)	(0.019)
Highest Qualification Achieved									
Degree	0.751**	0.757**	0.474**	0.467**	0.736**	0.720**	0.720**	0.723**	0.713**
	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.010)	(0.010)	(0.011)
Higher QF	0.531**	0.521**	0.284**	0.262**	0.501**	0.493**	0.491**	0.482**	0.486**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)
A-level	0.305**	0.311**	0.080**	0.050**	0.305**	0.316**	0.306**	0.315**	0.287**
	(0.008)	(0.009)	(0.007)	(0.007)	(0.009)	(0.009)	(0.010)	(0.010)	(0.011)
GCSE	0.223**	0.210**	-0.031**	-0.048**	0.205**	0.199**	0.189**	0.191**	0.187**
	(0.008)	(0.009)	(0.007)	(0.007)	(0.009)	(0.009)	(0.010)	(0.010)	(0.011)
Other QF	0.115**	0.121**	-0.112**	-0.132**	0.122**	0.117**	0.104**	0.117**	0.117**
	(0.009)	(0.009)	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)	(0.012)	(0.012)
N	30611	29806	28759	28191	27736	28977	28317	26328	25648
R^2	0.411	0.412	0.311	0.312	0.401	0.385	0.388	0.384	0.373

Note: Estimates from OLS log hourly wage equations, wages deflated to 2010 prices. All models also control for age squared, regional residency, and constant term. Statistical significance: #p<0.1; *p<0.05; **p<0.01. Estimated coefficients; Standard errors in parentheses. Dependent variable: log hourly real wage. Abbreviations: QF, qualification.

Table 2: Yearly estimates for young workers (not selectivity corrected), LFS 2002-2010

	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Female	-0.090**	-0.067**	-0.070**	-0.060**	-0.067**	-0.068**	-0.086**	-0.071**	-0.072**
	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)
Age	0.114**	0.101**	0.117**	0.136**	0.088**	0.104**	0.109**	0.127**	0.091**
	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.017)	(0.017)
Ethnicity									
Mixed	-0.088#	0.051	-0.133**	0.053	0.030	-0.057	0.015	-0.020	0.071
	(0.050)	(0.039)	(0.044)	(0.046)	(0.042)	(0.040)	(0.037)	(0.040)	(0.047)
Asian	-0.050*	-0.082**	-0.055*	-0.071**	-0.011	-0.091**	-0.055**	-0.070**	-0.100**
	(0.021)	(0.021)	(0.024)	(0.021)	(0.021)	(0.021)	(0.020)	(0.024)	(0.023)
Chinese	-0.196**	-0.181**	-0.013	-0.132*	-0.025	-0.226**	-0.129*	-0.110	-0.186**
	(0.062)	(0.067)	(0.066)	(0.057)	(0.068)	(0.063)	(0.058)	(0.076)	(0.070)
Other	-0.106*	-0.021	-0.077	-0.136**	-0.066	-0.120**	-0.056	-0.100*	-0.054
	(0.051)	(0.044)	(0.051)	(0.041)	(0.041)	(0.037)	(0.034)	(0.042)	(0.044)
Black	-0.069*	-0.073*	-0.187**	-0.153**	-0.052#	-0.058#	-0.105**	-0.147**	-0.091*
	(0.034)	(0.034)	(0.038)	(0.036)	(0.032)	(0.033)	(0.034)	(0.038)	(0.039)
Highest Qualification Achieved									
Degree	0.482**	0.509**	0.253**	0.223**	0.420**	0.444**	0.430**	0.431**	0.399**
	(0.020)	(0.020)	(0.014)	(0.014)	(0.021)	(0.020)	(0.021)	(0.023)	(0.025)
Higher QF	0.263**	0.296**	0.128**	0.068**	0.257**	0.282**	0.244**	0.260**	0.209**
	(0.023)	(0.024)	(0.021)	(0.021)	(0.025)	(0.024)	(0.025)	(0.028)	(0.029)
A-level	0.178**	0.208**	0.029*	-0.019	0.159**	0.192**	0.169**	0.189**	0.153**
	(0.018)	(0.019)	(0.013)	(0.012)	(0.020)	(0.020)	(0.020)	(0.023)	(0.024)
GCSE	0.118**	0.137**	-0.044**	-0.080**	0.098**	0.117**	0.092**	0.121**	0.089**
	(0.018)	(0.019)	(0.013)	(0.013)	(0.020)	(0.020)	(0.020)	(0.023)	(0.025)
Other QF	0.056**	0.126**	-0.090**	-0.097**	0.052*	0.047*	0.023	0.023	0.031
	(0.022)	(0.022)	(0.019)	(0.019)	(0.023)	(0.022)	(0.022)	(0.026)	(0.028)
N	7189	6714	6415	6315	6249	6598	6446	5784	5639
R^2	0.446	0.445	0.378	0.393	0.396	0.416	0.410	0.388	0.348

Note: Estimates from OLS log hourly wage equations, wages deflated to 2010 prices. All models also control for age squared, regional residency, and constant term. Statistical significance: #p<0.1; *p<0.05; **p<0.01. Estimated coefficients; Standard errors in parentheses. Dependent variable: log hourly real wage. Abbreviations: QF, qualification.

Table 3: Yearly estimates for full-time workers (not selectivity corrected), LFS 2002-2010

	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Female	-0.156**	-0.156**	-0.148**	-0.139**	-0.153**	-0.156**	-0.162**	-0.155**	-0.148**
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Age	0.076**	0.075**	0.080**	0.079**	0.075**	0.073**	0.072**	0.071**	0.074**
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ethnicity									
Mixed	-0.004	0.016	-0.061#	0.007	-0.010	-0.066#	-0.016	-0.008	0.014
	(0.041)	(0.034)	(0.036)	(0.039)	(0.033)	(0.035)	(0.034)	(0.034)	(0.036)
Asian	-0.100**	-0.085**	-0.114**	-0.116**	-0.069**	-0.113**	-0.103**	-0.076**	-0.083**
	(0.015)	(0.016)	(0.017)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)
Chinese	-0.139**	-0.100#	0.073	-0.006	-0.159**	-0.179**	-0.090#	-0.062	-0.151**
	(0.053)	(0.052)	(0.058)	(0.049)	(0.051)	(0.044)	(0.047)	(0.049)	(0.049)
Other	-0.086**	-0.042	-0.096**	-0.069*	-0.158**	-0.131**	-0.107**	-0.109**	-0.108**
	(0.033)	(0.032)	(0.032)	(0.031)	(0.026)	(0.026)	(0.024)	(0.028)	(0.029)
Black	-0.082**	-0.114**	-0.164**	-0.143**	-0.143**	-0.141**	-0.155**	-0.168**	-0.168**
	(0.021)	(0.021)	(0.022)	(0.023)	(0.020)	(0.019)	(0.020)	(0.021)	(0.022)
Highest Qualification Achieved									
Degree	0.732**	0.729**	0.427**	0.427**	0.712**	0.698**	0.704**	0.710**	0.700**
	(0.010)	(0.010)	(0.008)	(0.008)	(0.011)	(0.011)	(0.011)	(0.012)	(0.013)
Higher QF	0.518**	0.503**	0.250**	0.221**	0.484**	0.484**	0.501**	0.477**	0.477**
	(0.011)	(0.012)	(0.011)	(0.011)	(0.012)	(0.013)	(0.013)	(0.014)	(0.015)
A-level	0.312**	0.316**	0.068**	0.041**	0.314**	0.320**	0.312**	0.320**	0.292**
	(0.010)	(0.010)	(0.008)	(0.008)	(0.011)	(0.011)	(0.011)	(0.012)	(0.013)
GCSE	0.246**	0.227**	-0.041**	-0.056**	0.209**	0.205**	0.198**	0.191**	0.200**
	(0.010)	(0.010)	(0.009)	(0.009)	(0.011)	(0.011)	(0.011)	(0.012)	(0.013)
Other QF	0.128**	0.120**	-0.121**	-0.154**	0.131**	0.112**	0.104**	0.116**	0.111**
	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.013)	(0.014)	(0.015)
N	22594	21734	21239	20957	20541	21656	21188	19400	18824
R^2	0.396	0.398	0.294	0.294	0.388	0.377	0.380	0.381	0.364

Note: Estimates from OLS log hourly wage equations, wages deflated to 2010 prices. All models also control for age squared, regional residency, and constant term. Statistical significance: #p<0.1; *p<0.05; **p<0.01. Estimated coefficients; Standard errors in parentheses. Dependent variable: log hourly real wage. Abbreviations: QF, qualification.

Table 4: Yearly estimates for part-time workers (not selectivity corrected), LFS 2002-2010

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Female	0.008	0.023#	-0.010	-0.028#	0.002	0.017	-0.016	0.024#	0.013
	(0.013)	(0.013)	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Age	0.039**	0.038**	0.044**	0.044**	0.037**	0.039**	0.038**	0.034**	0.039**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ethnicity									
Mixed	-0.026	0.062	-0.104#	0.093	-0.037	-0.047	0.099#	0.024	0.050
	(0.062)	(0.065)	(0.060)	(0.069)	(0.058)	(0.060)	(0.060)	(0.056)	(0.064)
Asian	-0.052#	-0.002	-0.021	-0.031	-0.005	-0.075**	-0.074**	0.001	-0.115**
	(0.028)	(0.027)	(0.031)	(0.029)	(0.029)	(0.027)	(0.025)	(0.024)	(0.025)
Chinese	-0.130#	-0.025	0.022	-0.231**	-0.042	-0.160*	-0.129#	-0.257**	-0.046
	(0.068)	(0.082)	(0.072)	(0.078)	(0.074)	(0.078)	(0.073)	(0.081)	(0.084)
Other	0.032	-0.028	-0.025	-0.062	-0.009	-0.093#	-0.041	-0.154**	-0.110*
	(0.062)	(0.055)	(0.067)	(0.046)	(0.047)	(0.049)	(0.046)	(0.050)	(0.049)
Black	0.066#	0.011	-0.035	-0.012	0.020	-0.050	0.023	-0.092*	0.005
	(0.040)	(0.038)	(0.041)	(0.041)	(0.036)	(0.036)	(0.037)	(0.038)	(0.038)
Highest Qualification Achieved									
Degree	0.712**	0.752**	0.549**	0.538**	0.724**	0.704**	0.684**	0.657**	0.667**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.020)
Higher QF	0.505**	0.516**	0.341**	0.362**	0.492**	0.469**	0.412**	0.420**	0.462**
	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)	(0.020)	(0.020)	(0.021)	(0.022)
A-level	0.217**	0.234**	0.075**	0.053**	0.221**	0.250**	0.245**	0.245**	0.226**
	(0.015)	(0.015)	(0.015)	(0.015)	(0.017)	(0.017)	(0.018)	(0.018)	(0.019)
GCSE	0.153**	0.164**	0.000	-0.007	0.179**	0.166**	0.147**	0.161**	0.137**
	(0.014)	(0.014)	(0.013)	(0.013)	(0.015)	(0.016)	(0.016)	(0.017)	(0.018)
Other QF	0.065**	0.092**	-0.090**	-0.062**	0.075**	0.106**	0.084**	0.076**	0.086**
	(0.016)	(0.016)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)	(0.020)	(0.022)
N	8013	8069	7515	7232	7192	7319	7127	6928	6824
R^2	0.306	0.318	0.232	0.246	0.323	0.301	0.298	0.298	0.311

Note: Estimates from OLS log hourly wage equations, wages deflated to 2010 prices. All models also control for age squared, regional residency, and constant term. Statistical significance: #p<0.1; *p<0.05; **p<0.01. Estimated coefficients; Standard errors in parentheses. Dependent variable: log hourly real wage. Abbreviations: QF, qualification.

Appendix III The impact of the recession on the gender wage gap

Table 1: Estimates of the impact of the recession on the gender wage gap, all workers: LFS 2002-2010

	All	FT	PT	Degree	Higher QF	A-level	GCSE	Other QF	Banking	Private
Woman	-0.209**	-0.150**	0.002	-0.145**	-0.209**	-0.218**	-0.226**	-0.212**	-0.198**	-0.232**
	(0.002)	(0.002)	(0.006)	(0.005)	(0.007)	(0.004)	(0.004)	(0.006)	(0.006)	(0.002)
Woman in recession	0.007*	-0.006	0.004	-0.006	-0.005	-0.019*	0.008	0.023*	0.033**	0.005
	(0.004)	(0.004)	(0.009)	(0.008)	(0.011)	(0.007)	(0.007)	(0.010)	(0.010)	(0.004)
Age	0.070**	0.076**	0.039**	0.102**	0.075**	0.079**	0.066**	0.046**	0.091**	0.075**
	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ethnicity										
Mixed	-0.007	-0.016	0.008	-0.003	0.032	-0.047*	0.011	0.020	-0.023	-0.012
	(0.011)	(0.012)	(0.020)	(0.022)	(0.036)	(0.024)	(0.022)	(0.030)	(0.027)	(0.013)
Asian	-0.100**	-0.100**	-0.047**	-0.080**	-0.120**	-0.073**	-0.076**	-0.061**	-0.105**	-0.145**
	(0.005)	(0.005)	(0.009)	(0.009)	(0.016)	(0.012)	(0.013)	(0.010)	(0.012)	(0.005)
Chinese	-0.118**	-0.095**	-0.109**	-0.094**	-0.205**	-0.208**	-0.244**	-0.032	-0.047	-0.146**
	(0.014)	(0.017)	(0.025)	(0.022)	(0.052)	(0.049)	(0.053)	(0.033)	(0.036)	(0.017)
Other	-0.111**	-0.111**	-0.063**	-0.177**	-0.164**	-0.103**	-0.104**	-0.036*	-0.173**	-0.148**
	(0.009)	(0.010)	(0.017)	(0.017)	(0.029)	(0.026)	(0.029)	(0.015)	(0.023)	(0.010)
Black	-0.111**	-0.144**	-0.010	-0.210**	-0.113**	-0.097**	-0.055**	-0.055**	-0.267**	-0.153**
	(0.006)	(0.007)	(0.013)	(0.014)	(0.017)	(0.016)	(0.015)	(0.014)	(0.016)	(0.008)
Highest Qualification Achieved										
Degree	0.625**	0.588**	0.642**						0.527**	0.613**
	(0.003)	(0.003)	(0.006)						(0.009)	(0.004)
Higher QF	0.402**	0.375**	0.421**						0.315**	0.376**
	(0.003)	(0.004)	(0.006)						(0.011)	(0.004)
A-level	0.204**	0.194**	0.175**						0.243**	0.218**
	(0.003)	(0.003)	(0.005)						(0.009)	(0.003)
GCSE	0.099**	0.092**	0.102**						0.121**	0.111**
	(0.003)	(0.003)	(0.005)						(0.009)	(0.003)
Other QF	0.015**	0.000	0.028**						0.031**	0.022**
	(0.003)	(0.004)	(0.006)						(0.011)	(0.004)
Observations	254373	188133	66219	52974	25251	54198	55406	27895	37014	178759
R^2	0.372	0.358	0.293	0.199	0.171	0.261	0.240	0.154	0.345	0.370

Note: Estimates from OLS hourly wage equations, wages deflated to 2010 prices. See text for details. All models also control for year effects and age squared, regional residency, and constant term. Estimated coefficients; Standard errors in parentheses. **, *, # indicates statistical significance at the 1%, 5% and 10% level respectively. Dependent variable: log hourly real wage. Abbreviations: FT, full-time; PT, part-time; QF, qualification.

Table 2: Estimates of the impact of the recession on the gender wage gap, young workers: LFS 2002-2010

	All	FT	PT	Degree	Higher QF	A-level	GCSE	Other QF	Private
Woman	-0.070**	-0.053**	0.012	-0.047**	-0.105**	-0.103**	-0.056**	-0.085**	-0.086**
	(0.003)	(0.004)	(0.008)	(0.008)	(0.014)	(0.007)	(0.006)	(0.012)	(0.004)
Woman in recession	-0.005	-0.014#	0.003	0.016	0.036	-0.011	-0.016	0.011	-0.005
	(0.006)	(0.007)	(0.013)	(0.014)	(0.026)	(0.011)	(0.011)	(0.021)	(0.007)
Age	0.115**	0.144**	0.073**	0.311**	0.165**	0.186**	0.180**	0.141**	0.111**
	(0.005)	(0.007)	(0.009)	(0.030)	(0.031)	(0.011)	(0.008)	(0.018)	(0.006)
Ethnicity									
Mixed	-0.009	-0.001	0.017	0.020	0.089	-0.053*	-0.006	0.064	-0.009
	(0.014)	(0.017)	(0.024)	(0.032)	(0.064)	(0.026)	(0.025)	(0.049)	(0.016)
Asian	-0.067**	-0.054**	-0.006	-0.064**	-0.121**	-0.050**	-0.033#	-0.036#	-0.085**
	(0.007)	(0.008)	(0.013)	(0.013)	(0.031)	(0.016)	(0.018)	(0.018)	(0.008)
Chinese	-0.132**	-0.067*	-0.091**	-0.157**	-0.226*	-0.168**	-0.110	-0.145*	-0.127**
	(0.022)	(0.027)	(0.034)	(0.031)	(0.095)	(0.056)	(0.088)	(0.067)	(0.024)
Other	-0.091**	-0.071**	-0.043#	-0.096**	-0.205**	-0.037	-0.068	-0.061*	-0.095**
	(0.014)	(0.016)	(0.026)	(0.030)	(0.059)	(0.034)	(0.045)	(0.026)	(0.016)
Black	-0.103**	-0.122**	0.011	-0.169**	-0.175**	-0.078**	-0.063*	-0.055#	-0.122**
	(0.012)	(0.014)	(0.020)	(0.028)	(0.041)	(0.023)	(0.025)	(0.028)	(0.013)
Highest Qualification Achieved									
Degree	0.343**	0.323**	0.251**						0.338**
	(0.006)	(0.006)	(0.014)						(0.007)
Higher QF	0.166**	0.161**	0.151**						0.149**
	(0.008)	(0.008)	(0.016)						(0.009)
A-level	0.084**	0.089**	0.073**						0.093**
	(0.006)	(0.006)	(0.010)						(0.006)
GCSE	0.017**	0.006	0.034**						0.026**
	(0.006)	(0.006)	(0.010)						(0.006)
Other QF	-0.037**	-0.048**	-0.005						-0.031**
	(0.007)	(0.008)	(0.014)						(0.007)
Observations	57349	42259	15083	12515	3640	15473	14478	5152	46756
R^2	0.401	0.398	0.193	0.231	0.230	0.280	0.306	0.214	0.391

Note: Estimates from OLS hourly wage equations, wages deflated to 2010 prices. See text for details. All models also control for year effects and age squared, regional residency, and constant term. Estimated coefficients; Standard errors in parentheses. Banking estimates are not presented due to quasi complete separation in the collapsed categorical variables. **, *, # indicates statistical significance at the 1%, 5% and 10% level respectively. Dependent variable: log hourly real wage. Abbreviations: FT, full-time; PT, part-time; QF, qualification.

Table 3: Estimates of the impact of the recession on the gender wage gap, all workers, selectivity corrected: LFS 2002-2010

	All	FT	PT	Degree	Higher QF	A-level	GCSE	Other QF	Banking	Private
Woman	-0.193**	-0.148**	-0.021	-0.095**	-0.227**	-0.230**	-0.206**	-0.216**	-0.164**	-0.197**
	(0.003)	(0.003)	(0.013)	(0.008)	(0.013)	(0.009)	(0.006)	(0.012)	(0.006)	(0.003)
Woman in recession	0.009**	-0.006	0.006	0.001	-0.010	-0.020**	0.011	0.022*	0.030**	0.002
	(0.003)	(0.004)	(0.011)	(0.008)	(0.013)	(0.008)	(0.007)	(0.010)	(0.010)	(0.004)
Mills ratio	-0.035**	-0.431	0.616*	-0.176**	0.060#	0.028#	-0.042**	0.007	-2.421**	-1.952**
	(0.007)	(0.638)	(0.297)	(0.026)	(0.036)	(0.016)	(0.010)	(0.019)	(0.257)	(0.129)
Age	0.069**	0.075**	0.041**	0.099**	0.077**	0.080**	0.064**	0.046**	0.091**	0.074**
	(0.000)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ethnicity										
Mixed	-0.005	-0.016	-0.004	0.007	0.031	-0.048*	0.014	0.020	-0.026	-0.011
	(0.012)	(0.014)	(0.023)	(0.020)	(0.032)	(0.025)	(0.024)	(0.033)	(0.028)	(0.014)
Asian	-0.094**	-0.099**	-0.057**	-0.067**	-0.123**	-0.078**	-0.067**	-0.062**	-0.105**	-0.140**
	(0.005)	(0.005)	(0.012)	(0.011)	(0.014)	(0.013)	(0.011)	(0.013)	(0.014)	(0.007)
Chinese	-0.113**	-0.088**	-0.124**	-0.072**	-0.212**	-0.214**	-0.238**	-0.033	-0.048	-0.142**
	(0.018)	(0.023)	(0.030)	(0.023)	(0.052)	(0.063)	(0.058)	(0.038)	(0.037)	(0.020)
Other	-0.106**	-0.111**	-0.061**	-0.155**	-0.168**	-0.108**	-0.097**	-0.036*	-0.173**	-0.144**
	(0.010)	(0.012)	(0.021)	(0.022)	(0.032)	(0.033)	(0.025)	(0.015)	(0.025)	(0.011)
Black	-0.108**	-0.144**	-0.018	-0.202**	-0.115**	-0.100**	-0.050**	-0.056**	-0.270**	-0.151**
	(0.006)	(0.006)	(0.014)	(0.013)	(0.015)	(0.015)	(0.013)	(0.015)	(0.017)	(0.007)
Highest Qualification Achieved										
Degree	0.617**	0.588**	0.645**						0.538**	0.614**
	(0.003)	(0.004)	(0.006)						(0.010)	(0.005)
Higher QF	0.394**	0.374**	0.424**						0.339**	0.380**
	(0.004)	(0.005)	(0.006)						(0.012)	(0.005)
A-level	0.198**	0.194**	0.181**						0.246**	0.216**
	(0.003)	(0.003)	(0.006)						(0.009)	(0.004)
GCSE	0.094**	0.092**	0.103**						0.124**	0.112**
	(0.003)	(0.004)	(0.004)						(0.010)	(0.003)
Other QF	0.011**	0.000	0.026**						0.038**	0.024**
	(0.003)	(0.004)	(0.006)						(0.013)	(0.003)
Observations	254373	188133	66219	52974	25251	54198	55406	27895	37014	178759
R^2	0.372	0.358	0.293	0.199	0.171	0.261	0.240	0.154	0.346	0.371

Note: Estimates from OLS hourly wage equations, wages deflated to 2010 prices. See text for details. All models also control for year effects and age squared, regional residency, and constant term. Estimated coefficients; Standard errors in parentheses. Bootstrapped standard errors (50 replications). **, *, # indicates statistical significance at the 1%, 5% and 10% level respectively. Dependent variable: log hourly real wage. Abbreviations: FT, full-time; PT, part-time; QF, qualification.

Table 4: Estimates of the impact of the recession on the gender wage gap, young workers, selectivity corrected: LFS 2002-2010

	All	FT	PT	Degree	Higher QF	A-level	GCSE	Other QF	Private
Woman	-0.037**	-0.056**	-0.000	-0.021#	-0.068**	-0.157**	-0.017#	0.029	-0.071**
	(0.005)	(0.004)	(0.013)	(0.012)	(0.022)	(0.013)	(0.010)	(0.020)	(0.004)
Woman in recession	-0.003	-0.012	0.007	0.020	0.043*	-0.016	-0.010	0.020	-0.011
	(0.005)	(0.009)	(0.015)	(0.015)	(0.021)	(0.011)	(0.013)	(0.025)	(0.007)
Mills ratio	-0.063**	1.627*	0.299	-0.109**	-0.127**	0.105**	-0.068**	-0.168**	-2.029**
	(0.008)	(0.827)	(0.255)	(0.035)	(0.045)	(0.021)	(0.014)	(0.027)	(0.399)
Age	0.104**	0.145**	0.079**	0.281**	0.142**	0.202**	0.164**	0.118**	0.103**
	(0.005)	(0.008)	(0.011)	(0.029)	(0.027)	(0.010)	(0.011)	(0.019)	(0.005)
Ethnicity									
Mixed	-0.005	-0.005	0.009	0.035	0.114*	-0.075**	0.010	0.090#	0.001
	(0.012)	(0.020)	(0.025)	(0.033)	(0.056)	(0.024)	(0.031)	(0.051)	(0.016)
Asian	-0.055**	-0.057**	-0.012	-0.049**	-0.099**	-0.073**	-0.019	-0.008	-0.077**
	(0.009)	(0.011)	(0.016)	(0.014)	(0.034)	(0.015)	(0.019)	(0.021)	(0.008)
Chinese	-0.117**	-0.069*	-0.098**	-0.145**	-0.214**	-0.190**	-0.104	-0.131#	-0.120**
	(0.026)	(0.029)	(0.035)	(0.030)	(0.082)	(0.070)	(0.099)	(0.069)	(0.025)
Other	-0.080**	-0.075**	-0.051#	-0.086*	-0.182*	-0.058	-0.049	-0.037*	-0.087**
	(0.014)	(0.020)	(0.026)	(0.038)	(0.072)	(0.038)	(0.041)	(0.018)	(0.015)
Black	-0.092**	-0.126**	0.004	-0.153**	-0.148**	-0.102**	-0.047	-0.024	-0.113**
	(0.012)	(0.013)	(0.018)	(0.028)	(0.050)	(0.022)	(0.031)	(0.029)	(0.013)
Highest Qualification Achieved									
Degree	0.326**	0.324**	0.252**						0.331**
	(0.008)	(0.006)	(0.015)						(0.008)
Higher QF	0.150**	0.163**	0.152**						0.150**
	(0.010)	(0.007)	(0.016)						(0.008)
A-level	0.075**	0.089**	0.073**						0.088**
	(0.006)	(0.006)	(0.009)						(0.006)
GCSE	0.008	0.006	0.035**						0.024**
	(0.007)	(0.005)	(0.009)						(0.005)
Other QF	-0.043**	-0.048**	-0.005						-0.034**
	(0.007)	(0.007)	(0.013)						(0.008)
Observations	57349	42259	15083	12515	3640	15473	14478	5152	46756
R^2	0.401	0.398	0.193	0.231	0.231	0.282	0.308	0.220	0.391

Note: Estimates from OLS hourly wage equations, wages deflated to 2010 prices. See text for details. All models also control for year effects and age squared, regional residency, and constant term. Estimated coefficients; Standard errors in parentheses. Bootstrapped standard errors (50 replications). Banking estimates are not presented due to quasi complete separation in the collapsed categorical variables. **, *, # indicates statistical significance at the 1%, 5% and 10% level respectively. Dependent variable: log hourly real wage. Abbreviations: FT, full-time; PT, part-time; QF, qualification.

Appendix IV The impact of the recession on the gender wage gap, controlling for dependent children

Table 1: Estimates of the impact of the recession on the gender wage gap: LFS 2002-2010

	All	FT	PT	Degree	Higher QF	A-Level	GCSE	Other QF	Banking	Private
Woman	-0.209**	-0.147**	-0.003	-0.145**	-0.208**	-0.218**	-0.222**	-0.212**	-0.198**	-0.232**
	(0.002)	(0.002)	(0.006)	(0.005)	(0.007)	(0.004)	(0.004)	(0.006)	(0.006)	(0.002)
Woman in recession	0.007*	-0.006	0.003	-0.006	-0.005	-0.017*	0.007	0.023*	0.033**	0.005
	(0.004)	(0.004)	(0.009)	(0.008)	(0.011)	(0.007)	(0.007)	(0.010)	(0.010)	(0.004)
Observations	254373	188133	66219	52974	25251	54198	55406	27895	37014	178759
R^2	0.372	0.358	0.294	0.199	0.172	0.262	0.242	0.154	0.345	0.370

Note: Estimates from OLS hourly wage equations, wages deflated to 2010 prices. See text for details. All models also control for dependent children, year effects, and other socio-economic characteristics. Estimated coefficients; Standard errors in parentheses. **, *, # indicates statistical significance at the 1%, 5% and 10% level respectively. Dependent variable: log hourly real wage. Abbreviations: FT, full-time; PT, part-time; QF, qualification.

Table 2: Estimates of the impact of the recession on the gender wage gap, young workers: LFS 2002-2010

	All	FT	PT	Degree	Higher QF	A-Level	GCSE	Other QF	Private
Woman	-0.065**	-0.055**	0.012	-0.046**	-0.100**	-0.100**	-0.051**	-0.082**	-0.232**
	(0.003)	(0.004)	(0.008)	(0.008)	(0.014)	(0.007)	(0.006)	(0.012)	(0.002)
Woman in recession	-0.004	-0.012#	0.003	0.018	0.040	-0.008	-0.017	0.014	0.005
	(0.006)	(0.007)	(0.013)	(0.014)	(0.026)	(0.011)	(0.011)	(0.021)	(0.004)
Observations	57349	42259	15083	12515	3640	15473	14478	5152	178759
R^2	0.406	0.401	0.193	0.234	0.236	0.285	0.311	0.222	0.370

Note: Estimates from OLS hourly wage equations, wages deflated to 2010 prices. See text for details. All models also control for dependent children, year effects, and other socio-economic characteristics. Estimated coefficients; Standard errors in parentheses. Banking estimates are not presented due to quasi complete separation in the collapsed categorical variables.**, *, # indicates statistical significance at the 1%, 5% and 10% level respectively. Dependent variable: log hourly real wage. Abbreviations: FT, full-time; PT, part-time; QF, qualification.

Chapter 3 Does Postpartum Depression Affect Employment?

Introduction

Depression in the postpartum period (PPD) is considered a major public health problem (Stewart et al., 2003; Hay et al., 2008; Chew-Graham et al., 2009). It is a relatively common psychological disorder following childbirth which, if left untreated, may have long-term adverse effects on women's mental health. It can increase the risk of continuing or recurrent depression for the mother, with adverse consequences for the early mother-infant relationship, impairing the child's emotional development and affecting children's subsequent cognitive performance (Cogill et al., 1986; Murray, 1992). It is estimated that postpartum depression affects around 10% to 15% of women in developed countries (O'Hara and Swain, 1996; O'Hara, 1997; Prince et al., 2007). In the United Kingdom, postpartum depression represents a substantial public health problem as 8%-15%[1] of women suffer from the condition with long-term consequences for maternal mood and child development (Chew-Graham et al., 2009). Research not only shows that postpartum depression has high prevalence rates (NHS Choices, 2013), but can also lead to long-term disability and incapacity for work (Prince et al., 2007).

Empirical evidence regarding the effects of postpartum depression on maternal employment is very limited, however. The effect of postpartum depression on women's employment outcomes remains unaddressed despite ample evidence regarding its implications for the individual and society. The literature reviewed indicates that the interconnections between

[1] Reviewing prior studies, Forman et al. (2000) observe that depression in the postpartum period varies between 8% and 15% according to the different diagnostic criteria used. Citing Gaynes et al. (2005), Wisner et al. (2006) note that one in seven new mothers (14.5%) in the USA experience depressive episodes that impair maternal role function.

employment and maternal mental health are many, with various aspects. The high participation of women in the labour market and the growing number of young mothers who choose to return to employment after childbirth (Fagan and Norman, 2012), indicate the important role that work now plays in women's lives and how vital mental health is for personal and professional development (McDaid et al., 2008). Therefore, the potential consequences of postpartum depression on women's employment outcomes make postpartum depression not only a major public health concern, but also a significant issue that needs to be addressed due to the wider social implications involved. Employment is linked to individual wellbeing, to the national economy and the productivity and sustainability of social welfare systems (McDaid et al., 2008). Consequently, long-term disability and incapacity to work due to mental or physical illness impose substantial economic burdens on the country's healthcare and welfare systems. Mental health problems in the UK represent the largest single cause of disability, and the cost to the economy is estimated at £105 billion annually, according to the Mental Health Taskforce (2016). In the case of depression, the annual cost to the UK in 2004 (including medical care, drug, morbidity, and mortality costs) was estimated at 14 billion Euros (Sobocki et al., 2006).

Using data from the Millennium Cohort Study (MCS) and a timespan covering several years (3 to 11 years after the birth) the present study explores the possible effects of postpartum depression on maternal employment in the UK, with the aim of gaining an insight into the possible pathways or mechanisms through which PPD is likely to impact on maternal employment outcomes. The period between age 3 and 11 of the child was chosen in order to investigate whether PPD had any long-term effect on women's employment outcomes. The findings of this study are of significance to policy makers as they indicate that PPD has a direct effect on maternal employment at age 5 and an indirect effect at ages 7 and 11, mediated through subsequent maternal mental and physical health problems. These results are broadly in agreement with prior literature observations that mental health problems have far-reaching consequences and postpartum depression can make women more vulnerable to

subsequent mental health problems, suggesting the need for greater awareness of the effects of the condition on women's long-term employability trajectories.

Relevant Literature

As the interplay between postpartum depression and maternal employment outcomes has received limited research attention, we built a wider backdrop considering observations and findings of previous studies. Specifically, we discuss issues related to women's presence in the labour force, maternal employment trajectories after childbirth, mental disability, and the economic burden of depression on national economies, as well as the difficulties in diagnosing the condition, mainly due to multiple causal factors associated with PPD.

Maternal employment

Women's growing presence in the labour force is a topic of worldwide research interest. In the UK the number of mothers who choose to be in employment after giving birth has increased rapidly over the past few decades (Fagan and Norman, 2012). Estimates show that employment among mothers with dependent children rose from 67% in 1996 to 72% in 2013.[2] As Crosby and Hawkes (2008) observed, women's presence within the labour market has generated a large amount of research aimed at understanding its implications, particularly regarding employment in the first year or two following the birth of a child. The topic has mainly been examined from two distinct standpoints: the first focuses on the effects of childbearing on women's employment trajectories; and the second focuses on the effects of maternal employment on children's developmental trajectories. Two recent studies – one by Fagan and Norman (2012) in the UK context and the other by Chatterji et al. (2013) in the USA context – highlight the problems mothers face after childbirth. However, concerning the transition back to employment, neither study explored the possible

[2] Office for National Statistics: employment rates for men and women aged 16-64, April to June 2013. Available at: http://www.ons.gov.uk/ons/dcp171776_328352.pdf

impact of PPD on women's employment trajectories despite evidence for the high prevalence of the condition and its negative consequences on the mother's ability to function in her different roles – at home and at work.

Mental disability

Another aspect that has been in the focus of research is the relationship between employment and mental disability, especially in terms of incapacity to work due to poor mental health. Examining labour market experiences of people with disabilities in the UK, Smith and Twomey (2002) observe that work provides networks of friends and colleagues, a sense of participation or social inclusion, as well as opportunities for both personal and professional development, adding that nearly one in five people of working age in the UK had a long-term disability. The percentage of disabled people reporting as their main problem, mental illness including depression and phobias was 9%, with women presenting higher rates than men (Smith and Twomey, 2002). Research findings reveal that women show a greater prevalence of depressive disorders than men, especially during the childbearing years (Burke, 2003). As pointed out by McDaid et al. (2008), mental health is subject to discrimination and stigma and despite legislation and human rights instruments, people with mental health problems still face difficulties in terms of employment. The employment rate for adults with mental health problems is very low – only 43% of people with mental health problems are in employment compared to 65% of people with other health conditions (Mental Health Taskforce, 2016). Furthermore, the World Health Organization (2001) estimates that globally depression will emerge as one of the leading causes of disability by the year 2020, second only to heart disease.

Economic consequences

Another important aspect is the heavy burden on national economies incurred through absenteeism, early retirement and exclusion from the labour force due to mental health

problems, particularly stress and depression. This constitutes a growing concern for national governments, the European Union, and the World Health Organization (McDaid et al., 2008; Dewa and McDaid, 2011). Mental health is therefore of vital importance for society and for the individual (Almond and Healey, 2003) with increasingly significant economic consequences which are estimated to account for an average of 3%-4% of the European Union countries' gross national product (World Health Organization, 2011).

PPD determinants

Postpartum mood disturbances are traditionally viewed in terms of three categories: postpartum blues; postpartum (nonpsychotic) depression; and depression with psychotic features.[3] Each category differs in its prevalence, clinical presentation, and management (Robertson et al., 2003). Postpartum depression is the most common complication of childbearing. It tends to be recurrent and follows a chronic course (Burke, 2003). Research studies (Fisch et al., 1997; Cooper and Murray, 1998; Forman et al., 2000; Brockington, 2004; Wisner et al., 2006; Prince et al., 2007; Musters et al., 2008; O'Hara, 2009 and Yelland et al., 2010) show that there are multiple causal factors, both biological and non-biological, associated with the development of postpartum depression. Factors such as previous episodes/history of depression, hereditary depression, stressful life events, and disturbed relationships are usually considered strong predictors of the condition. Robertson et al. (2003) reviewing a large number of studies, evaluated antepartum depression, anxiety during pregnancy, stressful recent life events, lack of social support and previous history of depression as strong to moderate predictors of PPD, whereas ethnicity, maternal age, level of education, parity, and gender of the child (within Western societies) have no effect.

[3] According to Miller (2002, p.762) postpartum blues "are a transient state of heightened emotional reactivity" that affects nearly 50% of women who have recently given birth, 3 to 5 days after delivery, often coinciding with the start of lactation. Postpartum nonpsychotic depression is mostly due to a history of major depression, psychosocial stress, and inadequate social support. Postpartum psychotic depression is a psychosis characterised by delusions, hallucinations, or both, appearing within 3 weeks of birth, either for the first time or as part of a recurrent illness, due largely to depression or bipolar disorder with mixed "manic and depressive" features (Miller, 2002, p.763).

Earlier meta-analyses showing the relationship between significant risk factors and PPD were conducted by O'Hara and Swain (1996) and by Beck (1998 and 2001).

Some studies (O'Hara, 2009; Oppo et al., 2009) emphasise risk factors during pregnancy, while hormonal changes at birth are also considered to influence depression (Bloch et al., 2000). Other studies have found no major differences in the hormonal physiology of women who develop postpartum depression (Musters et al., 2008). It is also argued that the probability of developing postpartum blues is not related to psychiatric history, environmental stressors, cultural context, breastfeeding or parity. Nevertheless, those factors may have an influence on whether the blues develop into major depression (Miller, 2002). Unemployment has specifically been associated with PPD whereas the results of studies on the impacts of other social variables such as income and the mother's level of education appear controversial (Miyake et al., 2011; Vilella et al., 2012). Women who experience difficulties in their marital relationship (Beck, 2001; O'Hara, 2009) or have a poor marital relationship during pregnancy show an increased risk of developing postpartum depression. Mann et al. (2008) found a positive association between religiosity/spirituality and postpartum depression, and that organised religious participation was significantly protective from PPD symptoms. Other studies underline the importance of husbands and partners playing a positive role and stress the valuable support they can offer to the mother. However, Mitchell et al. (2011) and Musters et al. (2008) suggest that some women are genetically more reactive to the environment. The former study pointed to the interaction between a mother's genes and the environment in postpartum depression, while the latter suggested that "women who become depressed immediately postpartum may have an abnormal sensitivity to the normal physiological changes of childbirth" (Musters et al., 2008, p.400).

Due to differing definitions of postpartum depression across studies (Musters et al., 2008) and the multitude of risks associated with the condition, the National Institute for Health and

Care Excellence (NICE) published guidelines in 2007 (CG45) for the clinical management of antepartum and postpartum mental health. The guidelines establish a clinical care pathway indicating the steps healthcare professionals must follow in both antepartum and postpartum periods, taking into consideration women's needs and the local availability of psychological treatment. The 2007 NICE guidelines (CG45) were updated in 2014 and replaced by CG192.[4] Although emphasis is placed on detection and prevention, the condition often remains undiagnosed with devastating consequences for the mother.

Methods

In order to address the possible effect of PPD on employment the following equation (reduced model) is used:

$$Y_{it} = a_R + \beta_R PPD_{i,t=0} + \delta_R X_{i,t=0} + \varepsilon_{it} \quad (1)$$

where Y_{it} is the outcome variable (employment) measured at ages t=3, 5, 7, and 11 of the child, PPD is postpartum depression measured at 9 months, $t = 0$, i is the individual, t is age of the child at each MCS sweep, and $X_{it=0}$ is a vector of background variables measured at 9 months (for example child gender, ethnicity) and the subscript R denotes the reduced model.

A probit regression (eq.1) was applied to assess the possible association between PPD and employment (probability of being employed) as a base model without any controls and then adjusted (with the background variables) for longstanding physical health and health attitudes (to alcohol and smoking), depression related variables (antepartum depression and religiousness), relationship and social support variables (father present at birth, partner completed the questionnaire, and whether mother lived with both parents at age 15).[5] This subsequent application of the models facilitates a broader evaluation of the importance of

[4] Available at: https://www.nice.org.uk/guidance/cg192
[5] Income was not included due to the association with employment.

each set of the above predictors regarding the unadjusted association between PPD and maternal employment.

Direct and indirect effect of PPD on employment

Given the potential negative effect of a mental health episode (in this case PPD) on marital status, future mental and physical health and children's development, as described in the literature (Cogill et al., 1986; Reichman et al., 2013), it would be interesting to understand whether the potential detrimental effect of PPD on employment is a direct result of the illness itself, or if it is an indirect result through mediating factors (e.g. through future mental health episodes which in turn have a negative impact on maternal employment). In order to examine whether the effect of PPD on maternal employment is potentially mediated through (i) marital status, (ii) fertility, (iii) maternal mental health, (iv) maternal physical health and (v) child outcomes, a two stage approach is used.

Firstly, we examine whether an association exists between PPD and each of the mediating variables using the following equation (eq.2):

$$Z_{i,t-1} = a + bPPD_{i,t=0} + cX_{i,t=0} + u_{i,t-1} \quad (2)$$

where $Z_{i,t-1}$ is one of the mediating variables (marital status, maternal mental health, maternal physical health, fertility, and children's outcomes) measured at the previous sweep, $t-1$ at ages 3, 5, and 7 of the child, $PPD_{i,t=0}$ is postpartum depression, i is the individual, t is age of the child at MCS sweep, and $X_{i,t=0}$ is a vector of background variables. PPD and all background variables were measured at 9 months, $t = 0$.

Probit regressions were estimated in order to assess the effect of PPD on marital relationship, fertility, maternal physical health and maternal mental health, except for child

outcome measures where linear regression was applied. In order to better disentangle the indirect effect of PPD on employment, temporality is assumed (equation 3).[6]

$$Y_{it} = \alpha_F + \beta_F PPD_{i,t=0} + \gamma_F Z_{i,t-1} + \delta_F X_{i,t=0} + \epsilon_{it} \quad (3)$$

For example, to examine the indirect effect of marital status on employment at age 5 (t), we use marital status at age 3 ($t-1$) as a mediator. Hence, the outcome variable – employment - is estimated until age 11 (MCS5) and the mediating variables until age 7 (MCS4). Where no association was found between PPD and one of the variables, it was not used as a mediator. The regressions in equations 1 and 2 were subsequently estimated using PPD as a continuous indicator, as a robustness check.

Secondly a method proposed by Breen et al. (2013), and Karlson et al. (2010; 2013), known as the KHB decomposition method, is used.[7] This method disentangles the total effect of a variable on the outcome - in this case PPD on maternal employment - into a direct effect (the effect of PPD on maternal employment adjusting for a mediating variable, e.g. marital status) and an indirect effect (the difference between the total and direct effect) for nested non-linear models. This method is necessary to facilitate the estimation of the direct and indirect effect in probit models. For example, if this was a linear model then we could calculate the direct and indirect effect of PPD by firstly estimating equation 1 above and then re-estimating the equation with the inclusion of a mediator (e.g. maternal physical problems), as in equation 3 above. The coefficient of PPD in the second step is equal to the direct effect, while the difference of the two coefficients of PPD (β_R and β_F) is equal to the indirect effect. However, in probit models the indirect effect cannot be calculated in this way due to the rescaling of the model. The rescaling of the probit model occurs because the estimator of PPD depends on the error variance of the model. Hence, when a mediating (or

[6] Temporality refers to an assumption that there is a lag in the effect of PPD and other mediators on the outcome variable.

[7] We use the KHB Stata package. Available at: https://ideas.repec.org/c/boc/bocode/s457215.html

controlled) variable is added, this will change the coefficient of PPD whether or not the mediator is correlated with PPD. This is because, if the mediating variable is correlated with maternal employment, its inclusion will reduce the error variance of the probit model.

Following Kohler et al. (2011), we can rewrite the model as follows, ignoring the time subscript for ease of exposition:

$$Y^* = \alpha_F + \beta_F PPD + \gamma_F Z + \delta_F X + \epsilon \ (4)$$

$$Y^* = \alpha_R + \beta_R PPD + \delta_R X + \varepsilon \ (5)$$

where Y^* is the latent outcome variable, PPD is the variable whose effect we want to decompose, Z is the mediating variable, X are the control variables, β_F is the direct effect, β_R is the total effect, and ϵ, ε are the error terms. Equation 4 denotes the full model (F) and equation 5 is the reduced model (R). The only difference between these models is the effect of Z, the indirect effect, which can also be expressed as $\beta_R - \beta_F$.

Because Y* is a latent variable that is not observed, the outcome Y is measured using a threshold τ as follows:

$$Y \begin{cases} = 0 \ if \ Y^* < \tau \\ = 1 \ if \ Y^* \geq \tau \end{cases}$$

Given that the model is non-linear, the estimated coefficients for the direct and total effect are $b_F = \frac{\beta_F}{\sigma_F}$ and $b_R = \frac{\beta_R}{\sigma_R}$ respectively, where σ_F and σ_R are their respective scale parameters (which are a function of the residual standard deviation of the linear equations in (4) and (5)). Hence, it is clear that the indirect effect $(b_R - b_F)$ will be affected not only by the differences in coefficient effects, but also by the differences in scale parameters.

A direct way to achieve estimates for the indirect effect that are not affected by the rescaling of the model, is to calculate the residuals (R) of a linear regression of Z (mediating variable) on PPD (variable whose effect we want to decompose) (equation 6) and then use them in the main equation instead of Z (equation 7). The indirect effect is then the difference between $\widetilde{b}_R$ and b_F.

$$R = Z - (a + bPPD) (6)$$

$$Y^* = \tilde{\alpha}_R + \tilde{\beta}_R PPD + \tilde{\gamma}_R R + \tilde{\delta}_R X + \zeta \ (7)$$

$$\tilde{b}_R - b_F = \frac{\tilde{\beta}_R}{\tilde{\sigma}_R} - \frac{\beta_F}{\sigma_F} = \frac{\beta_R - \beta_F}{\sigma_F} \ (8)$$

The indirect effect in equation 8 equates to the differences in effects (total effect – modified reduced model) minus the direct effect (full model)), as in the linear case, divided by a common scale.

Data and Descriptive Statistics

The Millennium Cohort Study (MCS) began as a longitudinal study of approximately 18,000 children born in the UK in 2000. The MCS is a large-scale survey of children born in the four constituent countries of the United Kingdom. The first sweep (MCS1) was carried out during the period 2001-2002 and contained information on 18,819 children in 18,533 families, collected from the parents when they were 9-11 months old. The sample design allows for over-representation of families living in areas of England with high rates of child poverty or high proportions of ethnic minorities, and the three smaller countries of the UK. Detailed information on the sampling strategy and response rates for the survey can be found in Plewis et al. (2004) and Plewis (2007).

Full details about the survey, its origins, objectives, sampling and content of the sweeps are provided in the documentation attached to the data.[8] Four further sweeps of data have since been collected when the children were about three years old (MCS2), when they were about five years old (MCS3), when they were seven years old (MCS4) and when they were eleven years old (MCS5). For the present analysis, the chosen sample consisted of the main respondents who were the natural mothers and who also responded to all five sweeps. Observations with missing values were excluded. This left us with 9,669 observations for the main sample. Given the sampling design (clustering), the non-response rates and the sampling attrition from subsequent sweeps of the MCS survey, all results are weighted and the svy Stata commands are used to account for the MCS survey complex sampling design, unless otherwise indicated.

Variables

Mental health variables: Postpartum depression mood / maternal psychological distress

The two measures of maternal mental health in the MCS are the Malaise Inventory and the Kessler K6 scale. The first measure, the Malaise Inventory (Rutter et al., 1970 cited in Johnson, 2012) is a psychometrically valid measure of psychological distress (Rodgers et al., 1999 cited in Flouri et al., 2010). In the MCS study it was included only at the first sweep (MCS 1) when the baby was 9 months old and was derived from the answers to 9 questions designed to assess maternal psychosocial distress: *whether the respondents felt tired, miserable or depressed, worried, often get into a violent rage, become scared, easily upset or irritated, keyed up and jittery, every little thing get on their nerves and wear them out, and heart often race like mad*. Its items, coded as 0=no and 1=yes, measure physical and psychological symptoms of anxiety and depression. A score of at least 4 indicates psychosocial distress and, given its timing (9 months after birth), is used as an indicator of maternal depressed mood postpartum. The Malaise Inventory is widely used to measure

[8] A Guide to the Datasets (Seventh Edition). Available at: http://discover.ukdataservice.ac.uk/series/?sn=2000031

maternal depression (Malmberg and Flouri, 2011; Flouri et al., 2010). According to this measure, 15.5% of mothers (Appendix I, Table1) had experienced depressed mood 9 months after the birth of their child (scoring 4 and above in the Malaise Inventory), in accordance with the literature (Musters et al., 2008).[9]

The Kessler scale has been evaluated as a screen for the prevalence of serious mental illness within a community population of US adults for the purpose of discriminating between cases and non-cases of SMI (National Comorbidity Survey, 2013). The scale is in the process of being clinically validated in a number of countries. No clinical validation of the K6 scale has been carried out on a UK population to my knowledge, hence the proposed scoring (>13) is used with the caveat that the scale has been clinically validated for the US population. Using this evaluation, a score of 13 or more was taken as an appropriate reference level to estimate the prevalence of serious mental illness in the population. This scale is used to measure psychological distress from the respondents' report *of how often over the last 30 days they had felt depressed, hopeless, restless or fidgety, that everything they did was an effort, worthless and nervous*. For each question, the respondents indicate whether they have felt this way: none; a little; some; most or all of the time; and these categories are scored from 0 to 4, respectively. The questions form a 24-point scale. The scores for this study were grouped as 0-12 and 13-24, the latter indicating serious levels of mental health issues. In this study (Appendix I, Table 2) 11.3% of mothers suffered serious mental health problems (score of 13 or above) at age 3 (MCS2), falling to 6.11% at age 5 (MCS3) and rising slightly to 6.26% at age 7 (MCS4). In relation to postpartum depression it is interesting that, when the child is aged 3, the percentage of mothers who suffered serious mental health problems after having postpartum depression is 25.1% and at age 5 the percentage of mothers who suffered serious mental health problems after having postpartum

[9] The variable indicating whether the mother was ever diagnosed by a doctor with depression was asked at age 9 months (MCS1), which is the same sweep in which the variable used for deriving antepartum depression was asked, and the other psychological questions used to construct PPD (Malaise Index) were answered; however, the time when the diagnosis was made is not indicated. As a result, this variable is not used as a background variable as it is not clear whether it captures previous history of depression, antepartum depression or current (postpartum) depression.

depression is 17%, while at age 7, 17.7% mothers suffered serious mental health problems following postpartum depression. The recurrent episodes of maternal mental health problems after PPD are in accordance with Wisner et al. (2006).

Employment

Employment measured as a binary variable was derived from the main respondent Economic Activity Status and was constructed to indicate *whether the natural mother was in employment or not* after 9 months, and after 3, 5, 7 and 11 years respectively, since the birth of the cohort child. This was preferred over using the existing variable indicating whether the mother is in paid work or not, as it also accounts for employment leave. No proxy answers were allowed. Observations labelled 'waiting to start employment' were thus coded as 'not in employment'. As expected, at age 3, 53.8% of mothers were in employment 3 years after the birth, and 58.9% of mothers were in employment 5 years after the birth (in MCS3), 85.2% of mothers were in employment at age 7 (MCS4), and 70% of mothers were in employment at age 11 (MCS5).[10] The overall trend is for mothers to return to employment, but as is shown in Appendix I, Table 3, the pattern is not the same for mothers who experienced postpartum depression relative to mothers who did not. Out of the 84.5% of mothers who did not experience depression, 56% were in employment in MCS2, 61.5% in MCS3, 87% in MCS4 and 61.2% in MCS5.

Family structure – Marital status

The family structure variable is measured *using the natural mother's current legal marital status*. The categories include: legally separated; married (first and only marriage); remarried (second or later marriage); single - never married; divorced; and widowed. It appears that cohabiting parents fall in the single-never married category. Hence we cannot estimate differences in those who are in a cohabiting relationship from those who are not in

[10] Maternity leave ended at 29 weeks after childbirth at the time. (The Maternity and Parental Leave Regulations 1999. Available at: http://www.legislation.gov.uk/uksi/1999/3312/contents/made).

a partnership - either over time or due to the potential effect of PPD. [11] In Table 4, at age 9 months (MCS1), 56.4% of mothers were married, 32.2% were single - never married, 4.42% were divorced, 4.54% were remarried, 2.32% were legally separated, and 0.15% were widowed. Accordingly, mothers who suffered postpartum depressed mood had the highest percentage in the married category (58.1%) while the lowest percentage was found in the widowed category (0.093%). The same marital status rankings for both the total sample and for mothers who experienced postpartum depressed mood apply at age 3 (MCS2), age 5 (MCS3), and age 7 (MCS4).

Child outcomes–Cognitive (BAS) scores

The child outcome in this study (cognitive scores) is measured using the British Ability Scales (Early Years version) Vocabulary Test at age 3 (MCS2), age 5 (MCS3), and age 7 (MCS4). The BAS test measures *children's capacity to verbally name what they see in a picture.* It is a test of children's productive vocabulary in English. The BAS is generally recognised as an excellent measure of children's vocabulary, and thus is highly correlated with other language measures as well. It is also one of the best predictors of children's all-round intelligence and, like IQ it is not easy to drive up or down as it contains a strong genetic component (Dearden et al., 2011). In this study the variable utilised is the BAS ability scores. This was chosen because the scores have been adjusted for both item difficulty and age, so as to facilitate the performance comparison of younger and older cohort members (Connelly, 2013).[12] The variable was divided into quintiles for ease of comparison. From Appendix I, Table 5 at age 3 (MCS2), it can be observed that the highest percentage of children's BAS score for mothers who have not suffered from postpartum depression is in the fourth quintile, followed by the first quintile (25.3% and 18.7% respectively), while most of the children of mothers who have suffered from postpartum

[11] At age 3, 60% of the respondents in the single-never married category were cohabiting parents, at age 5 around 58% were cohabiting parents and at age 7 only 48% of respondents in the single-never married category were cohabiting parents.

[12] Age adjustment is made within three month age bands, so some variation could exist in each band.

depression scored in the first quintile followed by the fourth. At age 5 (MCS3) the pattern is again less clear regarding the children's BAS scores. The highest percentage is located in the fifth quintile, followed by the third quintile. The BAS scores of children (in percentages) whose mothers had suffered from postpartum depression are concentrated in the first and second quintile. At age 7 (MCS4), the BAS scores of children whose mothers had not suffered from PPD are concentrated in the fifth quintile, followed by the third quintile, while the BAS scores of children whose mothers had suffered from postpartum depression remain concentrated in the first two quintiles, as at age 5.

Longstanding physical health problems

Longstanding physical health problems are measured using a binary variable available in the MCS, indicating *whether the respondent had a longstanding (defined as something that has troubled you over a period of time or that is likely to affect you over a period of time) illness, disability or infirmity*. In Table 6, 32.9% of mothers who had experienced PPD had longstanding physical problems at age 3, while at age 5 the figure was 37.1%, and at age 7 was 35.9%. In the case of mothers who had not experienced PPD, 19.7% had longstanding physical problems at age 3, while at age 5 the figure was 22.5%, and at age 7 was 22.7%.

Fertility

The binary variables measuring fertility were derived by combining information on *whether there is a natural sibling in the household and the change in the number of siblings in the household*. In Table 7, the percentage of women who chose to have another child after the cohort member was born drops from 21.4% at age 3, to 7.24% at age 7. The rate of this maternal choice (of a subsequent birth) remains relatively similar for PPD mothers and non-PPD mothers across all sweeps. Specifically, 21.9% of PPD mothers and 18.6% of non-PPD mothers have had another child by age 3, 12.2% of PPD mothers and 12.7% of non-PPD

mothers have had another child by age 5, and 7.01% of PPD mothers and 8.47% of non-PPD mothers have had another child by age 7.

Background variables

The social and demographic characteristics used in this analysis broadly fall into five categories: maternal socio-demographic; maternal longstanding physical health and health attitudes; relationship and social support variables; child characteristics; and depression related variables. The following maternal socio-demographic characteristics control for social vulnerability (for example, nativity) and risks to socio-economic status: maternal age at birth; whether the mother was born in the UK (omitted variable foreign born); maternal highest educational qualification achieved (Higher degree, First degree, Diplomas in higher education, A / AS / S levels, O level / GCSE grades A-C, GCSE grades D-G, Other academic qualifications (incl. overseas), (omitted variable no qualifications)); worked during pregnancy; maternal ethnic identity, utilising the categories corresponding to those in the UK census (White, Indian, Pakistani and Bangladeshi, Mixed Ethnicity, Black, (omitted variable 'other ethnicity'); and OECD median poverty rate. Maternal longstanding physical health and health attitudes control for: physical health that often coincides with mental health problems; maternal longstanding illness; whether the mother smoked in pregnancy; and whether the mother consumed alcohol before pregnancy. Relationship and social support variables control for: relationship capital and support at birth; whether the mother lived with both parents when she was 15; whether the father completed the questionnaire/interview; and whether the father was present at the birth. Child characteristics control for the following risk factors regarding the child's health: baby's age in months in MCS1; baby's sex, male (omitted variable 'female'); baby's weight at birth; whether the baby was very early pre-term; whether the baby was very late post-term; whether the mother tried to breastfeed; and whether the baby has other siblings. The depression related variables control for: whether the mother was depressed in pregnancy

(antepartum depression); and whether the mother attends religious services.[13] An additional categorisation of the social and demographic characteristics (control variables) used in this study, according to pathway analysis, is the distinction between the confounder variables and the covariate variables. Confounder variables are variables that affect both the outcome variable (e.g. employment) and the variable of interest (PPD) according to MacKinnon et al. (2008), such as maternal ethnic identity. Covariate variables have a relationship with either the dependent variable or the independent variable or both, and "are not generally of theoretical interest but are often included in a model to explain additional variability in the dependent variable" (MacKinnon et al. 2008, p. S100). Thus confounder variables are: maternal socio-demographic characteristics. Covariates variables are: relationship and social support variables, child characteristics and depression related variables. Descriptive statistics for the control variables as well as the missing values are presented in Appendix I, Tables 8 and 9. All background variables were taken from the MCS1.

Results

Before presenting the results, the two steps of the analysis are explained. The first step consists of probit regressions to examine whether mothers who had experienced postpartum depression were more or less likely to be in employment, to be married, to experience physical or mental health problems. Linear regression analysis was utilised to evaluate whether children whose mothers had experienced postpartum depression have lower BAS scores. The association between the outcome variable (employment) and PPD, and the potential mediating variables (marital status, mental health problems, physical problems, fertility and child cognitive outcomes) and PPD were first estimated with no controls (Model 1), then adjusted for socio-economic characteristics and child characteristics (control variables) (Model 2), background longstanding physical health and health attitudes

[13] Due to high numbers of missing cases, the variable that indicates whether the baby was in ICU was not included but the variables, whether the baby was very early pre-term, and whether the baby was very late post-term, are used as proxies. For the same reason, the date when the mother stopped employment is not used.

(Model 3), depression related variables (Model 4), relationship and social support variables (Model 5) – fully adjusted. The unadjusted and adjusted models described earlier were estimated firstly using the Malaise Inventory score as a binary indicator (Table 1) and then as a continuous indicator for PPD as a robustness check (Table 2). The second step evaluated whether the relationship between PPD has a direct or indirect effect on maternal employment utilising the KHB decomposition (Tables 3-5).

Table 1: Marginal effects (Probit) using binary indicator of PPD: unadjusted and adjusted models

	Age 3 (MCS2)					Age 5 (MCS3)				
	Outcome variable									
	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
Employed	-0.142**	-0.049**	-0.041*	-0.041*	-0.041*	-0.161**	-0.075**	-0.066**	-0.066**	-0.066**
	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)
	Mediating variables									
	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
Married	-0.116**	-0.070**	-0.055**	-0.052**	-0.045**	-0.118**	-0.076**	-0.063**	-0.060**	-0.053**
	(0.017)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)	(0.017)
Mental Health	0.125**	0.083**	0.080**	0.080**	0.080**	0.084**	0.041**	0.038**	0.038**	0.038**
	(0.011)	(0.008)	(0.008)	(0.008)	(0.008)	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)
Child BAS	-2.931**	-0.420	-0.442	-0.443	-0.362	-3.331**	-0.730*	-0.771*	-0.761*	-0.667*
Scores	(0.484)	(0.379)	(0.386)	(0.386)	(0.382)	(0.456)	(0.329)	(0.326)	(0.328)	(0.326)
Physical	0.120**	0.118**	0.065**	0.064**	0.063**	0.134**	0.134**	0.083**	0.083**	0.082**
problems	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)
Fertility	-0.034*	-0.012	-0.007	-0.007	-0.003	0.005	0.002	0.006	0.007	0.008
	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)

Note: Marginal effects at means. Standard errors in parentheses. * p<0.05 ** p<0.01. See Appendix IA for full tables. Main dependent (outcome) variable: employed age 3: mean 0.538, standard error 0.008; age 5: mean 0.589, standard error 0.008; age 7: mean 0.852, standard error 0.006; age 11: mean 0.700, standard error 0.008; Main independent variable PPD measured at MCS1. First column indicates the dependent variables measured at MCS2-5 for the outcome variable and MCS2-4 for the mediating variables. Observations main dependent variable (employed), age 3: 9669; age 5: 9659; age 7: 9669; age 11: 9600. Observations mediating variables: married, age 3: 9669; age 5: 9665; age 7: 9669. Mental Health, age 3: 9669; age 5: 9669; age 7: 9669. Child BAS Scores, age 3: 9209; age 5: 9569; age 7: 9669. Physical problems, age 3: 9669; age 5: 9662; age 7: 9660. Fertility, age 3: 9073; age 5: 8994; age 7: 9089.

[+] unadjusted Model

[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1

[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1

[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1

[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 1 (cont'd): Marginal effects (Probit) using binary indicator of PPD: unadjusted and adjusted models

	Age 7 (MCS4)					Age 11 (MCS5)				
	Outcome variable									
	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
Employed	-0.100**	-0.038**	-0.032**	-0.032**	-0.031**	-0.147**	-0.063**	-0.053**	-0.053**	-0.051**
	(0.012)	(0.009)	(0.009)	(0.009)	(0.010)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
	Mediating variables									
	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
Married	-0.105**	-0.056**	-0.045**	-0.043**	-0.038*	n/a	n/a	n/a	n/a	n/a
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)					
Mental Health	0.088**	0.053**	0.050**	0.050**	0.049**	n/a	n/a	n/a	n/a	n/a
	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)					
Child BAS	-2.985**	-0.455	-0.384	-0.337	-0.246	n/a	n/a	n/a	n/a	n/a
Scores	(0.877)	(0.902)	(0.897)	(0.903)	(0.907)					
Physical	0.123**	0.126**	0.078**	0.078**	0.076**	n/a	n/a	n/a	n/a	n/a
problems	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)					
Fertility	0.014	-0.006	-0.006	-0.006	-0.008	n/a	n/a	n/a	n/a	n/a
	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)					

Note: Marginal effects at means. Standard errors in parentheses. * p<0.05 ** p<0.01. See Appendix IA for full tables. Main dependent (outcome) variable: employed age 3: mean 0.538, standard error 0.008; age 5: mean 0.589, standard error 0.008; age 7: mean 0.852, standard error 0.006; age 11: mean 0.700, standard error 0.008; Main independent variable PPD measured at MCS1. First column indicates the dependent variables measured at MCS2-5 for the outcome variable and MCS2-4 for the mediating variables. Observations main dependent variable (employed), age 3: 9669; age 5: 9659; age 7: 9669; age 11: 9600. Observations mediating variables: married, age 3: 9669; age 5: 9665; age 7: 9669. Mental Health, age 3: 9669; age 5: 9669; age 7: 9669. Child BAS Scores, age 3: 9209; age 5: 9569; age 7: 9669. Physical problems, age 3: 9669; age 5: 9662; age 7: 9660. Fertility, age 3: 9073; age 5: 8994; age 7: 9089.

[+] unadjusted Model

[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1

[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1

[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1

[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 2: Marginal effects (Probit) using continuous indicator of PPD: unadjusted and adjusted models

	Age 3 (MCS2)					Age 5 (MCS3)				
Outcome variable										
	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
Employed	-0.028**	-0.008*	-0.006	-0.006	-0.006	-0.034**	-0.017**	-0.015**	-0.015**	-0.014**
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Mediating variables										
	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
Married	-0.034**	-0.020**	-0.015**	-0.015**	-0.013**	-0.036**	-0.023**	-0.019**	-0.019**	-0.017**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Mental Health	0.023**	0.017**	0.017**	0.017**	0.017**	0.017**	0.010**	0.009**	0.009**	0.009**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Child BAS	-0.472**	-0.031	-0.033	-0.032	-0.021	-0.517**	-0.073	-0.079	-0.076	-0.064
Scores	(0.073)	(0.073)	(0.074)	(0.074)	(0.073)	(0.081)	(0.070)	(0.072)	(0.072)	(0.071)
Physical	0.033**	0.032**	0.017**	0.017**	0.017**	0.036**	0.035**	0.021**	0.020**	0.020**
problems	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Fertility	-0.016**	-0.010**	-0.009**	-0.009**	-0.008*	-0.001	-0.001	0.000	0.000	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)

Note: Marginal effects at means. Standard errors in parentheses. * p<0.05 ** p<0.01. Main dependent (outcome) variable: employed age 3: mean 0.538, standard error 0.008; age 5: mean 0.589, standard error 0.008; age 7: mean 0.852, standard error 0.006; age 11: mean 0.700, standard error 0.008; Main independent variable PPD measured at MCS1. First column indicates the dependent variables measured at MCS2-5 for the outcome variable and MCS2-4 for the mediating variables. Observations main dependent variable (employed), age 3: 9669; age 5: 9659; age 7: 9669; age 11: 9600. Observations mediating variables: married, age 3: 9669; age 5: 9665; age 7: 9669. Mental Health, age 3: 9669; age 5: 9669; age 7: 9669. Child BAS Scores, age 3: 9209; age 5: 9569; age 7: 9669. Physical problems, age 3: 9669; age 5: 9662; age 7: 9660. Fertility, age 3: 9073; age 5: 8994; age 7: 9089.

[+] unadjusted Model

[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1

[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1

[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1

[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 2 (cont'd): Marginal effects (Probit) using continuous indicator of PPD: unadjusted and adjusted models

	Age 7 (MCS4)					Age 11 (MCS5)				
Outcome variable										
	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
Employed	-0.026**	-0.011**	-0.010**	-0.010**	-0.009**	-0.030**	-0.013**	-0.011**	-0.011**	-0.010**
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Mediating variables										
	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
Married	-0.033**	-0.019**	-0.016**	-0.016**	-0.014**	n/a	n/a	n/a	n/a	n/a
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)					
Mental Health	0.019**	0.013**	0.012**	0.012**	0.012**	n/a	n/a	n/a	n/a	n/a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)					
Child BAS	-0.725**	-0.101	-0.082	-0.071	-0.062	n/a	n/a	n/a	n/a	n/a
Scores	(0.164)	(0.158)	(0.158)	(0.159)	(0.160)					
Physical	0.037**	0.036**	0.023**	0.023**	0.023**	n/a	n/a	n/a	n/a	n/a
problems	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)					
Fertility	0.003	0.000	0.000	0.000	0.000	n/a	n/a	n/a	n/a	n/a
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)					

Note: Marginal effects at means. Standard errors in parentheses. * p<0.05 ** p<0.01. Main dependent (outcome) variable: employed age 3: mean 0.538, standard error 0.008; age 5: mean 0.589, standard error 0.008; age 7: mean 0.852, standard error 0.006; age 11: mean 0.700, standard error 0.008; Main independent variable PPD measured at MCS1. First column indicates the dependent variables measured at MCS2-5 for the outcome variable and MCS2-4 for the mediating variables. Observations main dependent variable (employed), age 3: 9669; age 5: 9659; age 7: 9669; age 11: 9600. Observations mediating variables: married, age 3: 9669; age 5: 9665; age 7: 9669. Mental Health, age 3: 9669; age 5: 9669; age 7: 9669. Child BAS Scores, age 3: 9209; age 5: 9569; age 7: 9669. Physical problems, age 3: 9669; age 5: 9662; age 7: 9660. Fertility, age 3: 9073; age 5: 8994; age 7: 9089.

[+] unadjusted Model

[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1

[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1

[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1

[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

The estimates in Table 1 show that postpartum depression in relation to employment appears to have a strong effect 3 years after the birth of the child (MCS2) when adjusting for a minimum set of controls (Model 2). This effect (PPD mothers were 4.9% less likely to be employed) is weakened in the rest of the models, resulting in a reduced probability of PPD mothers being employed (4.1%), relative to non-PPD mothers, when adjusted for all confounders. As regards marital status, the estimates in Table 1 show that mothers who have experienced PPD have a reduced probability of being married 3 years after the birth of the child relative to mothers who have not experienced PPD. This probability is further reduced (5.5%) when adjusted for controls and maternal physical longstanding health problems and negative health-related attitudes (Model 3). Additionally, when adjusting for depression-related variables (Model 4), and relationship and social support (Model 5), the effect of PPD is marginally reduced to 5.2% and 4.5% respectively, resulting in a reduced probability of being married at age 3 (MCS2) for PPD mothers relative to non-PPD mothers. Mothers who have experienced PPD have an increased probability of facing subsequent mental health problems relative to mothers who have not experienced PPD. This effect remains the same (both in magnitude and in strength) across all models – after adjusting for controls – with the probability of subsequent mental health problems for mothers who have experienced PPD 3 years after the birth of the child being higher (8%). Regarding children's BAS scores at age 3, the association between BAS scores and PPD is diminished after adjusting for control variables (Model 2). Experiencing PPD after birth has a strong association with an increase in maternal longstanding physical health problems in later years compared to non-PPD mothers and, like mental health problems, is consistent across all sweeps. This effect remains the same (both in magnitude and in strength) across all models, after adjusting for physical health problems at baseline (Model 3). At age 3 there is a 6.3% increase in the probability of experiencing physical health problems for PPD mothers. There is no association between PPD and subsequent fertility at age 3.

In contrast, (in MCS3) 5 years after the birth, mothers who have experienced PPD were less likely to be employed (in the unadjusted Model). Adjusting for controls explains away more than half of this negative relationship. Maternal physical longstanding health problems and negative health-related attitudes (adjusted for) further constrict the negative relationship between PPD and the probability of maternal employment. The effect of PPD on maternal employment at age 5 (MCS3) is unaffected in the rest of the models. Mothers who have experienced PPD have a lower probability of being employed (6.6%) than non-PPD mothers when all available confounders in the sample are controlled (Model 5). Mothers who have experienced PPD have a reduced probability of being married 5 years after the birth relative to non-PPD mothers. The effect of PPD on maternal marital status 5 years after the birth of the child is further reduced in each model, resulting in a 5.3% reduction in the probability of being married at age 5 for PPD mothers. PPD has a strong effect on subsequent mental health problems at age 5 (MCS3), resulting in a higher probability (3.8%) that PPD mothers, relative to non-PPD mothers, to face subsequent mental health problems. However, at age 5, the association between BAS scores and PPD remains after adjusting for all confounders (Model 5), suggesting that children whose mothers had experienced PPD performed worse at BAS relative to children whose mothers had not experienced postpartum depression. Regarding the association between PPD and longstanding physical health problems, it increases – from age 3 – to 8.2% for PPD mothers relative to non-PPD mothers at age 5 (MCS3). As was the case for age 3 (MCS2), there is no association between PPD and subsequent fertility.

Regarding the negative effect of PPD on maternal employment at age 7 (MCS4), it can be observed that adjusting for controls (Model 2) explains around two thirds of the unadjusted effect of PPD on maternal employment. Adjusting for maternal physical longstanding health problems and negative health-related attitudes (Model 3), the negative probability faced by mothers who have experienced PPD – relative to non-PPD mothers– is marginally reduced (by 6 percentage points). When adjusting for all available confounders, mothers who have

suffered from PPD are 3.1% less likely to be employed 7 years after the birth of the child (Model 5). At age 7 (MCS4), PPD appears to have a negative effect on maternal marital status when adjusting for all confounders controls, resulting in a reduced probability (3.8%) that PPD mothers, relative to non-PPD affected mothers, to be married 7 years after the birth. Mothers who have experienced PPD have an increased probability of facing subsequent mental health problems relative to mothers who have not experienced PPD. This effect remains the same (both in magnitude and in strength) across all models – after adjusting for controls – with the probability of subsequent mental health problems for mothers who have experienced PPD 3 years after the birth of the child being higher (8%). Similarly, at age 7 there is an increased probability of subsequent mental health problems for mothers who have experienced PPD (4.9%), relative to non-PPD mothers. This effect remains the same (both in magnitude and in strength) across all models after adjusting for controls. There is no relationship between PPD and children's BAS scores – after adjusting for control variables – at age 7. Experiencing PPD after the birth of a child has a strong association with an increase in maternal longstanding physical health problems in later years compared to non-PPD mothers and, like mental health problems, is consistent across all sweeps. This effect remains the same (both in magnitude and in strength) across all models, after adjusting for physical health problems at baseline (Model 3). At age 7 there is a 7.6% increase in the probability of PPD mothers experiencing physical health problems. There is no association between PPD and subsequent fertility in any adjustments at any age; hence this variable was dropped as a potential mediator.

In MCS5, 11 years after the birth of the child, the negative effect of PPD on maternal employment remains. Adjusting for controls almost halves the unadjusted effect (Model 2), while adjusting for maternal physical longstanding health problems and negative health-related attitudes marginally reduces it (Model 3). The probability of mothers who have experienced PPD being employed 11 years after the birth is 5.1% less than for non-PPD mothers.

In Table 2 the continuous indicator shows strong associations of a smaller magnitude of PPD with the outcome variables (marital status at ages 3 to 7, maternal mental health at ages 3 to 7, maternal physical health at ages 3 to 7, and maternal employment at age 5 to age 11), with the exception of fertility at age 3 where a weak association is found, and of BAS scores where there is no effect. Also, in accordance with the discrete indicator, there is no effect of PPD on subsequent fertility at ages 5 and 7. In contrast with the discrete indicator, there is no effect of PPD on the probability of being employed 3 years after the birth of the child (where a weak effect was found). The effect of PPD on the outcome variables remains relative the same in magnitude in all adjustments.

Direct and Indirect effect–the KHB decomposition

Table 3: Evaluating potential mediators

	Probit equations (1)	KHB method (2)
	Age 3 (MCS2)	
Married	Yes	No
Mental Health	Yes	Yes
Child BAS Scores	No	Not considered
Physical problems	Yes	No
Fertility	No	Not considered
	Age 5 (MCS3)	
Married	Yes	Yes
Mental Health	Yes	Yes
Child BAS Scores	Yes	No
Physical problems	Yes	Yes
Fertility	No	Not considered
	Age 7 (MCS4)	
Married	Yes	No
Mental Health	Yes	Yes
Child BAS Scores	No	Not considered
Physical problems	Yes	Yes
Fertility	No	Not considered

Table 3 presents a summary of the relationship between PPD and the potential mediators examined in Table 1 above, and re-evaluated using the KHB method. Potential mediators that showed no statistical significance with PPD are not considered for evaluation using the KHB method. The first column of Table 3 indicates the potential mediators which were

examined in Table 1, in order to establish whether there is an association with PPD, using probit equations. However, in probit models this association cannot only be attributed to including the potential mediating variable but is also due to the rescaling of the model. Hence, all the potential mediators (which showed an association with PPD in probit models) are re-evaluated using the KHB method (the results are presented in Appendix II). This is to ensure that the association with PPD is not attributed to the rescaling of the probit models. For example, in Appendix II, Table 2, controlling for physical health problems at age 3, it can be observed that this variable has no impact as a mediator (indirect effect of physical health problems is statistically insignificant) on PPD and maternal employment at age 5, and hence it is excluded as a mediator. The mediators used in the KHB decomposition are shown in the second column of Table 3.[14]

Table 4: KHB decomposition of the effect of PPD on employment -at age 5 (MCS3)

Mediator: Maternal Mental Health Problems Age3			
	Average Partial Effects	Coefficient	Robust Standard Errors
Postpartum depression			
Total	-0.054	-0.175**	0.046
Direct	-0.043	-0.141**	0.047
Indirect	-0.010	-0.033**	0.008
N	9659		
Pseudo R2	0.20		

Note: * p<0.05 ** p<0.01. Standard errors of difference not known for APE method; robust standard errors presented for coefficients

[14] Due to concerns whether the maternal limiting longstanding illness (used as a mediator to capture physical health problems) actually captures physical health problems and/or mental health problems we performed robustness checks using the only available alternative measures, which could indicate maternal physical problems, in the MCS. However, there are different measures used in each sweep as discussed below.

At age 3 we used the limiting longstanding illness ICD-10 variable which indicates each mother's longstanding illness according to the international classification of diseases, ICD-10. According to this around 12% have mental disorders (including dementia /brain injury) in our sample, the rest have physical illnesses. Observations that had mental disorders were dropped. However, the ICD-10 is only available at age 3. The SF-8 health index is available only at age 5 as a full indicator (Johnson 2012). At age 7, only 4 out of 8 items are asked in the MCS (Johnson 2012). Since the physical health component in the SF-8 requires all 8 scales, we chose the bodily pain scale which is present at ages 5 and 7 as an indicator of maternal physical health problems. The bodily pain scale consists of one item.

The results obtained using these different indicators of the physical illness variable are presented in Appendix IIA. These results do not change the main (qualitative) results of using maternal limiting longstanding illness as a mediator.

Table 5: KHB decomposition of the effect of PPD on employment -at age 7 (MCS4)

Mediators: Maternal Mental Health Problems Age 3 Age 5, Physical Health Problems and Marital Status Age 5			
	Average Partial Effects	Coefficient	Robust Standard Errors
Postpartum depression			
Total	-0.029	-0.172**	0.063
Direct	-0.014	-0.085	0.063
Indirect	-0.014	-0.087**	0.015
N	9660		
Pseudo R^2	0.28		

Note: * p<0.05 ** p<0.01. Standard errors of difference not known for APE method; robust standard errors presented for coefficients

Table 6: KHB decomposition of the effect of PPD on employment - at age 11 (MCS5)

Mediators: Maternal Mental Health Problems Age 3 Age 5 Age 7 and Physical Health Problems Age 5 Age 7			
	Average Partial Effects	Coefficient	Robust Standard Errors
Postpartum depression			
Total	-0.042	-0.152**	0.050
Direct	-0.016	-0.058	0.051
Indirect	-0.026	-0.094**	0.013
N	9584		
Pseudo R2	0.19		

Note: * p<0.05 ** p<0.01. Standard errors of difference not known for APE method; robust standard errors presented for coefficients

Table 4 presents the total effect of PPD on maternal employment at age 5, the direct effect, and their difference (the indirect effect) expressed in average partial effects using the KHB decomposition method. The results indicate that postpartum depression has a strong direct effect. As observed, mothers who have experienced PPD have a reduced probability of being employed 5 years after the birth of the child by 0.054 or 5.4 percentage points relative to non-depressed mothers. When controlling for future maternal mental health at age 3 (Table 4), it was observed that the indirect effect is statistically significant. This indicates that PPD indirectly affects maternal employment at age 5 through maternal mental health problems at age 3. Furthermore, PPD has a direct effect of 0.054 and an indirect effect of

0.010, indicating that 19.20% of the total effect of PPD on maternal employment at age 5 is mediated through the mother's mental health at age 3.[15]

In Table 5, it is shown that mothers who have experienced PPD have a reduced probability of being employed 7 years after the birth of the child, relative to non-depressed mothers. When adjusting for maternal mental health problems (at ages 3 and 5), physical health problems, and marital status at age 5 as mediators, the direct effect of PPD becomes insignificant. This indicates that the effect of PPD on maternal employment at age 7 is mainly indirect; as it is mediated through mental health problems at ages 3 and 5, physical health problems, and marital status at age 5.

Table 6 displays the results of the KHB decomposition of the total effect of PPD on maternal employment at age 11, the direct effect and their difference (the indirect effect mediated through maternal mental health problems at ages 3, 5, and 7 and physical health problems at ages 5 and 7). However, only the indirect effect (reduced probability of employment for PPD experienced mothers at age 11 of 0.026) is strongly significant, indicating that PPD has an effect on maternal employment at age 11 only through maternal mental health problems at ages 3-7 and physical health problems at ages 5-7.

In order to understand the impact of subsequent mental and physical health problems on the total effect of PPD on maternal employment at age 11 at all MCS sweeps following the birth, the KHB decomposition was repeated using maternal mental health problems at age 3, age 5, and age 7 and maternal physical health problems at age 5 and age 7 as mediators (Table 17 in Appendix II).[16]It was observed that, when using the mediators individually, they explain the indirect effect of PPD on maternal employment to a lesser extent. For

[15] The percentage is calculated by the KHB package as $100 \times \frac{\tilde{b}_R - b_F}{\tilde{b}_R}$. Small differences are due to rounding errors.

[16] Examining marital status at age 5 as a potential mediator of the effect of PPD on maternal employment at age 11, using the KHB method, it was observed that it has no impact as a mediator

example, using maternal mental health problems at age 3 as a mediator, around 19% of the total effect of PPD on maternal employment at age 11 is mediated. Maternal mental health problems at age 5 account for around 21% and maternal mental health problems at age 7 explain around 39% of the total effect of PPD on maternal employment at age 11. Regarding maternal physical health problems, at age 5 explain approximately 8%, while maternal physical health problems at age 7 account for around 8% of the total effect of PPD on maternal employment at age 11. When maternal mental and physical health problems at age 3, age 5, and age 7 are used together as mediators, it was observed that they explain around 62% of the unconditional (total) effect of PPD on maternal employment at age 11 and render the direct effect of PPD on maternal employment insignificant.

As a robustness check, the KHB decomposition results of Tables 4-6 were repeated with persistence in employment as a mediator, for example using employment at age 3 as a mediator of the effect of PPD on employment at age 5. These results are presented in Appendix III. These robustness checks do not change the main results (qualitative results) of this study.

Discussion

This study examined the role of postpartum depression, the most common psychiatric disorder experienced by women after childbirth, on maternal employment outcomes. The analysis indicates that PPD has an effect on maternal employment at ages 5, 7 and 11. What is significant is the way PPD affects maternal employment. The analysis demonstrated the effect of PPD on maternal employment at age 5 is mediated by 19.20%. However, in later years the direct effect of PPD on maternal employment is diminished and the effect of PPD is mainly indirect. Specifically, the effect of PPD and maternal employment at age 7 and at age 11 is indirect and is mediated primarily through maternal mental health and physical health problems. An association between PPD and the following factors was also observed:

marital status (at age 3 and age 7); and BAS scores (at age 3). When these were examined as mediating factors (indirect effect of PPD on maternal employment) using the KHB method, without the rescaling effect of the probit model, no statistical effect was observed.

The main findings of the study cannot be compared with earlier findings and observations in prior literature as the issue has not been addressed from the same perspective (the effect of PPD on maternal employment outcomes eleven years after the birth). However, the probability of PPD affecting maternal employment through its strong association with mental health problems, 11 years after the birth, is a significant finding and is in line with prior research observations. Existing literature has expressed concern over PPD's tendency to recur and cause long-term damaging effects. Williamson and McCutcheon (2004) reviewing findings from previous studies, noted that depression which is linked with childbirth can recur, become chronic, or develop into severe episodes of depression following future pregnancies or life difficulties. Josefsson and Sydsjo (2007) emphasise that women with a history of postpartum depressive symptoms were more prone to suffer subsequent depressive symptoms. Research also indicates that women who experience an episode of postpartum depression are at increased risk of later episodes of depression (Seyfried and Marcus, 2003; Beck, 2006; O'Hara, 2009).

Viewed broadly, the findings of the study can contribute to the ongoing debate on two relevant areas of research: a) women's growing presence within the formal labour market and its implications, particularly as regards employment in the first year or two following the birth of a child (Crosby and Hawkes, 2008); and b) the impact of depression in the general population, particularly the consequences of mental disorders on the economy and the workplace (Thomas and Morris, 2003; Almond and Healey, 2003; McDaid et al., 2008). As mentioned earlier in this study, these areas (women's presence in the formal labour market and the prevalence of depression) are of concern to national governments, the European Union and the World Health Organization. The prevalence of postpartum

depression, its recurrent nature and long-term damaging effects should be taken into account by economists and employers' organizations and not only by medical professionals.

Depression impacts on the individual and society in many ways. Studies on the impact of depression on employment, as reviewed by Knapp (2003), find the indirect cost of depression on employment to be 23 times larger than the cost of depression to the health service, that depression constitutes the largest cause of work absenteeism in the UK, and that remission of depressive episodes affects employment more rapidly than health service use. These findings are related to the policy side of the economic consequences of depression (days off work, reduced productivity and costs). Additionally, the World Health Organisation (2011) emphasises the wider implications for society, advocating that mental health is an indivisible part of public health as it significantly affects countries and their human, social and economic capital. However, as Knapp (2003) observed, employment is not just a source of income but extends to the social identity of each individual. Work provides a sense of participation in terms of social inclusion, and opportunities for both personal and professional development (Smith and Twomey, 2002). The association between PPD and employment observed in the results of the present study, and the probability of long-term damaging effects on mothers' health, reinforce the concern expressed in many studies over the impact of depressive disorders and their growing prevalence in the adult population, with higher percentages for women. [17]

To summarise the findings of the study, PPD had an effect on maternal employment at ages 5-11. At age 5 only a portion of that effect is mediated through subsequent mental health problems. However, in later years the direct effect of PPD on maternal employment is diminished and the effect of PPD is mainly indirect. Specifically, the effect of PPD on maternal employment at age 7 and 11 is indirect and is mediated primarily through maternal mental health and physical health problems. This seems to be in line with the literature that

[17] Estimations by Smith and Twomey (2002) show 10% for women, and 8% for men

mental health problems have far-reaching consequences and that PPD can make women more vulnerable to a variety of negative outcomes.

Strengths and Limitations

The present study has several strengths. It specifically examines the possible effect of PPD on maternal employment in the UK and assesses the extent of the direct and indirect link between PPD and maternal employment eleven years after the birth. The study tests a range of factors (marital status, physical longstanding health problems, mental health problems, children's outcomes) as mediators in order to assess the indirect effect of PPD on maternal employment, utilising all available sweeps from the MCS. The study uses a wealth of data from the MCS relating to the gestation and birth, from antepartum maternal depression to the gestation age of the baby (early preterm/ late post-term). Due to the nature of the MCS, the results can be used to make assumptions about the population of the UK. Additionally, this study benefits from utilising non-maternal reporting measures on child outcomes to study the link between PPD and child outcomes in the MCS.

The limitations of the study are the lack of the Edinburgh Postnatal Depression Scale (EPDS) measure for postpartum mental health in a clinical setting from the MCS, as well as the measures of previous history of maternal psychological characteristics (prior to pregnancy), in addition to maternal family psychological characteristics that are not included in the MCS. The Malaise Index used to measure PPD and the Kessler scale used to assess mental health problems, differ in that the first measures psychosocial distress and the second measures the prevalence of serious mental illness in the population. This could potentially affect the mediating effect of PPD through subsequent mental health problems to a small extent. Replication of the study using medical data to account for hormonal/medical influences on PPD is needed as these are not included in the MCS. The study would therefore have benefited from their inclusion.

Conclusion and policy implications

Despite the limitations of the study, the findings suggest the need for greater awareness of the effects of PPD on women's long-term employability trajectories and the potential implications for society and the national economy, given the greater number of women participating in the formal labour market and the female propensity for depressive disorders. It is therefore imperative to conduct more research into the issue and specifically the potential consequences for young women's employment trajectories. The results do highlight the importance of maternal mental health as a determinant of employment outcomes and economic growth and the need for regular evaluations of maternal health – particularly for those women who were diagnosed with the condition or underwent treatment for PPD, given the illness' long-term influence. This might entail drastic changes as regards current mental health policies and to the healthcare provision system. Furthermore, it would entail an innovative approach and a comprehensive strategy that involves co-operation between government departments, healthcare professionals, and certainly employers' organizations or unions (Dewa and McDaid, 2011).

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Appendix I Descriptive statistics

Table 1: Postpartum Depression

Postpartum Depression	Percentage %	Observations
No	84.5	8168
Yes	15.5	1501
Total	100	9669

Note: Postpartum depression measured at MCS1, using Malaise Inventory

Table 2: Postpartum Depression and Subsequent Mental Health Issues

Mental Health	Age 3 (MCS2)			Age 5 (MCS3)			Age 7 (MCS4)		
	Postpartum depression			Postpartum depression			Postpartum depression		
	No	Yes	**Total**	No	Yes	**Total**	No	Yes	**Total**
No %	91.3	74.9	**88.7**	95.9	83	**93.9**	95.8	82.3	**93.7**
Observations	7420	1125	**8545**	7824	1243	**9067**	7848	1252	**9100**
Yes %	8.71	25.1	**11.3**	4.13	17	**6.11**	4.16	17.7	**6.26**
Observations	748	376	**1124**	344	258	**602**	320	249	**569**
Total %	84.5	15.5	**100**	84.5	15.5	**100**	84.5	15.5	**100**
Observations	8168	1501	**9669**	8168	1501	**9669**	8168	1501	**9669**

Note: Column percentages. Postpartum depression measured at MCS1. Subsequent mental health issues (using the Kessler Scale) were measured at MCS2-4.

Table 3: Postpartum Depression and Employment

Employment	Age 9 months (MCS1)			Age 3 (MCS2)			Age 5 (MCS3)		
	Postpartum depression			Postpartum depression			Postpartum depression		
	No	Yes	**Total**	No	Yes	**Total**	No	Yes	**Total**
No %	46.9	58.6	**48.7**	44	58.2	**46.2**	38.5	54.9	**41.1**
Observations	3553	839	**4392**	3320	842	**4162**	2889	771	**3660**
Yes %	53.1	41.4	**51.3**	56	41.8	**53.8**	61.5	45.1	**58.9**
Observations	4610	661	**5271**	4848	659	**5507**	5272	727	**5999**
Total %	100	100	**100**	100	100	**100**	100	100	**100**
Observations	8163	1500	**9663**	8168	1501	**9669**	8161	1498	**9659**

Note: Column percentages. Postpartum depression measured at MCS1. Employment measured at MCS1-5.

Table 3 (cont'd): Postpartum Depression and Employment

Employment	Age 7 (MCS4)			Age 11 (MCS5)		
	Postpartum depression			Postpartum depression		
	No	Yes	Total	No	Yes	**Total**
No %	13	24.5	14.8	23.4	6.67	**30**
Observations	936	339	1275	2093	608	**2701**
Yes %	87	75.5	85.2	61.2	8.74	**70**
Observations	7232	1162	8394	6024	875	**6899**
Total %	84.5	15.5	100	84.6	15.4	**100**
Observations	8168	1501	9669	8117	1483	**9600**

Note: Column percentages. Postpartum depression measured at MCS1. Employment measured at MCS1-5.

Table 4: Postpartum Depression and Marital Status (percentages)

Current Legal Marital Status	Age 9 months (MCS1)			Age 3 (MCS2)			Age 5 (MCS3)			Age 7 (MCS4)		
	Postpartum depression			Postpartum depression			Postpartum depression			Postpartum depression		
	No	Yes	**Total**	No	Yes	**Total**	No	Yes	**Total**	No	Yes	**Total**
Legally Separated	2.09	3.54	**2.32**	2.5	4.74	**2.84**	3.35	4.7	**3.56**	3.97	5.13	**4.15**
Married	58.1	46.9	**56.4**	62	50.6	**60.2**	61.3	50.3	**59.6**	61.1	52.3	**59.7**
Remarried	4.57	4.4	**4.54**	5.62	4.99	**5.52**	6.04	4.86	**5.86**	6.2	4.15	**5.88**
Single	30.8	39.7	**32.2**	25.8	33.5	**27**	23.3	32.3	**24.7**	21.5	29.2	**22.7**
Divorced	4.33	4.92	**4.42**	4.05	5.52	**4.28**	5.79	7.25	**6.02**	6.95	8.44	**7.18**
Widowed	0.0926	0.469	**0.151**	0.108	0.61	**0.186**	0.196	0.673	**0.27**	0.315	0.763	**0.384**
Total	84.5	15.5	**100**	84.5	15.5	**100**	84.5	15.5	**100**	84.5	15.5	**100**

Note: Column percentages. Postpartum depression measured at MCS1. Marital Status measured at MCS1-4.

Table 5: Postpartum Depression and BAS Scores (quintiles)

BAS Scores	Age 3 (MCS2)			Age 5 (MCS3)			Age 7 (MCS4)		
	Postpartum depression			Postpartum depression			Postpartum depression		
	No	Yes	**Total**	No	Yes	**Total**	No	Yes	**Total**
1st quintile	22	32.8	**23.7**	15.4	27.6	**17.2**	18.6	21.9	**19.1**
2nd quintile	18	18.1	**18**	19.1	19.5	**19.1**	19.1	23.3	**19.8**
3rd quintile	15.9	14.5	**15.7**	21.4	19.1	**21.1**	21.2	19.1	**20.9**
4th quintile	25.3	19.8	**24.5**	21.1	18	**20.6**	19.6	19	**19.5**
5th quintile	18.7	14.7	**18.1**	23	15.8	**21.9**	21.5	16.7	**20.8**
Total	84.2	15.8	**100**	84.6	15.4	**100**	84.5	15.5	**100**

Note: Column percentages. Postpartum depression measured at MCS1. BAS Scores measured at MCS2-4.

Table 6: Postpartum Depression and Longstanding Physical Health Problems

Physical problems	Age 3 (MCS2)			Age 5 (MCS3)			Age 7 (MCS4)		
	Postpartum depression			Postpartum depression			Postpartum depression		
	No	Yes	**Total**	No	Yes	**Total**	No	Yes	**Total**
No %	80.3	67.1	**78.3**	77.5	62.9	**75.2**	77.3	64.1	**75.3**
Yes %	19.7	32.9	**21.7**	22.5	37.1	**24.8**	22.7	35.9	**24.7**
Total %	84.5	15.5	**100**	84.5	15.5	**100**	84.5	15.5	**100**

Note: Column percentages. Postpartum depression measured at MCS1. Longstanding physical health problems measured at MCS2-4.

Table 7: Postpartum Depression and Fertility

Fertility	Age 3 (MCS2)			Age 5 (MCS3)			Age 7 (MCS4)		
	Postpartum depression			Postpartum depression			Postpartum depression		
	No	Yes	**Total**	No	Yes	**Total**	No	Yes	**Total**
No %	78.1	81.4	**78.6**	87.8	87.3	**87.7**	93	91.5	**92.8**
Yes %	21.9	18.6	**21.4**	12.2	12.7	**12.3**	7.01	8.47	**7.24**
Total %	84.5	15.5	**100**	84.5	15.5	**100**	84.6	15.4	**100**

Note: Column percentages. Postpartum depression measured at MCS1. Fertility measured at MCS2-4.

Table 8: Descriptives of control variables

Variables	Mean sample	Standard errors	Variables	Mean sample	Standard Errors
Maternal age at birth of CM	28.87	(0.129)	Baby pre term	0.075	(0.004)
Paid work during pregnancy	0.683	(0.008)	Other sibling	0.583	(0.007)
Mother born in UK	0.905	(0.006)	Birth weight in kilos	3.369	(0.007)
Maternal ethnic group – White	0.901	(0.010)	Baby's age in months	9.187	(0.009)
Maternal ethnic group – Mixed	0.009	(0.002)	Ever tried to breastfeed	0.692	(0.010)
Maternal ethnic group – Indian	0.017	(0.003)	Cohort Member Sex	0.505	(0.007)
Maternal ethnic group – Pakistani	0.035	(0.007)	Highest academic qualification – Higher Degree	0.032	(0.003)
Maternal ethnic group – Black	0.026	(0.005)	Highest academic qualification – First Degree	0.144	(0.008)
Interview government office region - North East	0.036	(0.011)	Highest academic qualification – Diploma in Higher Education	0.093	(0.004)
Interview government office region – Humber	0.085	(0.025)	Highest academic qualification – A-Level	0.099	(0.003)
Interview government office region – East Midlands	0.071	(0.017)	Highest academic qualification – O-Level GCSE Grades A-C	0.359	(0.009)
Interview government office region – West Midlands	0.078	(0.020)	Highest academic qualification – O-Level GCSE Grades D-G	0.108	(0.005)
Interview government office region – East of England	0.094	(0.020)	Highest academic qualification – Other Qualification	0.019	(0.002)
Interview government office region – London	0.123	(0.026)	Smoke during pregnancy	0.365	(0.008)
Interview government office region – South East	0.149	(0.026)	Alcohol	0.332	(0.008)
Interview government office region – South West	0.079	(0.019)	Longstanding Illness	0.219	(0.006)
Interview government office region – Welsh	0.052	(0.005)	Antepartum depression	0.004	(0.001)
Interview government office region – Scotland	0.091	(0.006)	Attend religious services	0.159	(0.007)
Interview government office region – N. Ireland	0.042	(0.003)	Dad present at birth	0.852	(0.006)
OECD below 60% median poverty indicator	0.287	(0.010)	Lived with both parents at 15	0.776	(0.006)
Baby post term	0.009	(0.001)	Partner not complete interview	0.015	(0.002)
Observations	9669		Observations	9669	

Note: Standard errors in parentheses; Variables measured at age 9 months (MCS1). Abbreviations: CM, cohort member, child

Table 9: Item non-response

Variables	Values Missing
Worked pregnant	4
Mother born in UK	1
Ethnic group	14
OECD below 60% median poverty indicator	13
Baby pre term	74
Baby post term	74
Birth weight in kilos	6
Ever tried to breastfeed	1
Highest academic qualification	9
Smoking	9
Longstanding illness	3

Note: Some observations have missing values on more than one variable

Appendix IA Estimations: Base Model and Adjustments (Probit)

Table 1: Association of PPD and employment at age 3 (MCS2)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Employed Age 3	Employed Age 3	Employed Age 3	Employed Age 3	Employed Age 3
Postpartum depression	-0.142**	-0.049**	-0.041*	-0.041*	-0.041*
	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)
Maternal age at birth of child		0.005**	0.005**	0.005**	0.005**
		(0.001)	(0.001)	(0.001)	(0.002)
Paid work during pregnancy		0.471**	0.468**	0.468**	0.468**
		(0.017)	(0.017)	(0.017)	(0.017)
Mother born in UK		0.032	0.033	0.032	0.031
		(0.032)	(0.032)	(0.032)	(0.032)
OECD below 60% median poverty indicator		-0.196**	-0.191**	-0.192**	-0.188**
		(0.018)	(0.018)	(0.018)	(0.019)
Ever tried to breastfeed		-0.036*	-0.038*	-0.037*	-0.038*
		(0.017)	(0.018)	(0.018)	(0.018)
Child gender		-0.031*	-0.031*	-0.032*	-0.032*
		(0.013)	(0.013)	(0.013)	(0.013)
Smoke during pregnancy			-0.020	-0.022	-0.021
			(0.015)	(0.015)	(0.015)
Alcohol			0.014	0.014	0.014
			(0.017)	(0.017)	(0.017)
Longstanding illness			-0.044**	-0.044**	-0.044**
			(0.016)	(0.016)	(0.016)
Antepartum depression				0.026	0.028
				(0.127)	(0.128)
Observations	9669	9669	9669	9669	9669

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 2: Association of PPD and employment at age 5 (MCS3)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Employed Age 5	Employed Age 5	Employed Age 5	Employed Age 5	Employed Age 5
Postpartum depression	-0.161**	-0.075**	-0.066**	-0.066**	-0.066**
	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)
Maternal age at birth of child		0.004**	0.004**	0.005**	0.005**
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		0.360**	0.358**	0.357**	0.357**
		(0.017)	(0.017)	(0.017)	(0.017)
Mother born in UK		0.003	0.005	0.004	0.003
		(0.028)	(0.028)	(0.029)	(0.029)
OECD below 60% median poverty indicator		-0.184**	-0.179**	-0.180**	-0.178**
		(0.016)	(0.016)	(0.016)	(0.016)
Ever tried to breastfeed		-0.026	-0.028	-0.027	-0.028
		(0.016)	(0.016)	(0.016)	(0.016)
Child gender		0.001	0.000	-0.001	-0.000
		(0.012)	(0.012)	(0.012)	(0.012)
Smoke during pregnancy			-0.012	-0.013	-0.013
			(0.015)	(0.015)	(0.015)
Alcohol			0.020	0.020	0.020
			(0.015)	(0.015)	(0.015)
Longstanding illness			-0.060**	-0.060**	-0.060**
			(0.016)	(0.016)	(0.016)
Antepartum depression				-0.002	-0.001
				(0.105)	(0.105)
Observations	9659	9659	9659	9659	9659

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 3: Association of PPD and employment at age 7 (MCS4)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Employed Age 7	Employed Age 7	Employed Age 7	Employed Age 7	Employed Age 7
Postpartum depression	-0.100**	-0.038**	-0.032**	-0.032**	-0.031**
	(0.012)	(0.009)	(0.009)	(0.009)	(0.010)
Maternal age at birth of child		0.003**	0.003**	0.003**	0.002*
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		0.068**	0.065**	0.065**	0.064**
		(0.009)	(0.009)	(0.009)	(0.009)
Mother born in UK		-0.021	-0.016	-0.015	-0.014
		(0.015)	(0.014)	(0.014)	(0.014)
OECD below 60% median poverty indicator		-0.140**	-0.133**	-0.133**	-0.126**
		(0.009)	(0.009)	(0.009)	(0.009)
Ever tried to breastfeed		0.022**	0.021**	0.021**	0.020*
		(0.008)	(0.008)	(0.008)	(0.008)
Child gender		-0.018**	-0.017*	-0.017*	-0.017*
		(0.007)	(0.007)	(0.007)	(0.007)
Smoke during pregnancy			-0.033**	-0.033**	-0.030**
			(0.008)	(0.008)	(0.008)
Alcohol			0.004	0.004	0.004
			(0.008)	(0.008)	(0.008)
Longstanding illness			-0.028**	-0.028**	-0.027**
			(0.008)	(0.009)	(0.009)
Antepartum depression				-0.035	-0.031
				(0.044)	(0.043)
Observations	9669	9669	9669	9669	9669

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 4: Association of PPD and employment at age 11 (MCS5)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Employed Age 11	Employed Age 11	Employed Age 11	Employed Age 11	Employed Age 11
Postpartum depression	-0.147**	-0.063**	-0.053**	-0.053**	-0.051**
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Maternal age at birth of child		0.007**	0.008**	0.008**	0.007**
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		0.226**	0.223**	0.223**	0.222**
		(0.014)	(0.014)	(0.014)	(0.014)
Mother born in UK		0.026	0.028	0.028	0.028
		(0.023)	(0.023)	(0.023)	(0.023)
OECD below 60% median poverty indicator		-0.130**	-0.125**	-0.125**	-0.121**
		(0.014)	(0.014)	(0.014)	(0.014)
Ever tried to breastfeed		0.014	0.013	0.014	0.014
		(0.015)	(0.015)	(0.015)	(0.015)
Child gender		-0.002	-0.002	-0.002	-0.002
		(0.012)	(0.012)	(0.012)	(0.012)
Smoke during pregnancy			-0.011	-0.012	-0.011
			(0.014)	(0.014)	(0.014)
Alcohol			0.018	0.017	0.018
			(0.014)	(0.014)	(0.014)
Longstanding illness			-0.070**	-0.069**	-0.069**
			(0.013)	(0.013)	(0.013)
Antepartum depression				-0.088	-0.088
				(0.092)	(0.091)
Observations	9600	9600	9600	9600	9600

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 5: Association of PPD and marital status at age 3 (MCS2)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Married Age 3	Married Age 3	Married Age 3	Married Age 3	Married Age 3
Postpartum depression	-0.116**	-0.070**	-0.055**	-0.052**	-0.045**
	(0.017)	(0.016)	(0.016)	(0.016)	(0.016)
Maternal age at birth of child		0.018**	0.016**	0.016**	0.015**
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		0.031*	0.025	0.027	0.023
		(0.016)	(0.016)	(0.015)	(0.016)
Mother born in UK		-0.111**	-0.096**	-0.085**	-0.093**
		(0.030)	(0.028)	(0.027)	(0.029)
OECD below 60% median poverty indicator		-0.279**	-0.261**	-0.258**	-0.230**
		(0.016)	(0.017)	(0.016)	(0.017)
Ever tried to breastfeed		0.086**	0.084**	0.078**	0.072**
		(0.014)	(0.014)	(0.014)	(0.015)
Child gender		-0.028*	-0.025*	-0.020	-0.019
		(0.013)	(0.013)	(0.013)	(0.013)
Smoke during pregnancy			-0.163**	-0.154**	-0.149**
			(0.013)	(0.013)	(0.013)
Alcohol			-0.018	-0.015	-0.014
			(0.014)	(0.014)	(0.014)
Longstanding illness			-0.017	-0.020	-0.017
			(0.015)	(0.015)	(0.016)
Antepartum depression				0.076	0.096
				(0.087)	(0.090)
Observations	9669	9669	9669	9669	9669

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 6: Association of PPD and marital status at age 5 (MCS3)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Married Age 5	Married Age 5	Married Age 5	Married Age 5	Married Age 5
Postpartum depression	-0.118**	-0.076**	-0.063**	-0.060**	-0.053**
	(0.016)	(0.017)	(0.017)	(0.017)	(0.017)
Maternal age at birth of child		0.016**	0.014**	0.013**	0.012**
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		0.032	0.026	0.028	0.023
		(0.017)	(0.016)	(0.016)	(0.017)
Mother born in UK		-0.093**	-0.078**	-0.068*	-0.073*
		(0.030)	(0.029)	(0.029)	(0.029)
OECD below 60% median poverty indicator		-0.266**	-0.248**	-0.246**	-0.219**
		(0.016)	(0.016)	(0.016)	(0.016)
Ever tried to breastfeed		0.075**	0.072**	0.067**	0.061**
		(0.016)	(0.016)	(0.016)	(0.017)
Child gender		-0.008	-0.005	-0.001	0.001
		(0.012)	(0.012)	(0.012)	(0.013)
Smoke during pregnancy			-0.146**	-0.138**	-0.132**
			(0.014)	(0.014)	(0.014)
Alcohol			-0.010	-0.007	-0.006
			(0.014)	(0.013)	(0.014)
Longstanding illness			-0.018	-0.021	-0.018
			(0.014)	(0.014)	(0.014)
Antepartum depression				0.049	0.066
				(0.090)	(0.098)
Observations	9665	9665	9665	9665	9665

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 7: Association of PPD and marital status at age 7 (MCS4)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Married Age 7	Married Age 7	Married Age 7	Married Age 7	Married Age 7
Postpartum depression	-0.105**	-0.056**	-0.045**	-0.043**	-0.038*
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Maternal age at birth of child		0.013**	0.011**	0.011**	0.009**
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		0.032*	0.027	0.029	0.025
		(0.016)	(0.016)	(0.016)	(0.017)
Mother born in UK		-0.083**	-0.068*	-0.058*	-0.063*
		(0.028)	(0.027)	(0.027)	(0.027)
OECD below 60% median poverty indicator		-0.264**	-0.247**	-0.244**	-0.218**
		(0.017)	(0.018)	(0.017)	(0.018)
Ever tried to breastfeed		0.080**	0.076**	0.072**	0.066**
		(0.014)	(0.014)	(0.014)	(0.015)
Child gender		-0.006	-0.002	0.002	0.004
		(0.012)	(0.012)	(0.013)	(0.013)
Smoke during pregnancy			-0.148**	-0.140**	-0.134**
			(0.013)	(0.013)	(0.013)
Alcohol			-0.001	0.001	0.004
			(0.015)	(0.014)	(0.015)
Longstanding illness			-0.007	-0.010	-0.006
			(0.014)	(0.014)	(0.014)
Antepartum depression				0.037	0.051
				(0.089)	(0.096)
Observations	9669	9669	9669	9669	9669

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 8: Association of PPD and mental health problems at age 3 (MCS2)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Kessler Age 3	Kessler Age 3	Kessler Age 3	Kessler Age 3	Kessler Age 3
Postpartum depression	0.125**	0.083**	0.080**	0.080**	0.080**
	(0.011)	(0.008)	(0.008)	(0.008)	(0.008)
Maternal age at birth of child		0.001	0.001	0.001	0.001
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		-0.029**	-0.028**	-0.028**	-0.028**
		(0.008)	(0.008)	(0.008)	(0.008)
Mother born in UK		-0.083**	-0.080**	-0.080**	-0.079**
		(0.010)	(0.010)	(0.010)	(0.010)
OECD below 60% median poverty indicator		0.022**	0.022**	0.022**	0.019*
		(0.008)	(0.008)	(0.008)	(0.008)
Ever tried to breastfeed		-0.009	-0.008	-0.008	-0.008
		(0.008)	(0.008)	(0.008)	(0.008)
Child gender		-0.009	-0.008	-0.008	-0.008
		(0.007)	(0.007)	(0.007)	(0.007)
Smoke during pregnancy			-0.019*	-0.019**	-0.019*
			(0.007)	(0.007)	(0.008)
Alcohol			-0.028**	-0.028**	-0.028**
			(0.008)	(0.008)	(0.008)
Longstanding illness			0.024**	0.024**	0.023**
			(0.008)	(0.008)	(0.008)
Antepartum depression				0.040	0.039
				(0.045)	(0.046)
Observations	9669	9669	9669	9669	9669

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 9: Association of PPD and mental health problems at age 5 (MCS3)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Kessler Age 5	Kessler Age 5	Kessler Age 5	Kessler Age 5	Kessler Age 5
Postpartum depression	0.084**	0.041**	0.038**	0.038**	0.038**
	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)
Maternal age at birth of child		-0.000	-0.000	-0.000	-0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Paid work during pregnancy		-0.016**	-0.015**	-0.015**	-0.014**
		(0.005)	(0.004)	(0.004)	(0.004)
Mother born in UK		-0.028**	-0.028**	-0.027**	-0.027**
		(0.006)	(0.006)	(0.006)	(0.006)
OECD below 60% median poverty indicator		0.012**	0.011*	0.011*	0.009*
		(0.005)	(0.004)	(0.004)	(0.005)
Ever tried to breastfeed		-0.000	0.000	-0.000	0.001
		(0.005)	(0.004)	(0.004)	(0.004)
Child gender		-0.002	-0.002	-0.002	-0.002
		(0.004)	(0.003)	(0.003)	(0.003)
Smoke during pregnancy			0.003	0.003	0.002
			(0.004)	(0.004)	(0.004)
Alcohol			-0.003	-0.003	-0.003
			(0.005)	(0.004)	(0.004)
Longstanding illness			0.014**	0.013**	0.013**
			(0.004)	(0.004)	(0.004)
Antepartum depression				0.000	-0.002
				(0.021)	(0.021)
Observations	9669	9669	9669	9669	9669

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 10: Association of PPD and mental health problems at age 7 (MCS4)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Kessler Age 7	Kessler Age 7	Kessler Age 7	Kessler Age 7	Kessler Age 7
Postpartum depression	0.088**	0.053**	0.050**	0.050**	0.049**
	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Maternal age at birth of child		-0.001	-0.001	-0.001	-0.001
		(0.000)	(0.000)	(0.000)	(0.000)
Paid work during pregnancy		-0.014*	-0.012*	-0.012*	-0.012*
		(0.006)	(0.005)	(0.005)	(0.005)
Mother born in UK		-0.027**	-0.028**	-0.029**	-0.028**
		(0.007)	(0.006)	(0.006)	(0.007)
OECD below 60% median poverty indicator		0.018**	0.016**	0.016**	0.013*
		(0.006)	(0.005)	(0.005)	(0.006)
Ever tried to breastfeed		-0.007	-0.006	-0.006	-0.005
		(0.005)	(0.005)	(0.005)	(0.005)
Child gender		-0.002	-0.002	-0.002	-0.003
		(0.004)	(0.004)	(0.004)	(0.004)
Smoke during pregnancy			0.009	0.008	0.008
			(0.005)	(0.005)	(0.005)
Alcohol			0.002	0.002	0.001
			(0.006)	(0.006)	(0.006)
Longstanding illness			0.015**	0.015**	0.015**
			(0.005)	(0.005)	(0.005)
Antepartum depression				0.011	0.008
				(0.027)	(0.027)
Observations	9669	9669	9669	9669	9669

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 11: Association of PPD and BAS scores at age 3 (MCS2)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	BAS Scores Age 3	BAS Scores Age 3	BAS Scores Age 3	BAS Scores Age 3	BAS Scores Age 3
Postpartum depression	-2.931**	-0.420	-0.442	-0.443	-0.362
	(0.484)	(0.379)	(0.386)	(0.386)	(0.382)
Maternal age at birth of child		0.147**	0.152**	0.153**	0.150**
		(0.027)	(0.028)	(0.028)	(0.028)
Paid work during pregnancy		1.326**	1.333**	1.330**	1.303**
		(0.305)	(0.300)	(0.300)	(0.298)
Mother born in UK		2.238**	2.213**	2.197**	2.125**
		(0.611)	(0.606)	(0.607)	(0.603)
OECD below 60% median poverty indicator		-2.114**	-2.156**	-2.162**	-1.882**
		(0.359)	(0.362)	(0.362)	(0.366)
Ever tried to breastfeed		0.779**	0.778**	0.787**	0.705*
		(0.281)	(0.281)	(0.281)	(0.280)
Child gender		-2.853**	-2.865**	-2.872**	-2.864**
		(0.222)	(0.221)	(0.221)	(0.220)
Smoke during pregnancy			0.391	0.375	0.394
			(0.273)	(0.276)	(0.273)
Alcohol			0.311	0.306	0.329
			(0.287)	(0.287)	(0.287)
Longstanding illness			-0.112	-0.101	-0.092
			(0.314)	(0.318)	(0.317)
Antepartum depression				-0.629	-0.532
				(2.422)	(2.424)
Observations	9209	9209	9209	9209	9209

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 12: Association of PPD and BAS scores at age 5 (MCS3)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	BAS Scores Age 5	BAS Scores Age 5	BAS Scores Age 5	BAS Scores Age 5	BAS Scores Age 5
Postpartum depression	-3.331**	-0.730*	-0.771*	-0.761*	-0.667*
	(0.456)	(0.329)	(0.326)	(0.328)	(0.326)
Maternal age at birth of child		0.146**	0.148**	0.149**	0.144**
		(0.024)	(0.024)	(0.024)	(0.024)
Paid work during pregnancy		0.968**	0.977**	0.980**	0.954**
		(0.333)	(0.334)	(0.333)	(0.335)
Mother born in UK		2.857**	2.825**	2.833**	2.766**
		(0.579)	(0.579)	(0.579)	(0.578)
OECD below 60% median poverty indicator		-2.124**	-2.158**	-2.147**	-1.924**
		(0.357)	(0.366)	(0.367)	(0.378)
Ever tried to breastfeed		1.148**	1.133**	1.138**	1.086**
		(0.288)	(0.286)	(0.287)	(0.288)
Child gender		-0.638*	-0.651**	-0.657**	-0.646**
		(0.247)	(0.246)	(0.246)	(0.244)
Smoke during pregnancy			0.330	0.334	0.353
			(0.281)	(0.282)	(0.280)
Alcohol			0.560*	0.558*	0.568*
			(0.232)	(0.233)	(0.231)
Longstanding illness			0.006	0.027	0.038
			(0.262)	(0.263)	(0.262)
Antepartum depression				-2.537	-2.518
				(2.312)	(2.298)
Observations	9569	9569	9569	9569	9569

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 13: Association of PPD and BAS scores at age 7 (MCS4)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	BAS Scores Age 7	BAS Scores Age 7	BAS Scores Age 7	BAS Scores Age 7	BAS Scores Age 7
Postpartum depression	-2.985**	-0.455	-0.384	-0.337	-0.246
	(0.877)	(0.902)	(0.897)	(0.903)	(0.907)
Maternal age at birth of child		0.109	0.105	0.104	0.096
		(0.057)	(0.058)	(0.058)	(0.059)
Paid work during pregnancy		2.287**	2.251**	2.274**	2.246**
		(0.696)	(0.699)	(0.698)	(0.700)
Mother born in UK		-2.407*	-2.388*	-2.293*	-2.331*
		(0.934)	(0.931)	(0.934)	(0.943)
OECD below 60% median poverty indicator		-5.230**	-5.166**	-5.104**	-4.931**
		(0.808)	(0.801)	(0.806)	(0.830)
Ever tried to breastfeed		1.121	1.078	1.056	1.028
		(0.626)	(0.626)	(0.625)	(0.629)
Child gender		-3.730**	-3.737**	-3.726**	-3.715**
		(0.454)	(0.453)	(0.451)	(0.451)
Smoke during pregnancy			-0.194	-0.110	-0.079
			(0.569)	(0.569)	(0.567)
Alcohol			0.680	0.690	0.692
			(0.576)	(0.578)	(0.575)
Longstanding illness			-0.546	-0.511	-0.497
			(0.690)	(0.695)	(0.692)
Antepartum depression				-7.162	-7.167
				(6.498)	(6.509)
Observations	9669	9669	9669	9669	9669

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 14: Association of PPD and physical problems at age 3 (MCS2)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Physical problems Age 3	Physical problems Age 3	Physical problems Age 3	Physical problems Age 3	Physical problems Age 3
Postpartum depression	0.120**	0.118**	0.065**	0.064**	0.063**
	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Maternal age at birth of child		0.004**	0.003**	0.003**	0.003**
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		-0.051**	-0.031*	-0.031*	-0.031*
		(0.013)	(0.013)	(0.013)	(0.013)
Mother born in UK		0.011	0.006	0.004	0.005
		(0.021)	(0.019)	(0.019)	(0.019)
OECD below 60% median poverty indicator		0.033*	0.015	0.014	0.013
		(0.014)	(0.014)	(0.014)	(0.014)
Ever tried to breastfeed		-0.014	-0.014	-0.014	-0.013
		(0.012)	(0.012)	(0.012)	(0.012)
Child gender		0.005	0.007	0.007	0.007
		(0.009)	(0.009)	(0.009)	(0.009)
Smoke during pregnancy			0.002	0.000	0.000
			(0.011)	(0.011)	(0.011)
Alcohol			-0.010	-0.010	-0.010
			(0.011)	(0.011)	(0.011)
Longstanding illness			0.372**	0.372**	0.371**
			(0.012)	(0.012)	(0.012)
Antepartum depression				0.061	0.062
				(0.084)	(0.084)
Observations	9669	9669	9669	9669	9669

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 15: Association of PPD and physical problems at age 5 (MCS3)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Physical problems Age 5	Physical problems Age 5	Physical problems Age 5	Physical problems Age 5	Physical problems Age 5
Postpartum depression	0.134**	0.134**	0.083**	0.083**	0.082**
	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)
Maternal age at birth of child		0.006**	0.005**	0.005**	0.005**
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		-0.032*	-0.011	-0.011	-0.011
		(0.013)	(0.012)	(0.012)	(0.012)
Mother born in UK		0.011	0.006	0.006	0.006
		(0.023)	(0.023)	(0.023)	(0.022)
OECD below 60% median poverty indicator		0.059**	0.042**	0.041**	0.040**
		(0.016)	(0.015)	(0.015)	(0.015)
Ever tried to breastfeed		-0.009	-0.008	-0.008	-0.008
		(0.012)	(0.013)	(0.013)	(0.013)
Child gender		-0.008	-0.007	-0.007	-0.007
		(0.011)	(0.011)	(0.011)	(0.011)
Smoke during pregnancy			0.008	0.007	0.007
			(0.011)	(0.011)	(0.011)
Alcohol			-0.013	-0.013	-0.013
			(0.012)	(0.012)	(0.012)
Longstanding illness			0.382**	0.381**	0.381**
			(0.012)	(0.012)	(0.012)
Antepartum depression				0.115	0.115
				(0.088)	(0.088)
Observations	9662	9662	9662	9662	9662

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 16: Association of PPD and physical problems at age 7 (MCS4)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Physical problems Age 7	Physical problems Age 7	Physical problems Age 7	Physical problems Age 7	Physical problems Age 7
Postpartum depression	0.123**	0.126**	0.078**	0.078**	0.076**
	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)
Maternal age at birth of child		0.006**	0.006**	0.006**	0.006**
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		-0.057**	-0.040**	-0.040**	-0.039**
		(0.013)	(0.013)	(0.013)	(0.013)
Mother born in UK		0.053*	0.050	0.050	0.050*
		(0.026)	(0.026)	(0.026)	(0.025)
OECD below 60% median poverty indicator		0.050**	0.031*	0.030*	0.028
		(0.015)	(0.015)	(0.015)	(0.015)
Ever tried to breastfeed		0.001	0.004	0.003	0.003
		(0.012)	(0.012)	(0.012)	(0.012)
Child gender		0.009	0.011	0.012	0.012
		(0.010)	(0.009)	(0.009)	(0.009)
Smoke during pregnancy			0.027*	0.027*	0.026*
			(0.012)	(0.012)	(0.012)
Alcohol			-0.013	-0.013	-0.013
			(0.013)	(0.013)	(0.013)
Longstanding illness			0.346**	0.345**	0.344**
			(0.012)	(0.012)	(0.012)
Antepartum depression				0.146	0.146
				(0.098)	(0.099)
Observations	9660	9660	9660	9660	9660

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 17: Association of PPD and fertility at age 3 (MCS2)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Fertility Age 3	Fertility Age 3	Fertility Age 3	Fertility Age 3	Fertility Age 3
Postpartum depression	-0.034*	-0.012	-0.007	-0.007	-0.003
	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)
Maternal age at birth of child		-0.001	-0.001	-0.001	-0.002
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		-0.050**	-0.051**	-0.050**	-0.052**
		(0.015)	(0.015)	(0.015)	(0.015)
Mother born in UK		0.009	0.012	0.014	0.012
		(0.018)	(0.018)	(0.019)	(0.018)
OECD below 60% median poverty indicator		-0.008	-0.004	-0.003	0.014
		(0.014)	(0.014)	(0.014)	(0.015)
Ever tried to breastfeed		0.044**	0.043**	0.042**	0.037**
		(0.013)	(0.012)	(0.012)	(0.012)
Child gender		0.010	0.010	0.012	0.012
		(0.009)	(0.009)	(0.009)	(0.009)
Smoke during pregnancy			-0.023*	-0.021	-0.018
			(0.011)	(0.012)	(0.012)
Alcohol			-0.003	-0.002	-0.002
			(0.011)	(0.011)	(0.011)
Longstanding illness			-0.018	-0.019	-0.019
			(0.013)	(0.013)	(0.013)
Antepartum depression				0.055	0.059
				(0.072)	(0.076)
Observations	9073	9073	9073	9073	9073

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 18: Association of PPD and fertility at age 5 (MCS3)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Fertility Age 5	Fertility Age 5	Fertility Age 5	Fertility Age 5	Fertility Age 5
Postpartum depression	0.005	0.002	0.006	0.007	0.008
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Maternal age at birth of child		-0.004**	-0.004**	-0.004**	-0.004**
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		-0.014	-0.016	-0.015	-0.016
		(0.010)	(0.010)	(0.010)	(0.010)
Mother born in UK		-0.026*	-0.024	-0.023	-0.023
		(0.013)	(0.013)	(0.013)	(0.013)
OECD below 60% median poverty indicator		-0.021	-0.017	-0.017	-0.011
		(0.011)	(0.011)	(0.011)	(0.011)
Ever tried to breastfeed		0.012	0.011	0.011	0.009
		(0.010)	(0.010)	(0.010)	(0.010)
Child gender		0.001	0.001	0.002	0.002
		(0.007)	(0.007)	(0.007)	(0.007)
Smoke during pregnancy			-0.019*	-0.018	-0.017
			(0.009)	(0.009)	(0.009)
Alcohol			0.003	0.003	0.003
			(0.009)	(0.009)	(0.009)
Longstanding illness			-0.019*	-0.019*	-0.019*
			(0.009)	(0.009)	(0.009)
Antepartum depression				-0.028	-0.028
				(0.073)	(0.073)
Observations	8994	8994	8994	8994	8994

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Table 19: Association of PPD and fertility at age 7 (MCS4)

	Model 1[+]	Model 2[++]	Model 3[+++]	Model 4[++++]	Model 5[+++++]
	Fertility Age 7	Fertility Age 7	Fertility Age 7	Fertility Age 7	Fertility Age 7
Postpartum depression	0.014	-0.006	-0.006	-0.006	-0.008
	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)
Maternal age at birth of child		-0.002**	-0.002**	-0.002**	-0.002**
		(0.001)	(0.001)	(0.001)	(0.001)
Paid work during pregnancy		-0.021**	-0.021**	-0.020*	-0.020*
		(0.008)	(0.008)	(0.008)	(0.008)
Mother born in UK		-0.017	-0.017	-0.016	-0.015
		(0.010)	(0.010)	(0.010)	(0.010)
OECD below 60% median poverty indicator		0.032**	0.032**	0.032**	0.034**
		(0.008)	(0.008)	(0.008)	(0.008)
Ever tried to breastfeed		0.006	0.006	0.006	0.005
		(0.007)	(0.007)	(0.007)	(0.007)
Child gender		-0.016**	-0.016**	-0.016*	-0.016*
		(0.006)	(0.006)	(0.006)	(0.006)
Smoke during pregnancy			0.003	0.004	0.004
			(0.006)	(0.006)	(0.007)
Alcohol			-0.006	-0.006	-0.006
			(0.007)	(0.007)	(0.007)
Longstanding illness			-0.004	-0.004	-0.004
			(0.007)	(0.007)	(0.007)
Antepartum depression				-0.045	-0.043
				(0.046)	(0.045)
Observations	9089	9089	9089	9089	9089

Note: Marginal effects at means; Standard errors in parentheses; * p<0.05 ** p<0.01; All adjusted models (Model 2 onwards) include controls for ethnicity, regional residency, maternal highest educational qualification, baby pre-term, baby post-term, other siblings, baby's weight at birth, and baby's age in months. Model 4 includes controls for attending religious services. Model 5 includes controls for baby's father present at birth, mother lived with both parents until 15, and baby's father completed questionnaire.

[+] unadjusted Model
[++] Adjusted for socio-economic characteristics and child characteristics (control variables) at MCS1
[+++] Adjusted for characteristics in Model 2 and for longstanding physical health problems and health attitudes at MCS1
[++++] Adjusted for characteristics in Model 3 and for depression related variables at MCS1
[+++++] Adjusted for characteristics in Model 4 and for relationship and social support variables at MCS1

Appendix II Decomposing the direct and indirect effect of postpartum depression on employment using the KHB decomposition

Table 1: KHB decomposition of the effect of PPD on employment using mental health problems in MCS2 as mediator

MCS3 Employed	Coefficient	Robust Std. Error	z
Postpartum depression			
Total	-0.175	0.046	-3.75
Direct	-0.141	0.047	-2.99
Indirect	-0.033	0.008	-4.34
N	9659		
Pseudo R2	0.20		

Table 2: KHB decomposition of the effect of PPD on employment using physical health problems in MCS2 as mediator

MCS3 Employed	Coefficient	Robust Std. Error	z
Postpartum depression			
Total	-0.171	0.046	-3.68
Direct	-0.168	0.046	-3.60
Indirect	-0.003	0.003	-0.89
N	9659		
Pseudo R2	0.19		

Table 3: KHB decomposition of the effect of PPD on employment using marital status in MCS2 as mediator

MCS3 Employed	Coefficient	Robust Std. Error	z
Postpartum depression			
Total	-0.171	0.000	-3.69
Direct	-0.172	0.000	-3.71
Indirect	0.001	0.641	0.47
N	9659		
Pseudo R2	0.19		

Table 4: KHB decomposition of the effect of PPD on employment using mental health problems in MCS3 as mediator

MCS4 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.181	0.061	-2.95
Direct	-0.155	0.062	-2.50
Indirect	-0.026	0.008	-3.06
N	9669		
Pseudo R2	0.26		

Table 5: KHB decomposition of the effect of PPD on employment using physical health problems in MCS3 as mediator

MCS4 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.185	0.060	-3.06
Direct	-0.166	0.060	-2.77
Indirect	-0.018	0.006	-3.23
N	9662		
Pseudo R2	0.26		

Table 6: KHB decomposition of the effect of PPD on employment using marital status in MCS3 as mediator

MCS4 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.184	0.061	-3.00
Direct	-0.161	0.061	-2.63
Indirect	-0.023	0.007	-3.00
N	9665		
Pseudo R2	0.27		

Table 7: KHB decomposition of the effect of PPD on employment using BAS Scores in MCS3 as mediator

MCS4 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.190	0.061	-3.13
Direct	-0.185	0.060	-3.06
Indirect	-0.005	0.003	-1.66
N	9569		
Pseudo R2	0.26		

Table 8: KHB decomposition of the effect of PPD on employment using mental health problems in MCS2 as mediator

MCS4 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.184	0.060	-3.03
Direct	-0.151	0.060	-2.50
Indirect	-0.033	0.009	-3.45
N	9669		
Pseudo R2	0.26		

Table 9: KHB decomposition of the effect of PPD on employment using, mental health problems in MCS2 MCS3, marital status and physical health problems in MCS3 as mediators

MCS4 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.172	0.063	-2.75
Direct	-0.085	0.063	-1.35
Indirect	-0.087	0.015	-5.87
N	9660		
Pseudo R2	0.28		

Table 10: KHB decomposition of the effect of PPD on employment using mental health problems in MCS4 as mediator

MCS5 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.150	0.050	-3.00
Direct	-0.092	0.051	-1.80
Indirect	-0.058	0.010	-5.60
N	9600		
Pseudo R2	0.19		

Table 11: KHB decomposition of the effect of PPD on employment using mental health problems in MCS3 as mediator

MCS5 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.152	0.049	-3.06
Direct	-0.119	0.049	-2.42
Indirect	-0.032	0.0073	-4.30
N	9600		
Pseudo R2	0.18		

Table 12: KHB decomposition of the effect of PPD on employment using mental health problems in MCS2 as mediator

MCS5 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.155	0.050	-3.09
Direct	-0.125	0.050	-2.48
Indirect	-0.029	0.007	-4.04
N	9600		
Pseudo R2	0.18		

Table 13: KHB decomposition of the effect of PPD on employment using physical health problems in MCS3 as mediator

MCS5 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.156	0.049	-3.14
Direct	-0.143	0.050	-2.88
Indirect	-0.012	0.004	-2.98
N	9593		
Pseudo R2	0.18		

Table 14: KHB decomposition of the effect of PPD on employment using physical health problems in MCS4 as mediator

MCS5 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.154	0.054	-3.10
Direct	-0.142	0.053	-2.86
Indirect	-0.012	0.005	-3.04
N	9591		
Pseudo R2	0.18		

Table 15: KHB decomposition of the effect of PPD on employment using marital status in MCS3 as mediator

MCS5 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.153	0.049	-3.09
Direct	-0.154	0.049	-3.13
Indirect	0.001	0.002	0.47
N	9596		
Pseudo R2	0.18		

Table 16: KHB decomposition of the effect of PPD on employment using marital status in MCS4 as mediator

MCS5 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.154	0.049	-3.10
Direct	-0.155	0.049	-3.14
Indirect	0.001	0.001	0.89
N	9600		
Pseudo R2	0.18		

Table 17: KHB decomposition using of the effect of PPD on employment physical and mental health problems in MCS2 MCS3 and MCS4 as mediators

MCS5 Employed	Coefficient	Robust Std. Error.	z
Postpartum depression			
Total	-0.152	0.050	-3.04
Direct	-0.058	0.051	-1.14
Indirect	-0.094	0.013	-7.01
N	9584		
Pseudo R2	0.19		

Appendix IIA Decomposing the direct and indirect effect of postpartum depression on employment using the KHB decomposition-Robustness checks for longstanding physical health as a mediator using different measures at age 3, age 5, and age 7.

Table 1: KHB decomposition of the effect of PPD on employment using physical health problems (ICD-10 coded) in MCS2 as mediator

MCS3 Employed	Coefficient	Robust Std. Error	z
Postpartum depression			
Total	-0.141	0.047	-3.04
Direct	-0.140	0.047	-3.01
Indirect	-0.001	0.002	-0.29
N	9445		
Pseudo R2	0.19		

Table 2: KHB decomposition of the effect of PPD on employment using physical health problems (SF-8 amount of bodily pain) in MCS3 as mediator

MCS4 Employed	Coefficient	Robust Std. Error	z
Postpartum depression			
Total	-0.185	0.060	-3.08
Direct	-0.164	0.060	-2.72
Indirect	-0.021	0.008	-2.73
N	9661		
Pseudo R2	0.26		

Table 3: KHB decomposition of the effect of PPD on employment using physical health problems (SF-8 amount of bodily pain) in MCS4 as mediator

MCS5 Employed	Coefficient	Robust Std. Error	z
Postpartum depression			
Total	-0.148	0.049	-3.00
Direct	-0.121	0.049	-2.45
Indirect	-0.027	0.007	-4.17
N	9662		
Pseudo R2	0.18		

Appendix III Decomposing the direct and indirect effect of postpartum depression on employment using the KHB decomposition: Using persistence in employment as a robustness check

Table 1: KHB decomposition of the effect of PPD on employment - at age 5 (MCS3)

Mediators: Mental Health Problems, Employment Age 3				
	Average Partial Effects	Coefficient	Robust Standard Errors	Z
Postpartum depression				
Reduced	-0.047	-0.199	0.055	-3.59
Full	-0.030	-0.127	0.056	-2.25
Difference	-0.017	-0.072	0.023	-3.09
N	9659			
Pseudo R2	0.37			

Note: Standard errors of difference not known for APE method; robust standard errors presented for coefficients

Table 2: KHB decomposition of the effect of PPD on employment - at age 7 (MCS4)

Mediators: Maternal Mental Health Problems Age 3 Age 5, Marital Status, Physical Health Problems Age 5 and Employment Age 3 Age 5				
	Average Partial Effects	Coefficient	Robust Standard Errors	Z
Postpartum depression				
Reduced	-0.028	-0.176	0.062	-2.85
Full	-0.010	-0.064	0.062	-1.02
Difference	-0.018	-0.112	0.017	-6.40
N	9656			
Pseudo R2	0.31			

Note: Standard errors of difference not known for APE method; robust standard errors presented for coefficients

Table 3: KHB decomposition of the effect of PPD on employment - at age 11 (MCS5)

Mediators: Maternal Mental Health Problems, Employment Age 3 Age 5 Age 7 and Physical Health Problems Age 5 Age 7				
	Average Partial Effects	Coefficient	Robust Standard Errors	Z
Postpartum depression				
Reduced	-0.037	-0.159	0.053	-3.01
Full	0.000	0.001	0.054	0.02
Difference	-0.037	-0.160	0.024	-6.65
N	9580			
Pseudo R^2	0.30			

Note: Standard errors of difference not known for APE method; robust standard errors presented for coefficients

Chapter 4 Does Postpartum Depression Predict Emotional and Cognitive Difficulties in 11 Year Olds?

Introduction

Postpartum depression (PPD) is a prevalent, major depressive disorder following childbirth with long-term effects on the mother and her offspring (O'Hara, 2009). Although its symptoms last between one and six months, its consequences for the child are not restricted to infancy alone, but might extend into toddlerhood, preschool age and even school age (Bernard-Bonnin, 2004). Research into the long-term impact of postpartum depression on child development indicates different impacts at different points in time over a child's development and potentially negative consequences for the child's cognitive, social, and emotional spheres. However, there is no consensus since some researchers support the view that chronic or recurrent maternal depression, rather than postpartum depression per se, is likely to relate to later effects on the child (Grace et al., 2003; Agnafors et al., 2013) whereas others attribute a strong role to the PPD effect (Cogill et al., 1986; Sharp et al., 1995; Essex et al., 2003; and Pawlby et al., 2008).

From the standpoint of the child, it appears that children born to postpartum mothers are likely to start life at a disadvantage compared to children of non-depressed mothers. Furthermore, these children are at increased risk of developing mood disorders (Thapar et al., 2012) or even psychiatric disorders (Pawlby et al., 2008). Previous research has demonstrated that emotional and behavioural problems in childhood can persist into later life, leading to educational difficulties, lower earnings and possibly to a lifelong disability.

From the standpoint of a woman, maternal depression in the postpartum period is associated with ongoing maternal difficulties because of the condition's recurrent nature and chronic course (Burke, 2003). Thus PPD might lead to substantial impairments in the ability of the mother to handle daily responsibilities (O'Hara, 2009) and cope with the demands of motherhood.

The purpose of the current study is to investigate the specific role and influence of mothers' postpartum depression on children's emotional and cognitive outcomes at age 11 – a key stage of transition in child development before entering adolescence. The study seeks to provide new information on the cognitive and socio-emotional outcomes of 11-year-old children, identifying the strength of possible associations between maternal PPD and children's outcomes, through multiple evidence provided by mothers, teachers, and children. What the current study brings to the forefront is the variation observed in the assessments of the child's socio-emotional skills provided by mothers, teachers and children, thus presenting a broader picture of the role played by postpartum depression in children's outcomes while avoiding the possibility of biased or one-sided reports. The results show that, at age 11, PPD impacts on child emotional difficulties only when reported by the mother; when reported by the children themselves PPD has no association either with boys' or girls' emotional problems; whereas there is a strong association regarding boys' emotional problems when these are reported by teachers. Cognitive ability tests using BAS (British Ability Scales) and CGT (Cambridge Gambling Task) show no association between PPD and children's cognitive performance at age 11, in contrast with the main body of research.

Literature Review

The interconnections between maternal health problems and children's outcomes have been the subject of an extensive body of empirical research focusing on different age groups and

key stages of child development (ranging from birth to early adulthood). Age 11 represents a key stage of transition in child development, before the start of adolescence and the onset of puberty (Remscmidt, 1994; Kessler et al., 2001; Agnafors et al., 2013). As Patton and Viner (2007) explain, puberty is initiated in late childhood and is accompanied by physical, psychological and emotional changes. Despite indications of significant implications for children and their future trajectories, only three prior studies set in the UK have focused specifically on the outcomes of 11-year-olds in relation to maternal postpartum depression. The most recent is by Pawlby et al. (2008) which examined postpartum depression and emotional disorders in 11-year-olds based on 147 women drawn from two general practices in South London. The second is by Hay et al. (2003) and examined pathways to violence in the 11-year-old children of postpartum depressed mothers compared to children of non-depressed mothers using a sample of 132 families from an urban British community. The third is a study by Hay et al. (2001) which focused on intellectual problems shown by 11-year-old children whose mothers had postpartum depression, based on 132 children and 132 women from two general practices in South London. All three are clinical studies with rather limited sample sizes.

The question raised here is, why choose this specific age group as the time period of investigation in the current study? Firstly, focusing on a specific age group (as opposed to a wide age range) enhances our insight into the problems observed at this particular stage of development – a significant stage of transition in the life of children before entering adolescence and before reaching puberty when psychological development is intense (Patton and Viner, 2007). Secondly, research findings have indicated that different stages of development are characterised by particular problems and disorders. For instance, the plethora of major emotional changes and psychological difficulties observed in adolescence are rarely met in childhood and, as Kessler et al. (2001, p.1) noted, “major depression is comparatively rare among children, but common among adolescents, with up to a 25% lifetime prevalence by the end of adolescence”. Depression is also prevalent in the adult

population, unlike in childhood where its existence is considered as relatively uncommon but, as research findings indicate, somewhere between childhood and adulthood its prevalence shows a dramatic increase (Allgood-Merten et al., 1990).

Multiple informant approach

For the assessment and ratings of children's socio-emotional outcomes in the current study, the multiple informant approach is used to obtain information from three sources: mothers, teachers and children. This approach enables researchers to obtain evaluations from different perspectives. Another advantage is that through the multiple informant approach the possibility of biased reports or 'contaminated' information from impaired mothers is avoided.

A number of studies exploring the issue of bias have indicated that mother's emotional impairment may affect her perceptions of her child and consequently maternal reports (Fergusson et al., 1993; Boyle and Pickles, 1997; Najman et al. 2001). Several explanations have been put forward to account for the issue of bias on the part of impaired mothers. For their part Najman et al. (2001) argued that if impaired mothers are "biased" in their observations of the world around them, there is a possibility that this "biased observation" is likely to be reflected in their response to their children and also to other relationships, life events, etc. As observed by Barry et al. (2005, p. 265) the mother's symptoms might be associated "with a stressful home environment," exacerbating child behaviour problems and eventually leading to "a reciprocal relation between symptomatology in mothers and children". Reviewing a number of hypotheses Kroes et al. (2003, p.201) indicated that mothers might project symptoms of their own psychological states on their children in accordance to the projection hypothesis whereas the social attribution theory supports that "ambiguous environmental stimuli" (internalizing behaviour problems) have a greater tendency to inference and distortion of social perception compared to more obvious stimuli

(externalizing behaviour problems). For their part, Youngstrom et al. (1999) found strong evidence regarding correlations between maternal dysphoria and descriptions of child functioning. Another possibility according to Najman et al. (2000) is the impaired mother's lesser capacity to control her child rather than the child's behaviour.

The views on the issue of maternal bias discussed in this section indicate that there is growing evidence that mothers' distress or psychopathology is related to emotional and behaviour problems in their children and that may lead to small or moderate parental reporting distortions. However, some studies support that there are considerable advantages to using caregivers as informants about child functioning. As Youngstrom et al. (1999) explained caregivers (in particular mothers) observe the child over a longer time and in broader developmental contexts than would any other adult and that for researchers and psychologists mothers' reports of child behaviour are a central piece of data because of the high-intensity link between the mother and her child over a long period of time. Luoma et al. (2004, p.50) also support that in both clinical and research settings the mother is still "the primary source of information concerning infants and young children", because usually is the person who knows her child best.

As regards disagreements or low levels of agreement observed between informants' reports on the functioning of a child, these can be viewed as valuable sources of information in so far as each source provides a unique viewpoint (Kolko and Kazdin, 1993). They can alternatively be considered as "variations in judgements of the child's functioning across situations and interaction partners" (Achenbach et al., 1987, p.228). Regarding the choice of informant, this depends on the type of disorder being investigated. Goodman et al. (2000) point out that information from parents is considered slightly more useful for detecting emotional disorders (internalizing disorders) while information from teachers is slightly more useful for detecting conduct and hyperactivity disorders (externalizing disorders). This view is also reflected in findings by Berg-Nielsen et al. (2003) who observed that even non-

pathological levels of depressive symptoms in mothers may represent a bias when mothers report internalizing symptoms in their adolescents. However, Kroes et al. (2003, p.201) pointed out that internalizing child behaviour problems associated with maternal psychopathological symptoms, displayed at home, might not be manifested in other situations, or they might be manifested in different ways under different circumstances.

Apart from maternal bias in reporting, endogeneity in the informants responses can be due to omitted variables. Although in this study we control for a variety of observed confounders the responses might be biased due to an unobserved factor. For example teachers might report higher levels of emotional difficulties in children if they perceived that the school district has a high criminality rate, or mothers might report higher levels of emotional difficulties in their children due to relationship concerns. If these unobserved factors also affect children's emotional well-being then an endogeneity problem would occur.

The scale and multi-faced causes of PPD

Maternal postpartum depression is a well-described phenomenon but its risk factors and symptoms can still elude diagnosis (Beck, 2006). Its prevalence in Western societies and in the UK is approximately 15% (Grace et al., 2003; Murray et al. 2010), and its long-term effects on the mother, her offspring, and family are well documented in a large body of literature (Cooper and Murray, 1998; Brockington, 2004; Beck, 2006; Hay et al., 2008; O'Hara, 2009). Research findings indicate that postpartum depression interferes with self-care and parenting, and offspring are at risk of disturbances in development (O'Hara, 2009). Most research points to the factor of heritability; the transmission of risk for disorder via genetic factors, which is estimated at approximately 37% for depressive disorder (Sullivan et al., 2000 cited in Halligan et al., 2007). On the other hand, there is a growing body of research which indicates that parenting behaviour is a major mechanism by which parental

psychopathology, marital difficulties, major life events, and economic hardship come to be associated with depression in children and adolescents (Sheeber et al., 2001). However, there is no common understanding as regards all the mechanisms through which parental mental health problems impact on children or on the complex interaction of genetic and environmental influences and the influence of correlated mediating factors (Smith, 2004).

Child Gender

Gender seems to play a significant role. Numerous studies indicate that boys are at greater risk of poor development in childhood than girls when faced with maternal postpartum depression and that pre-pubertal boys have a slightly higher rate of depressed mood than girls. This difference reverses in early adolescence, when there is a dramatic increase in depression among girls but not boys (Hankin and Abramson, 2001; Kessler et al., 2001). Thus, being female is significantly associated with depression in adolescents and adults, but before adolescence the rate of depressive disorders is about equal in girls and boys (Garber, 2006). The female preponderance for depression begins to emerge around age 13 (Hankin and Abramson, 2001). During early to middle adolescence, the rate of depressive symptoms in girls rises to two to three times that of boys, and this gender difference is partly attributed to hormonal changes, increased stress, different socialization experiences, and other factors (Anderson et al., 1987 and Costello et al., 1996 cited in Garber, 2006). In view of the above, regression models in this study are fitted separately for boys and girls in order to explore whether PPD has a different effect on each gender's emotional problems.

As regards cognitive functioning and intellectual development, findings in the literature indicate that boys and girls are affected in different ways, with boys more at risk than girls who appear relatively protected against the effects of their mothers' illness (Cogill et al., 1986; Sharp et al., 1995; Essex et al., 2003; Grace et al., 2003). Exploring intellectual problems in 11-year-old children of mothers who had depression at 3 months postpartum,

Hay et al. (2001) find that adverse experiences in infancy predict cognitive ability and academic performance a decade later (lower IQ scores, attentional problems, difficulties in mathematical reasoning and special educational needs). Academic performance at age 16, which was explored by Murray et al. (2010), shows that the adverse effects of postpartum depression on male infants' cognitive functioning may persist throughout development, but not in the case of girls.

Time of exposure

The time of exposure to maternal depression is another factor linked with increased risk of depression both in adolescence (Halligan et al., 2007; Hammen et al., 2008; Hay et al., 2008) but also with negative outcomes in childhood (Essex et al., 2001; Hay et al., 2003; Beck, 2006; Kiernan and Huerta, 2008). The findings of these studies point to the harmful effects of maternal postpartum depression on children's emotional and behavioural development, particularly when the exposure takes place in infancy, "an important time for the development of a secure mother-infant attachment, which in turn provides a framework for the infant's regulation of emotion" (Essex et al., 2001, p.154). As Pawlby et al. (2008) emphasised, children of mothers who were clinically diagnosed with postpartum depression at 3 months were 4 times as likely to suffer from a psychiatric disorder themselves at 11 years of age. A view emerging from the evidence above is that infancy is a crucial period for children's development. This is in line with the theory of attachment which posits that early interaction is a particularly important determinant of the quality of attachment that develops between the mother-child dyad, as observed by Campbell and Cohen (1997), who also stressed that the timing and chronicity of depression in infancy is of great importance given the infant's dependency on the mother as the primary caregiver. Evidence from prior studies suggest that infants who experience a prolonged period of maternal withdrawal or inconsistent behaviour will be more likely to show disorganised patterns of attachment and

security in toddlerhood compared to children of controlled mothers (Campbell and Cohen, 1997; Essex et al., 2001).

As regards the effect of PPD on children's developmental outcomes, Agnafors et al. (2013, p.170) support that "ongoing maternal depressive symptoms (as distinct from PPD) was the strongest predictor of child behaviour problems at age 12". Beck (2006) reviewing results of several studies concerning the effect of postpartum depression on children's cognitive development (covering different stages from infancy to childhood), concludes that the results were mixed, in contrast with findings of studies on children's emotional and behavioural development which demonstrated the adverse effect of PPD. Grace et al. (2003) in a review of articles on the effects of postpartum depression on cognitive and behavioural outcomes, underlined that chronic or recurrent maternal depression, rather than postpartum depression per se, was likely to relate to later effects on the child, and that girls and boys are affected in different ways in terms of cognitive development, such as language and IQ. Murray et al. (1996) find that there was no evidence of an adverse effect of PPD on cognitive functioning after the age of 5, even amongst vulnerable subgroups of children. Recent evidence by Maselko et al. (2015) regarding 7-year-old children and peripartum depression, also find no effect on cognitive outcomes. On the other hand, Cogill et al. (1986) reported significant intellectual deficits in 4-year-old children whose mothers had suffered with depression, but only when this depression occurred in the first year of the child's life. Along the same lines, Sharp et al. (1995) found that postpartum depression affected the intellectual development of the infant sons of women who were depressed in the first year postpartum. Hay et al. (2001) showed that maternal diagnosis of depression at 3 months postpartum predicts deficits in the children's cognitive abilities and academic performance a decade later. In view of the strong associations observed in a number of studies between maternal postpartum depression and children's outcomes and particularly the findings in the studies by Hay et al. (2001) and Pawlby et al. (2008) concerning the impact of PPD on 11-year-olds, it is anticipated that the present investigation would also

lead to similar results as regards the long-term impact of PPD on children's emotional and cognitive outcomes.

Data and Methods

The Millennium Cohort Study (MCS) was used for the analysis in the present chapter. A description of the MCS is given in Chapter 3 (see Data and Methods). For the present analysis, the chosen sample consisted of 11-year-old children whose main respondents were the natural mothers who responded to all five sweeps. Observations with missing values were excluded, resulting in 5,397 observations for the main sample. Given the sampling design (clustering), the non-response rates and the sampling attrition from subsequent sweeps of the MCS, all results are weighted (to correct for the above) unless indicated otherwise.

Sample selection

The MCS teachers' survey at age 11 (MCS5) was conducted only in England and Wales, resulting in 7,430 observations for children. This sample is further restricted for the natural mother who was the main respondent in all sweeps of the MCS in order to obtain information regarding maternal mental health problems at ages 3-7 (MCS2-MCS4). The vast majority - nearly 96% at age 11 - of all the main respondents in the MCS are the natural mothers (see MCS technical report on response). We excluded 15 observations in which the natural mother was not the main respondent. Restricting for the natural mother as the main respondent in all sweeps of the MCS reduces the sample size to 5,635 observations. This reduction (attrition) is corrected in the MCS using the survey weights as described above. Regarding item non-response, most of the missing values result from the mother-reported SDQ (137 observations). Other non-response items vary from 1 (mother born in the UK) to 43 (baby was born late post-term), missing values (see Appendix I, Table 1a). Restricting for item non-response reduces the sample to 5,397 observations.

In order to see whether the average individual in this sample differs in their characteristics from the individual excluded from the sample, tests that assess whether the means of the selected sample versus the means of the missing sample in each variable are statistically equal were performed (see Appendix I, Table 1b). Although the outcome variables show no statistical difference in the means, tests regarding the main independent variable PPD indicate sample selection (the missing sample had higher means for PPD relative to the selected sample) (see Appendix I, Table 1b). Hence, the results of this study cannot be generalised but only applied to this specific sample.

Outcome measures

Children's Emotional Distress – Child Reported

Child self-reported measures of wellbeing were derived from the MCS5 child questionnaire. As an observed inventory or a unique measure of emotional distress/mental difficulties of children was not available at age 11 (in MCS5), exploratory factor analysis (EFA) was implemented in order to examine the variation in the data and construct an index of the latent measure of children's emotional distress. The questions imputed as possible factors were: "In the last four weeks, how often did you feel happy?"; "In the last four weeks, how often did you get worried about what would happen to you?"; "In the last four weeks, how often did you feel sad?"; "In the last four weeks, how often did you feel afraid or scared?"; "In the last four weeks, how often did you laugh?"; and, "In the last four weeks, how often did you get angry?". The questions were answered using a 5 point Likert scale ranging from 'never' to 'almost always'.[1] The scores were reversed in the first and last questions. Given the ordered nature of the variables, polychoric correlations instead of Pearson's correlations were estimated in Stata using the polychoric package in accordance with the literature

[1] Through personal communication it was indicated that some of the child-reported questions were extracted from the PEDSQL questionnaire, though the emotional functioning component is not available in its entirety in the MCS. PEDSQL is available at http://pedsql.org/about_pedsql.html

(Kolenikov 2004).[2] The factors were extracted using principal factor and the loadings were retained using the Kaiser Criterion (Eigen values>1) and scree plot test (see Appendix I, Figure 3), both of which resulted in just one factor (see Appendix I, Table 2 and 3).[3]

Children's Emotional Distress – Mother and Teacher Reported

Emotional distress for 11-year-olds was derived from the Strengths and Difficulties Questionnaires (SDQ) (Goodman, 1997), reported separately by the mothers and the teachers. The SDQ is a brief behavioural screening questionnaire for 4 to 16-year-olds. The questionnaire consists of 25 items that cover the following five aspects of children's behaviour: conduct problems; emotional symptoms; inattention-hyperactivity; peer problems; and pro-social behaviour. The items are rated in a Likert scale (0-2) ranging from 'not true' to 'certainly true'. The same version should be completed by parents and teachers. SDQ is a well-known instrument and has been used extensively in many studies to measure socio-emotional development (O'Connor et al., 2003; Kiernan and Huerta, 2008; Prady and Kiernan, 2012; Pearce et al., 2013). According to Goodman et al. (2000) the SDQ can be used to predict mental difficulties in children whereas Thapar et al. (2012) noted that SDQ provides additional screens for attention deficit hyperactivity disorder (ADHD) and disruptive behaviour symptoms.

In the present study, the total strengths and difficulties score was used, which adds the first four aspects of children's behaviour (except the pro-social behaviour aspect). Hence the total difficulties score ranges from 0 to 40, and is counted as missing if one of the 4 behavioural aspect scores is missing. Frequency distribution graphs illustrating the association between PPD and non-PPD mothers, and total difficulties scores, are shown in Appendix I (Figures 1(a)-2(b)). Most of the children (96.6% of children in the mother reported SDQ and 97.1% in the teacher reported SDQ) fall within the borderline and normal

[2] Available at http://web.missouri.edu/~kolenikovs/stata
[3] See Fabrigar and Wegener (2012) on the use of principal factor versus principal component factors for EFA.

ranges of the total difficulties score of the SDQ (0-15), for both PPD and non-PPD mothers. Regarding British norms of SDQ, it is observed that in this study, the mean SDQ teacher reported total difficulties score differs from the British mean total difficulties SDQ teacher norms by nearly 1 point for boys and 0.8 points for girls, whereas regarding the mother reported SDQ this difference is 0.5 points for both genders (Appendix I, Table 4).[4] Although the values are similar, the differences could be due to the fact that SDQ norms are presented for age ranges (in this case age 11-15) instead of a specific age (age 11), as is the case in this study. In general, we observe that boys have on average higher SDQ total difficulties scores (mother or teacher reported) than girls. However, the average scores in the child index for both genders are similar (Appendix I, Table 4). As expected, there is a moderate to high correlation between the two SDQ measures, but a low to moderate correlation between the child index and the SDQ measures (Appendix I, Table 5). Regarding children's cognitive outcomes, the average scores on all three measures are similar for both genders, and all three measures have low correlations between them for both boys and girls (Appendix I, Tables 4 and 5).

Children's Cognitive outcomes – British Ability Scales.

The British Ability Scales (BAS) has become established as a leading standardised measurement for assessing a child's cognitive ability and has been used in many longitudinal studies. Children's verbal reasoning and verbal knowledge are assessed through Verbal Similarities. Three words are read out to the child who must explain how the three words are similar. This assessment is designed to be used with children aged from 5 years to 17 years and 11 months. All of the children at age 11 (MCS5) start at the 16th item, the starting point for their age. There are decision points after items 28 and 33 at which it is decided whether the test stops or continues, according to the child's performance, taking

[4] SDQ British norms can be accessed at http://www.sdqinfo.org/norms/UKNorm4.pdf Males 11-15, SDQ Total Difficulties Parent Questionnaire: 8.8 (5.9); SDQ Total Difficulties Teacher Questionnaire: 7.6 (6.5). Females 11-15, SDQ Total Difficulties Parent Questionnaire: 7.6 (5.6); SDQ Total Difficulties Teacher Questionnaire: 5.0 (5.4); Mean scores (standard deviation).

into account the number of failures and passes obtained. After five consecutive failures the test is automatically stopped, provided that at least three items have been passed prior to this, otherwise they are routed back to the previous starting point. In this study the variable utilised is the standardised BAS ability scores. This was chosen because the scores have been adjusted for both item difficulty and age so as to facilitate the performance comparison of younger and older cohort members (Connelly, 2013).[5]

Children's Cognitive outcomes – Cambridge Gambling Task

The Cambridge Gambling Task (Rogers et al., 1999 cited in Brown and Sullivan, 2014) tests decision-making and risk-taking behaviour. Each child is presented with a row of 10 boxes, of which some are red and some are blue, and told that a yellow token is hidden in one of the boxes. The child must first decide whether the token is hidden in a red box or a blue box (decision-making). Secondly, the child must decide how many points (from an initial 100 points) wishes to gamble on being correct (risk-taking). The likelihood of each choice being correct is indicated on each trial by the ratio of red to blue boxes displayed. Possible values of bets are presented every 5 seconds. Generated outcomes of this test are: quality of decision making; deliberation time; delay aversion; risk-taking; overall proportion bet; and risk adjustment. As indicated in Brown and Sullivan (2014) quality of decision-making and risk-adjustment can be attributed to wider cognitive skills and are the two measures examined in this study.

Main independent variable PPD

PPD is assessed using the Malaise Inventory (Rutter et al., 1970 cited in Johnson 2012). This measure is a psychometrically valid measure of psychological distress (Rodgers et al., 1999 cited in Flouri et al., 2010). [6] A description of the Malaise Inventory is given in

[5]Age adjustment is made within three month age bands, so some variation could exist within each band.
[6] The variable indicating whether the mother had ever been diagnosed by a doctor with depression was asked in MCS1, which is the same sweep in which the variable used for deriving antepartum depression was asked, and

Chapter 3. According to this measure, 14.6% of mothers in this sample – 7.36% for boys and 7.26% for girls – had experienced depressed mood 9 months after the birth of their child (scoring 4 and above in the Malaise Inventory), in accordance with the literature (Appendix I, Table 6).

Control variables

As has been noted in many studies, certain factors contribute to differences in emotional outcomes in children by exacerbating or moderating the effects of maternal depression. As Sinclair and Murray (1998) stressed, family social class and the child's gender have the most pervasive influences on adjustment. Mensah and Kiernan (2010) also note that their exploration of gender differences showed that the effects of mothers' mental health were stronger for boys than for girls. According to Hay et al. (2008), repeated exposure to maternal depression rather than early exposure to maternal depression may explain its effects on children. Additionally, socio-demographic variables, including race or ethnicity (minority), family income level (poverty), age of mother (an adolescent mother), and marital status (single parent families), are considered important as this set of variables helps to define the context of the lives of children and, when conceptualized as stressors, is likely to contribute significantly to the development of psychopathology in the children of depressed mothers (Goodman and Gotlib, 1999). As regards poverty, Dearden et al. (2011) find that there are substantial differences in cognitive and socio-emotional development between children from rich and poor backgrounds, even at the age of 3, and that this gap widens by the age of 5. In terms of family structure, it is possible that the elevated rates of behavioural problems in children of depressed mothers who have gone through divorce are related to the additional stresses of divorce or marital conflict on children. On the other hand, the presence of a father may moderate the impact of maternal depression on children's functioning by

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the other psychological questions used to construct PPD (Malaise Index) were answered. However, the timing of when the diagnosis was made is not indicated. As a result this variable is not used as a background variable as it is not clear whether it captures previous history of depression, antepartum depression or current (postpartum) depression.

decreasing the childcare burden on the depressed mother or by providing an alternative, potentially healthier, parenting style for children.

Methods

Linear regressions were separately applied to assess the possible association between PPD and the child's outcome measures (emotional distress/cognitive ability) in boys and girls of 11 years of age.[7] The equations were estimated first as a base model controlling for time invariant predictors and socio-demographics (for example mother's age at birth, ethnicity, worked while pregnant, baby's age, preterm, post term), Model 1, then adjusting for history of maternal mental illness in subsequent sweeps at ages 3-7 (MCS2-MCS4), Model 2, adjusting for cohort baby's risk factors at birth (MCS1) (potentially time variant), Model 3. In Model 2, we do not control for maternal mental illness at age 11. Controlling for risk factors at age 11 will not facilitate the assessment of whether PPD is associated with children's outcomes at age 11, as the directionality of the risk factors with the children's outcomes when both are measured at age 11 will not be clear. For example, maternal mental illness at age 11 could affect 11-year-old children's emotional problems and vice versa. Additionally, regarding Model 3, we acknowledge that some of the potentially time-varying factors (for example, the mother's physical long-term illness), may change during the 11 year time period and could potentially affect the association between PPD and children's outcomes, by mediating this effect in later years. However, this is not the purpose of this study so, as mentioned above, the potential time-varying predictors are measured at age 9 months (MCS1). The sequential structure of the above models facilitates a broader evaluation of the mechanisms of each set of predictors regarding the association between PPD and the emotional and cognitive outcomes of 11-year-old children.

[7] Separate regressions examining the potential association between PPD and child outcomes (emotional, cognitive) by gender of the child and maternal highest qualification (tertiary/ non-tertiary education) are not presented because of the small subpopulation sizes. Additionally, we tried to estimate a confirmatory factor analysis model of two hypothesised latent constructs (emotional distress, cognitive ability), using the children's outcomes as indicators. Stata package confa, available at: http://fmwww.bc.edu/repec/bocode/c/confa.ado. However, this was not pursued as there are no model fit indices available for complex survey data.

The main equation, which was applied separately for boys and girls, to examine the association between PPD and the child's outcome measures is:

$$Y_{it_5} = a + bPPD_{it_1} + cX_{it_1} + dMH_{it_4} + gMH_{it_3} + kMH_{it_2} + e_{it_{1-5}}$$

where Y_{it_5} is the outcome variable (emotional difficulties, cognitive ability) at age 11 (MCS5), i is the individual, t_5 is the MCS sweep (subscript denotes sweep, in this case MCS5, age 11), PPD_{it_1} is postpartum depression, X_{it_1} is a vector of background variables measured at MCS1, MH_{it_4} is maternal mental health problems in subsequent sweeps (subscript denotes sweep, in this case maternal mental health problems in MCS4, age 7 of the child) and $e_{it_{1-5}}$ is the error term. Dependent variables have been standardised to facilitate comparison.

Models

Control variables are grouped within the three models as follows: Model 1 controlling for socio-demographics which include: maternal age at birth; baby's age in months; baby's weight at birth; whether the baby was very early pre-term; whether the baby was very late post-term; whether the mother was born in the UK (omitted variable foreign born); maternal ethnic identity category to which she felt she belonged, utilising the categories corresponding to the UK census (White, Indian, Pakistani and Bangladeshi, Mixed Ethnicity, Black, omitted variable 'other ethnicity'); and maternal highest educational qualification achieved (Higher degree, First degree, Diplomas in higher education, A / AS / S levels, O level / GCSE grades A-C, GCSE grades D-G, Other academic qualifications (incl. overseas), omitted category 'no qualifications').[8] Model 2 additionally adjusted for

[8] Due to a high number of missing cases the variable that indicates whether the baby was in ICU was not included, but the variables 'whether baby was very early pre-term' and 'whether the baby was very late post-term' are used as proxies.

history of maternal mental illness (using the Kessler K6 scale) in subsequent sweeps at ages 3 years, 5 years, and 7 years. Model 3 further adjusted for cohort baby's risk factors at birth which are potentially time variant (can be changed in the course of the child's life) but we measured at MCS1 (age 9 months) using the following variables: the OECD median poverty rate; maternal longstanding illness; whether the mother smoked before pregnancy; whether the mother consumed alcohol before pregnancy; and whether the baby has other siblings. All background variables except episodes of maternal mental health problems (MCS2-MCS4) were taken from MCS1.

Results

The estimates presented in Appendix II show the association between PPD and the emotional and cognitive outcomes (standardised score) experienced by 11-year-old children, adjusted for non-time variant predictors and socio-demographics (Model 1), then adjusted for history of maternal mental illness in subsequent sweeps (Model 2), and finally adjusted for cohort baby's risk factors at birth (Model 3). Table 1 summarises the main findings regarding children's emotional problems.

Table 1: Child Emotional Problems as Reported by Mothers, Teachers and Children: Association with PPD

Postpartum Depression	Model 1	Model 2	Model 3
Teacher Reported SDQ Total Difficulties Boys	0.229*	0.216*	0.208*
	(0.089)	(0.094)	(0.093)
Teacher Reported SDQ Total Difficulties Girls	0.040	0.043	0.038
	(0.057)	(0.057)	(0.057)
Mother Reported SDQ Total Difficulties Boys	0.419**	0.352**	0.339**
	(0.072)	(0.070)	(0.071)
Mother Reported SDQ Total Difficulties Girls	0.290**	0.231**	0.221**
	(0.074)	(0.076)	(0.075)
Child Index Boys	0.100*	0.082	0.076
	(0.049)	(0.049)	(0.049)
Child Index Girls	0.059	0.045	0.041
	(0.063)	(0.064)	(0.064)

Note: Results from 18 separate OLS estimations. Standardised coefficients; Standard errors in parentheses. *p<0.05 **p<0.01. Dependent variables measured at age 11 (MCS5), mean and standard errors of dependent variables (see Appendix I Table 4); Independent variable measured at age 9 months (MCS1); Model 1 adjusts for time invariant predictors and socio-demographics; Model 2 adjusts for characteristics in Model 1 and history of maternal mental illness (ages 3-7); Model 3 adjusts for characteristics in Model 2 and potential time risk factors at birth (see Appendix II for complete tables). Observations: Teacher's SDQ, boys: 2673; Teacher's SDQ, girls: 2724; Mother's SDQ, boys: 2673; Mother's SDQ, girls: 2724; Child Index, boys: 2528; Child Index, girls: 2612.

In the teacher's reported SDQ (Table 1) there is an association between PPD and the average child total difficulties for boys. However, no association between PPD and child difficulties was found in any of the three models for girls. In Model 1, PPD increases the mean of the total difficulties score by almost 0.229 standard deviation points for boys, while adjusting for subsequent maternal mental health problems (Model 2) slightly reduces this negative association with the mean total difficulties score for boys to 0.216 standard deviation points. Adjusting for risk factors at birth (Model 3), reduces the association between PPD and the average total difficulties score by 0.208 of the standard deviation. Overall, the adjustment in Model 2 and Model 3 has not affected the size of the association between PPD and teacher reported mean total difficulties in boys. Furthermore, examining the relationship between PPD and subsequent maternal mental health episodes (at ages 3, 5 and 7) in Model 2, reveals that there is no statistical significance with the SDQ teacher reported children's difficulties at age 11 (see Appendix II, Tables 1-2). In general, for 11-year-old boys and girls no association is found between maternal mental health problems (future episodes) and SDQ teacher reported child difficulties (see Appendix II, Tables 1-2)

but there is an association with antepartum depression and SDQ teacher reported child difficulties for girls (see Appendix II, Table 2).

In contrast to the teacher reported SDQ measure, PPD is associated with children's difficulties for both genders at age 11 using the SDQ mother reported measure (Table 1). Specifically, PPD increases the average total difficulties score by 0.42 of a standard deviation for boys in Model 1, while adjusting for subsequent maternal mental health problems reduces this negative association with boys' average total difficulties score to 0.352 of a standard deviation, which reduces further when adjusting for risk factors at birth to 0.339 (Model 3). In the case of girls, PPD is strongly associated with an increase in the difficulties score, but by a much smaller scale. In Model 1 PPD increases the average total difficulties score by 0.29 of a standard deviation, while adjusting for subsequent maternal mental health problems reduces this relationship to 0.231 points of a standard deviation, which remains relatively unchanged for Model 2 and Model 3. Subsequent episodes of maternal mental health problems affect boys' emotional difficulties to a larger extent than girls (an increase of around 0.8 of a standard deviation for boys at age 7). For girls, however, maternal mental health problems show an association with the average total difficulties score at ages 5 and 7 (see Appendix II, Tables 3 and 4).

In the case of the child index (Table 1) there is no association between PPD and child difficulties in all but one of the three models for boys and girls.

Table 2: Child Cognitive Outcomes: Association with PPD

Postpartum Depression	Model 1	Model 2	Model 3
British Ability Scales: Verbal Similarities Boys	-0.012	0.009	0.009
	(0.063)	(0.065)	(0.065)
British Ability Scales: Verbal Similarities Girls	-0.049	-0.047	-0.041
	(0.055)	(0.057)	(0.058)
CANTAB: Quality of Decision Making Boys	-0.056	-0.050	-0.043
	(0.066)	(0.065)	(0.066)
CANTAB: Quality of Decision Making Girls	0.011	-0.004	-0.003
	(0.059)	(0.058)	(0.058)
CANTAB: Risk Adjustment Boys	-0.046	-0.057	-0.045
	(0.072)	(0.073)	(0.073)
CANTAB: Risk Adjustment Girls	-0.119	-0.098	-0.096
	(0.068)	(0.070)	(0.070)

Note: Results from 18 separate OLS estimations. Standardised coefficients; Standard errors in parentheses. *p<0.05 **p<0.01. Dependent variables measured at age 11 (MCS5), mean and standard errors of dependent variables (see Appendix I Table 4); Independent variable measured at age 9 months (MCS1); Model 1 adjusts for time invariant predictors and socio-demographics; Model 2 adjusts for characteristics in Model 1 and history of maternal mental illness (ages 3-7); Model 3 adjusts for characteristics in Model 2 and potential time risk factors at birth (see Appendix II for complete tables). Observations: BAS, boys: 2636; BAS, girls: 2694; CANTAB Decision Making, boys: 2554; CANTAB Decision Making, girls: 2614; CANTAB Risk Adjustment, boys: 2055; CANTAB Risk Adjustment, girls: 2058.

Regarding children's cognitive outcomes (Table 2), there is no association between PPD and BAS verbal similarities in any of the three Models for boys and girls as well as for the two CANTAB measures. Furthermore, examining the relationship between PPD and subsequent maternal mental health episodes (at ages 3, 5 and 7) in Model 2, there is no statistical significance for BAS verbal similarities at age 11. In general, for 11-year-old children no association is found between maternal mental health problems (either ante or postpartum or future episodes) and BAS verbal similarities as well as for the two CANTAB measures (see Appendix II, Tables 7-12).

Furthermore, as a robustness check the association of PPD with the emotional and cognitive outcomes of 11-year-old children was re-estimated using chronic/lingering maternal mental health episodes as a single variable (the mother experiences mental health episodes in all sweeps; at ages 3, 5 and 7) in Model 2. The estimations do not change the main results (qualitative results) of this study (see Appendix III, Tables 1-2). As a second robustness check we re-estimated all the models, except the teacher reported SDQ measures, for the full sample, including observations where teacher's assessments were missing (whole of the

UK). We find that the qualitative results of this study do not change except in the child-reported index for boys, where we find a strong association of PPD and boys' emotional difficulties (see Appendix IV, Tables 1-2).

Discussion

This study has examined the role of maternal postpartum depression on children's emotional and cognitive outcomes at age 11, using a large MCS sample comprised of 5,397 children. The analysis indicates that PPD impacts on mother reported measures of their children's emotional development, whereas no residual variation is found when using child reported measures. Teacher reported measures show an association for boys only. No association between PPD and children's cognitive outcomes was found in any of the models.

What characterises the results is the heterogeneity observed in the assessments provided by mothers, teachers and children, leading to three different perceptions. The results showed that PPD impacts on child emotional difficulties at age 11 only when these are reported by the mother; when reported by the teacher there is a strong association with boys' emotional problems only; while it has no association with either boys' or girls' emotional problems at age 11 when reported by the children themselves.

The strong association between PPD and emotional distress in 11-year-old children (when the depressed mother is the source of information) was an expected result. According to Goodman et al. (2011), the association between maternal depression and child outcomes would be stronger when the depressed mother is the source of information on the child, relative to teachers and children themselves. The indication of a strong association between PPD and emotional distress in 11-year-old children, even when controlling for subsequent depressive episodes (age 3-7) and socio-demographics, seems to be in agreement with the findings of other empirical studies which have investigated the association between PPD and children's outcomes (Essex et al., 2003; Josefsson and Sydsio, 2007; Agnafors et al.,

2013) and also with the findings of Pawlby et al. (2008) and Hay et al. (2001; 2003), indicating that adverse experiences in infancy are associated with children's poor outcomes in later life (emotional, intellectual, behavioural). The strong association with boys' emotional problems based on teacher-reported information is in line with findings from prior research as regards the factor of a child's gender (Hankin and Abramson, 2001; Kessler et al., 2001; Garber, 2006; Goodman et al., 2011) whereas the finding that PPD has no association with either boys or girls based on reports by children was an unexpected one and needs further investigation.

Ratings by multiple informants offer a broader picture, while taking into consideration concerns about biased reports on the part of affected mothers raised by a number of researchers (Fergusson et al., 1993; Boyle and Pickles, 1997; Goodman et al., 2011; Johnston et al., 2014). Much of the research on the impact of PPD on children's outcomes relies on reports by mothers and on self-reports by children, together or separately, through interviews or questionnaires, in order to obtain information on the mental status and behavioural problems faced by offspring, as well as information about children's cognitive and intellectual abilities. Teacher reports (less common) are also utilised to obtain information on children's behaviour or their adjustment to the school environment or as an independent source of information.

The heterogeneity observed in the assessments between the three types of informants in the current study might be the result of different evaluation thresholds and perceptions by the respondents (mothers, teachers and children) that result in different pictures of the same child, particularly regarding assessment of children's psychological wellbeing (Johnston et al., 2014). The heterogeneity in the assessments by the mothers and teachers might be due to children's different behaviours in different contexts (Boyle and Pickles, 1997).

Given the association between depression and negative perceptions (Fergusson et al., 1993; Boyle and Pickles, 1997; Goodman et al., 2011) the possibility of bias cannot be excluded taking into account the strong association observed in the current study between maternal depression and child outcomes when the mother was the informant of data regarding the child. Apart from the possibility of mothers' perceptions being biased, it can be considered that depressed mothers may be more sensitive to signs of emotional and behavioural disturbances in their children than are other informants (Goodman et al., 2011). Concerns over the issue of bias in mothers' reports were raised in separate studies by Sinclair and Murray (1998), Essex et al. (2001), and Josefsson and Sydsjo (2007) who argued that women with postpartum depressive symptoms were likely to have negative perceptions of child behaviour, which influenced their selection of informants. Concerns over the possibility of mothers' ratings being distorted systematically by their emotional state were discussed by Boyle and Pickles (1997) who at the same time underlined the powerful relationship mothers share with their children, making them an important source of information for research studies. They also cautioned against automatically interpreting the rating errors in the reports of mother-informants as bias because they might simply be the result of children's different behaviours in different environments such as the family and school contexts. No studies to my knowledge have re-evaluated respondents' SDQ assessments of children, when these children reached adulthood.

The children's perceptions appear to be in disagreement with the mothers' assessments of a PPD association with boys' and girls' emotional problems and with the teachers' reports of an association with boys only, and are not in line with previous research findings which indicated that boys are at greater risk of poor development in childhood relative to girls. The harmful associations of maternal postpartum depression with children's emotional and behavioural development, particularly regarding the sons of depressed mothers, are well-documented in a large body of research (Sharp et al., 1995; Campbell and Cohen, 1997; Hay et al., 2003; Beck 2006). The timing of children's early exposure to maternal PPD in infancy

(assessed at 9 months postpartum in this study) is also considered a strong predictor of children's mental health problems and other disturbances, e.g. lower IQ scores (Hay et al., 2001), significant intellectual deficits (Cogill et al., 1986) and serious violent symptoms (Hay et al., 2003). As indicated in the robustness check for the full sample, (see the results section in this chapter) the estimates show that PPD is a strong predictor for boys' emotional difficulties. This is in accordance with the main body of research evidence. However, one must consider that our index is not validated whereas the SDQ questionnaires are validated for measuring mental health difficulties in Britain. The comparisons using the children's self-reported index could be re-estimated in the two samples (full and reduced), when the boys reach adulthood, in order to see which of the two constructed measures is the best predictor of emotional problems. Despite the caveat of the inconsistency in the boys' self-reported indicator we opt to use the reduced sample results because in this way we can have a comparison between all three of the informants (mothers, teachers, and children). Additionally the reduced sample enables us to have a comparison between the two validated measures mother-reported SDQ and teacher-reported SDQ. Furthermore, the estimates in both samples show that the mother-reported SDQ and the girls' self-reported index are consistent. Besides, all three measures are consistent when using chronic/ lingering maternal mental health episodes as a robustness check.

Teachers' reports are mostly utilised to obtain information on children's behaviour or adjustment to the school environment or as an independent source of information. Pawlby et al. (2008) observed an agreement between informants' ratings, whereas in the current study, the informants' ratings are characterised by heterogeneity. Teachers' reports as an independent source of information for research were employed in a number of studies investigating the impact of maternal depression on children's outcomes at different stages of development. Hay et al. (2001, p. 877) described teachers' ratings as an "uncontaminated" measure, while Sinclair and Murray (1998) and Essex et al. (2001) opted to use only teachers reports in separate studies, as a measure for rating the children's adjustment to

school in the first study and in the second study for assessing children's mental symptoms in kindergarten. Another point to emerge is that maternal reports can prove a valuable source of data and a reliable predictor of a child's functioning if compared and evaluated together, or against information from other respondents (fathers, teachers, and health specialists). Thus, maternal reports cannot be ignored due to fear of bias as mothers might be more sensitive to signs of emotional problems in their children, because, as Boyle and Pickles (1997) point out, mothers share a unique and intense relationship with their children.

Our findings on cognitive outcomes also reflect the evidence provided by Murray and al. (1996) and Maselko et al. (2015). The first study examined the effect of postpartum depression on later cognitive competence by age 5, while the second one examined the influence of peripartum depression on 7-year-old children in a randomized control trial in Pakistan. Both studies found no effect on cognitive outcomes. However, the majority of evidence from previous research on cognitive outcomes points to mixed results (Beck, 2006) and suggests that boys and girls are affected in different ways in terms of cognitive development such as language and IQ, with boys more at risk (Grace et al., 2003) – see the literature review section of this chapter.

The difference between the emotional and cognitive outcomes of 11-year-old children in the present study can be interpreted as an indication of the complex interactions and multiple ways through which postpartum depression can impact on children's outcomes at different stages of the life cycle. A point to be noted is that only interviewer-assessed tests were used to measure cognitive outcomes in this study. Therefore, there is a need for further research into the issue of the effect of PPD on children's cognitive outcomes employing different assessment methods.

Strengths and Limitations

This study would have benefited from a strengths and difficulties child-reported questionnaire, which is not available at age 11 (in MCS5), as this could have facilitated the comparison between the three different categories of respondents (mothers, teachers, and children) on the same measure of emotional distress (the SDQ). Additionally, clinical interviews/ diagnosis of the children would have facilitated the identification of bias in children's responses.

Despite its limitations, this study has contributed to the debates on PPD and children's emotional outcomes as well as the respondents' perception bias. One of the strengths of this study is the use of multiple evidence and perceptions by three different types of informants (mothers, children, and teachers), thereby offering a broader picture while taking into account concerns raised by some researchers over the issue of biased reports, based on respondents' perceptions – through over-reporting by affected mothers (Fergusson et al., 1993 and Goodman et al., 2011) or teachers' negative perceptions (Johnston et al., 2014). The focus on the 11-year-old group has enhanced our insight into the role of maternal PPD regarding an important stage of development and a significant period of transition which has not previously been the focus of research, with the exception of three clinical studies with relatively small sample sizes. The present study uses data from the MCS, a longitudinal cohort study with a large sample size. Additionally, there is an opportunity to draw a comparison between the findings of this observational study and the findings of other studies such as clinical ones or studies using different methods. If examined together or in parallel, they can provide possibilities of different evaluations, increasing understanding of the complex interactions between children and their caregiving environment for policy makers and designers of preventive strategies regarding children's wellbeing and future trajectories outcomes.

Conclusion and policy implications

The findings of the current study only relate to a specific stage of development (end of late childhood period). However, what happens at the threshold of adolescence is of significance from the perspective of policy intervention and prevention strategies because, as many studies have indicated, emotional disorders and behavioural problems in late childhood can persist into later life, leading to educational failure in early adolescence (Hay et al., 2001) and the possibility of lower earnings in adult life. As emphasised in the recent Mental Health Taskforce (2016) report, prevention is of significance particularly as regards key stages of development in a child's life. Age 11, the time period investigated in the current study, is an important stage in children's development before they enter adolescence and reach puberty. Thus, the findings of the present study have important implications for educational authorities, health professionals and policy makers as they add to the growing body of research on the long-term influence of postpartum depression on children's socio-emotional outcomes (observed 11 years after the birth) and also confirm that a significant percentage of mothers – over 14% in the sample – experienced depressed mood nine months after the birth of their child. These findings point to the need for intervention through programmes aiming at creating healthy early environments in infancy – a crucial period for children's development - and enabling quality parenting at all key stages of development, because health and wellbeing during childhood are believed to shape future health and learning outcomes later in adolescent and adult life. Mothers constitute infants' first "social environment" (Grace et al., 2003, p. 263) and quality of parenting must therefore be a priority in the government's plans and strategies that are aimed at counteracting the emotional consequences of PPD for affected mothers during the postpartum period and beyond. Additionally, to be successful, intervention strategies must be designed to target both the mother and the child, taking into consideration the specific problems and needs of subgroups within the population. The long-term effect of maternal PPD on children's outcomes must be a cause for concern to policy makers, given that in the UK one in ten

children aged 5-16 has a diagnosable mental health problem and one in five mothers suffers from depression, anxiety or even psychosis during the perinatal period (Mental Health Taskforce, 2016). Mental health policies must take into account the crucial role of maternal mental health for the health and wellbeing of future generations, given the complex role of postpartum depression and its potential consequences for both mother and child outcomes.

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Appendix I Figures and Descriptive Statistics

Figure 1(a) Teacher SDQ frequencies-No PPD

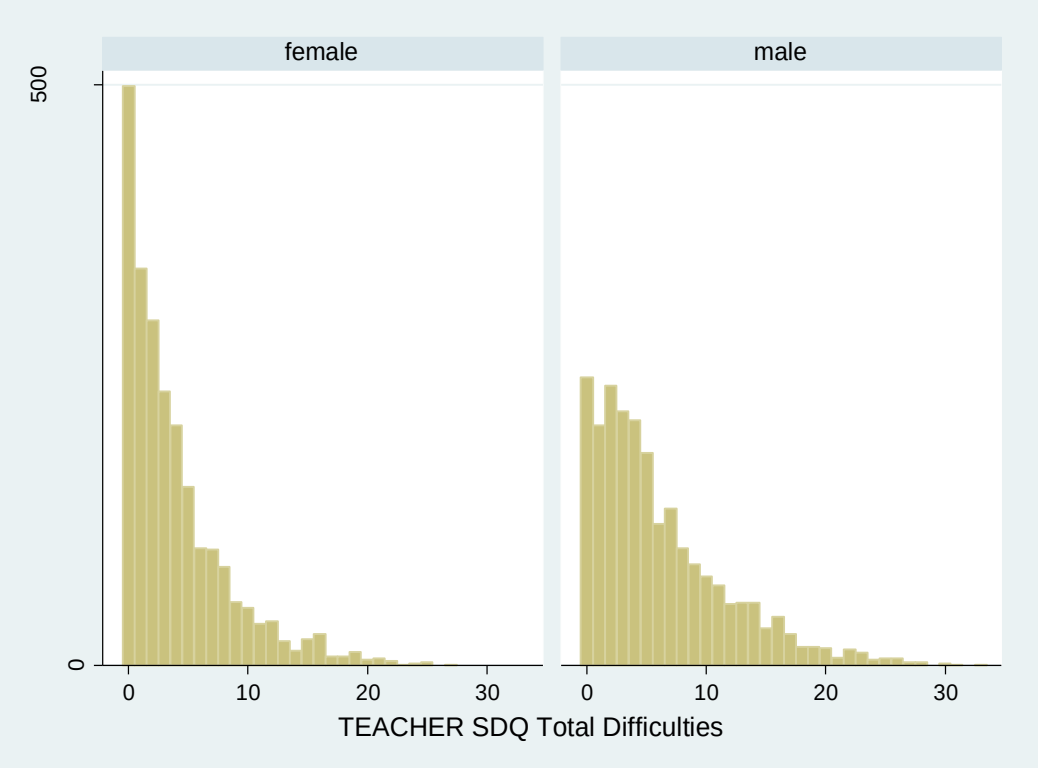

Figure 1(b) Teacher SDQ frequencies-PPD

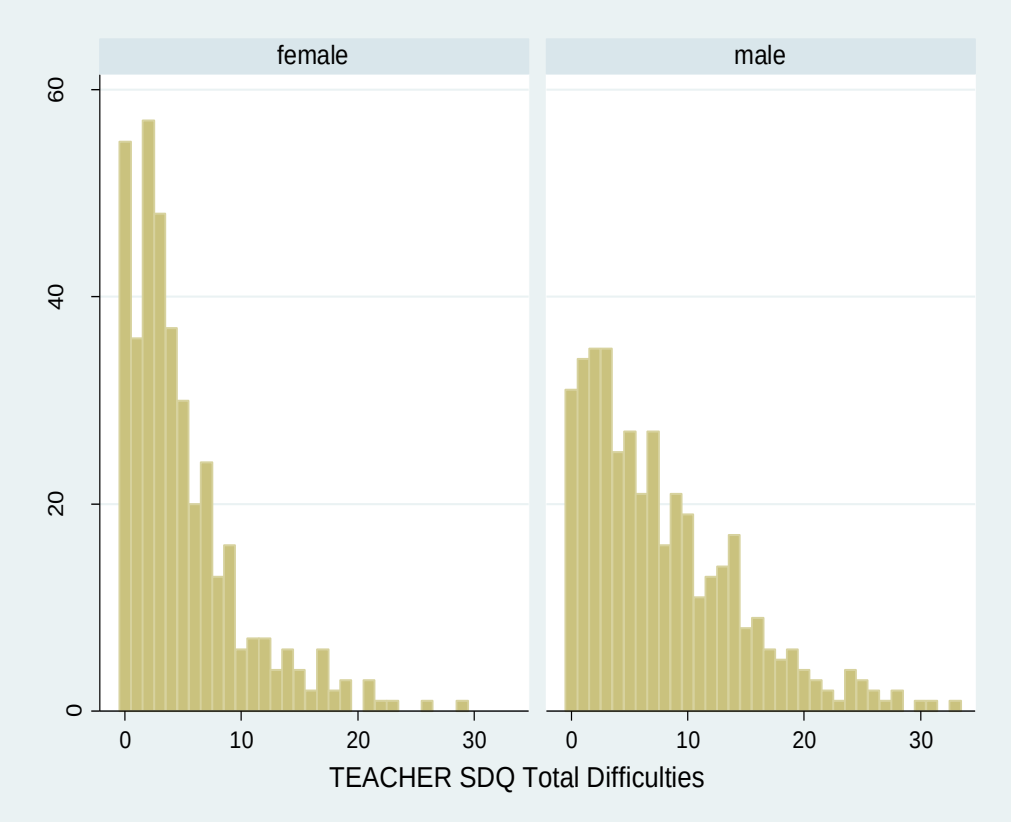

Figure 2 (a) Parent SDQ frequencies-No PPD

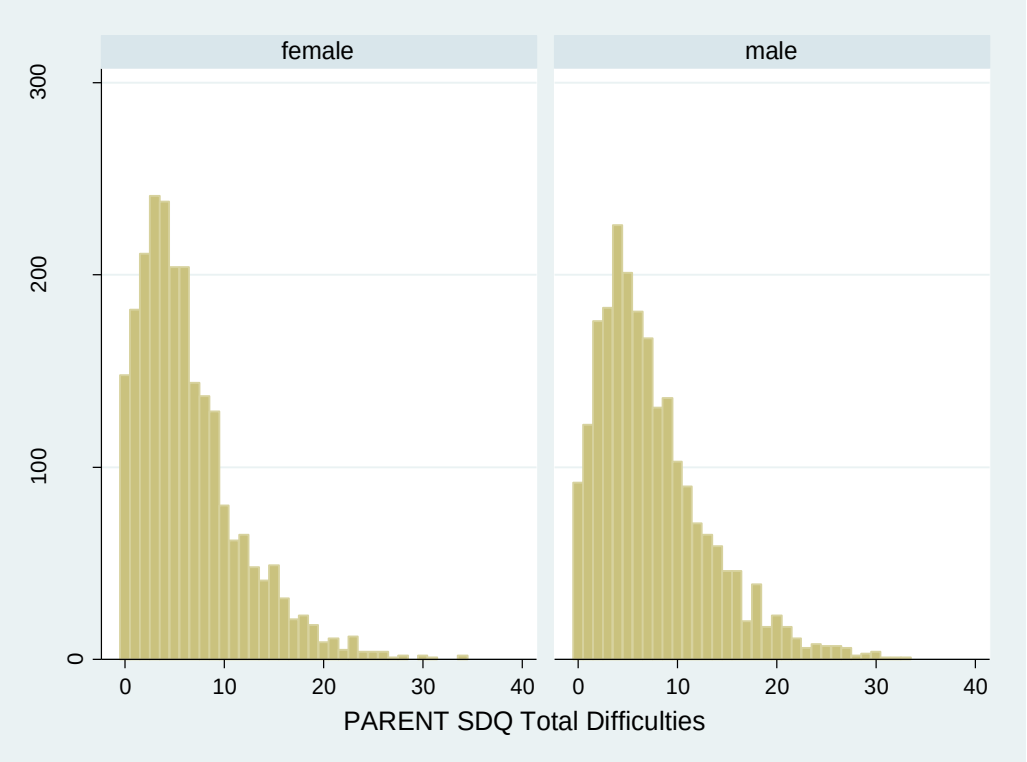

Figure 2(b) Parent SDQ frequencies-PPD

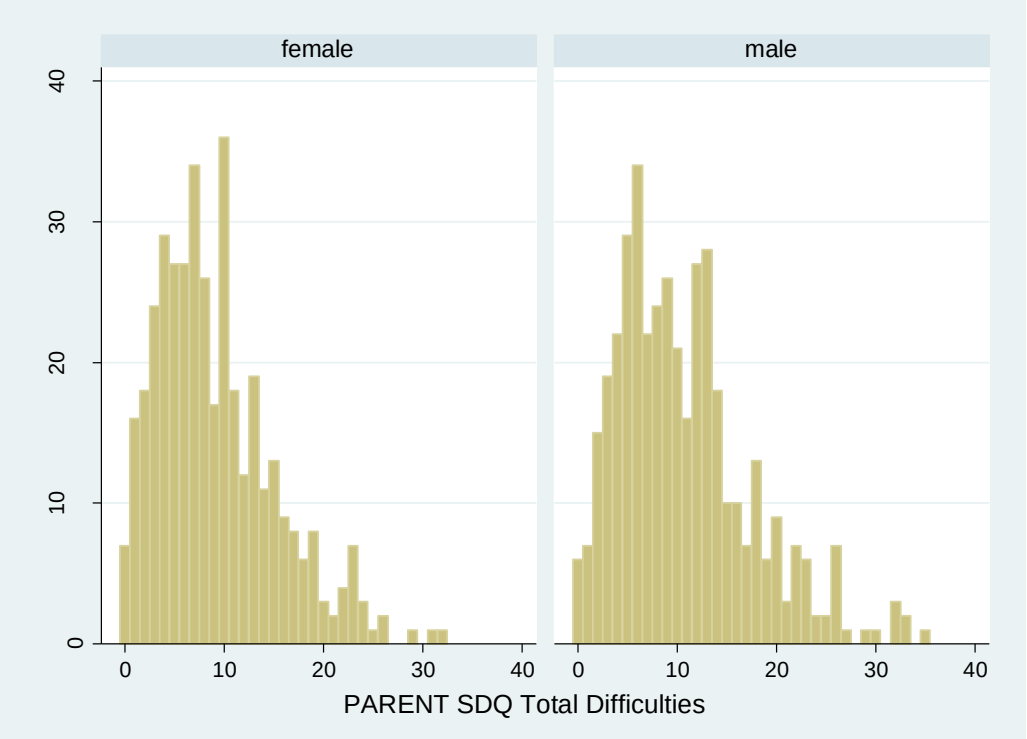

Figure 3 Scree plot of Eigenvalues of factor loadings

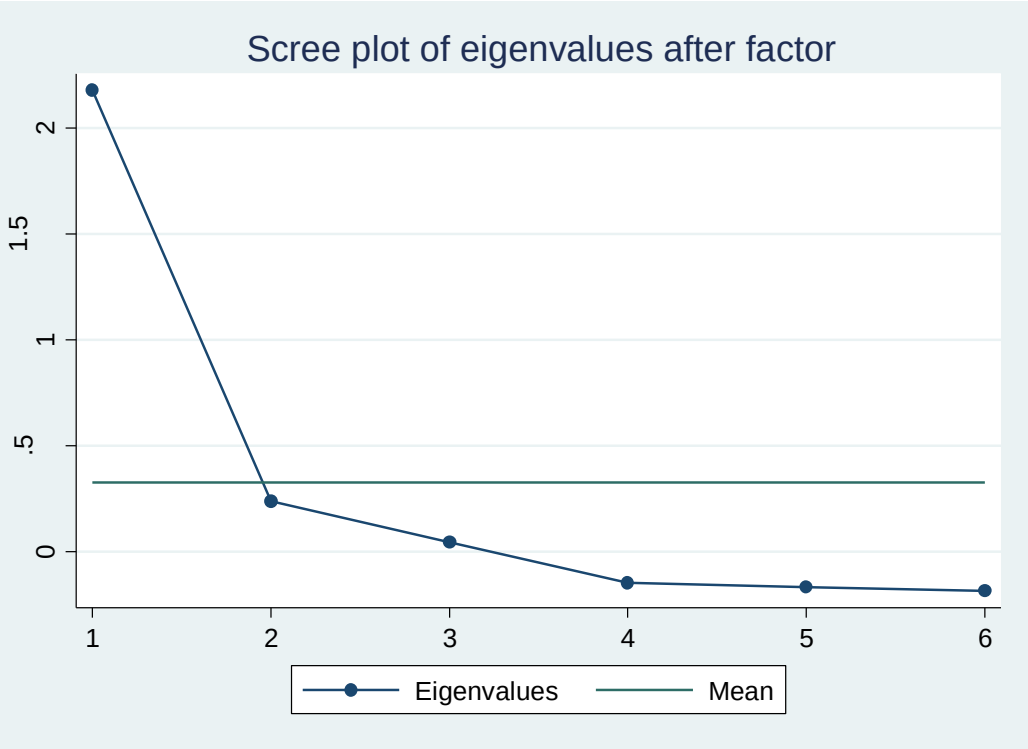

Table 1a: Item non-response

Variables	Values Missing
SDQ Teacher Reported	34
SDQ Mother Reported	137
Mother born in UK	1
Ethnic group	12
OECD below 60% median poverty indicator	6
Baby post term	43
Baby pre term	43
Birth weight in kilos	2
Highest academic qualification	4
Smoking	4
Longstanding illness	2

Note: Some observations have missing values on more than one variable

Table 1b: Sample selection tests

Variables	Mean Selected Sample	Mean Missing Sample	Mean Difference	Difference T-test P-Value Pr(|T|>|T|)
Outcome				
SDQ Teacher Reported	5.425	6.196	-0.771	0.153
	(0.107)	(0.538)	(0.539)	
SDQ Mother Reported	7.624	9.015	-1.391	0.063
	(0.124)	(0.728)	(0.745)	
Child Index	2.369	2.368	0.001	0.991
	(0.016)	(0.062)	(0.063)	
CANTAB Quality of Decision Making	0.818	0.814	0.004	0.732
	(0.003)	(0.013)	(0.013)	
CANTAB Risk Adjustment	1.070	1.018	0.051	0.507
	(0.017)	(0.077)	(0.077)	
BAS Verbal Similarities	59.075	58.696	0.379	0.611
	(0.297)	(0.772)	(0.743)	
Main Independent Variable				
Postpartum depression	0.146	0.308	-0.162	0.000
	(0.006)	(0.041)	(0.039)	
Controls				
Maternal depression age3 (MCS2)	0.107	0.325	-0.218	0.000
	(0.006)	(0.042)	(0.042)	
Maternal depression age5 (MCS3)	0.052	0.188	-0.136	0.000
	(0.004)	(0.035)	(0.034)	
Maternal depression age7 (MCS4)	0.051	0.176	-0.125	0.000
	(0.004)	(0.033)	(0.033)	
Maternal age at birth of CM	29.167	28.794	0.373	0.439
	(0.154)	(0.477)	(0.481)	
Worked pregnant	0.699	0.548	0.151	0.001
	(0.009)	(0.045)	(0.044)	
Mother born in UK	0.911	0.739	0.172	0.000
	(0.006)	(0.038)	(0.037)	
Married	0.620	0.577	0.043	0.344
	(0.012)	(0.046)	(0.046)	
Maternal ethnic group – White	0.905	0.607	0.298	0.000
	(0.010)	(0.048)	(0.046)	
Maternal ethnic group – Mixed	0.010	0.017	-0.007	0.531
	(0.002)	(0.011)	(0.011)	
Maternal ethnic group – Indian	0.019	0.040	-0.021	0.117
	(0.002)	(0.014)	(0.013)	
Maternal ethnic group – Pakistani	0.028	0.138	-0.110	0.001
	(0.005)	(0.036)	(0.033)	
Maternal ethnic group – Black	0.027	0.043	-0.016	0.168
	(0.005)	(0.013)	(0.012)	
OECD below 60% median poverty indicator	0.252	0.430	-0.178	0.000
	(0.011)	(0.044)	(0.042)	
Baby post term	0.010	0.014	-0.005	0.639
	(0.002)	(0.010)	(0.011)	
Baby preterm	0.076	0.135	-0.059	0.069
	(0.004)	(0.032)	(0.032)	

Note: Standard errors in parentheses; outcome variables measured at age 11 (MCS5); main independent variable measured at age 9 months (MCS1); control variables measured at age 9 months (MCS1), except maternal mental health measured at ages 3-7 (MCS2-4). Abbreviations: CM, cohort member, child.

Table 1b (cont'd): Sample selection tests

Variables	Mean Selected Sample	Mean Missing Sample	Mean Difference	Difference T-test P-Value Pr(|T|>|T|)
Other siblings	0.574	0.616	-0.041	0.329
	(0.009)	(0.043)	(0.042)	
Birth weight in kilos	3.360	3.243	0.117	0.063
	(0.009)	(0.062)	(0.063)	
Baby's age in months	9.186	9.166	0.020	0.581
	(0.011)	(0.036)	(0.036)	
Ever tried to breastfeed	0.716	0.689	0.027	0.479
	(0.012)	(0.040)	(0.039)	
Gender child	0.499	0.583	-0.085	0.020
	(0.009)	(0.035)	(0.036)	
Highest academic qualification – Higher degree	0.032	0.022	0.010	0.287
	(0.003)	(0.009)	(0.009)	
Highest academic qualification – First degree	0.155	0.097	0.058	0.030
	(0.010)	(0.027)	(0.026)	
Highest academic qualification – Diploma	0.100	0.065	0.035	0.066
	(0.004)	(0.019)	(0.019)	
Highest academic qualification – A-Level	0.094	0.051	0.043	0.010
	(0.004)	(0.016)	(0.016)	
Highest academic qualification – O-Level [A-C]	0.358	0.270	0.088	0.008
	(0.011)	(0.032)	(0.033)	
Highest academic qualification – O-Level [D-G]	0.115	0.125	-0.010	0.731
	(0.007)	(0.028)	(0.028)	
Highest academic qualification – Other	0.017	0.050	-0.033	0.040
	(0.002)	(0.016)	(0.016)	
Smoking	0.502	0.568	-0.066	0.317
	(0.016)	(0.065)	(0.066)	
Alcohol	0.350	0.289	0.062	0.095
	(0.010)	(0.038)	(0.037)	
Longstanding illness	0.215	0.223	-0.009	0.794
	(0.007)	(0.033)	(0.033)	
Antepartum depression	0.004	0.004	0.000	0.865
	(0.001)	(0.001)	(0.001)	
Baby's father present at birth	0.867	0.687	0.179	0.000
	(0.007)	(0.044)	(0.043)	
Lived with both parents until 15	0.769	0.783	-0.014	0.710
	(0.008)	(0.038)	(0.038)	
Partner completed questionnaire	0.012	0.055	-0.043	0.003
	(0.002)	(0.015)	(0.015)	
N	5397	253		

Note: Standard errors in parentheses; outcome variables measured at age 11 (MCS5); main independent variable measured at age 9 months (MCS1); control variables measured at age 9 months (MCS1), except maternal mental health measured at ages 3-7 (MCS2-4). Abbreviations: CM, cohort member, child.

Table 2: Factor analysis (EFA)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor 1	2.151	1.856	1.091	1.091
Factor 2	0.296	0.254	0.150	1.241
Factor 3	0.042	0.196	0.021	1.263
Factor 4	-0.154	0.013	-0.078	1.184
Factor 5	-0.167	0.029	-0.085	1.099
Factor 6	-0.196	-	-0.099	1.000

Note: Extraction using principal factors. LR test: P>chi2 (15) = 0

Table 3: Factor loadings (pattern matrix) and unique variances

Variable	Factor 1	Uniqueness
"happy" (rev.)	0.454	0.794
"worried"	0.670	0.551
"sad"	0.771	0.406
"afraid"	0.726	0.472
"laugh" (rev.)	0.187	0.965
"angry"	0.583	0.661

Table 4: Descriptive of outcome variables by gender

	Male		Female	
	Mean	Std. Err.	Mean	Std. Err.
SDQ Teacher Reported	6.652	0.163	4.204	0.117
SDQ Mother Reported	8.270	0.164	6.981	0.145
Child Index	2.339	0.021	2.400	0.020
BAS Scores	59.345	0.349	58.807	0.317
Risk Assessment	1.089	0.021	1.050	0.022
Quality of Decision	0.812	0.005	0.824	0.004

Table 5: Correlation of outcome variables by gender

	Male			Female		
	Emotional outcomes					
	SDQ Mother Reported	SDQ Teacher Reported	Child Index	SDQ Mother Reported	SDQ Teacher Reported	Child Index
SDQ Mother Reported	1.0000			1.0000		
SDQ Teacher Reported	0.5344	1.0000		0.4884	1.0000	
Child Index	0.2919	0.2151	1.0000	0.2879	0.2197	1.0000
	Cognitive outcomes					
	BAS Scores	Risk Assessment	Quality of Decision	BAS Scores	Risk Assessment	Quality of Decision
BAS Scores	1.0000			1.0000		
Risk Assessment	0.1114	1.0000		0.1298	1.0000	
Quality of Decision	0.1064	0.1495	1.0000	0.0908	0.0831	1.0000

Note: Unweighted correlations

Table 6: Postpartum depression by gender

	Postpartum Depression		
	No	Yes	Total
Female			
Percentage	42.9	7.26	50.1
Observations	2334	390	2724
Male			
Percentage	42.5	7.36	49.9
Observations	2268	405	2673
Total	85.4	14.6	100
	4602	795	5397

Appendix II Estimations

Table 1: Teacher Reported SDQ -Total Difficulties Score for boys

	Model 1[i]	Model 2[ii]	Model 3[iii]
	Teacher Total Difficulties	Teacher Total Difficulties	Teacher Total Difficulties
Postpartum depression	0.229*	0.216*	0.208*
	(0.089)	(0.094)	(0.093)
Antepartum depression	0.942	0.954	0.979
	(0.775)	(0.790)	(0.826)
Maternal mental health problems-Age 3		-0.059	-0.068
		(0.099)	(0.097)
Maternal mental health problems-Age 5		0.130	0.125
		(0.183)	(0.178)
Maternal mental health problems-Age 7		0.126	0.118
		(0.192)	(0.183)
N	2673	2673	2673
R^2	0.143	0.144	0.152

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Table 2: Teacher Reported SDQ -Total Difficulties Score for girls

	Model 1[i]	Model 2[ii]	Model 3[iii]
	Teacher Total Difficulties	Teacher Total Difficulties	Teacher Total Difficulties
Postpartum depression	0.040	0.043	0.038
	(0.057)	(0.057)	(0.057)
Antepartum depression	0.630*	0.622*	0.609*
	(0.291)	(0.296)	(0.289)
Maternal mental health problems-Age 3		-0.094	-0.086
		(0.064)	(0.065)
Maternal mental health problems-Age 5		-0.044	-0.038
		(0.094)	(0.092)
Maternal mental health problems-Age 7		0.171	0.152
		(0.105)	(0.106)
N	2724	2724	2724
R^2	0.091	0.093	0.097

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Table 3: Mother Reported SDQ -Total Difficulties Score for boys

	Model 1[i]	Model 2[ii]	Model 3[iii]
	Parent Total Difficulties	Parent Total Difficulties	Parent Total Difficulties
Postpartum depression	0.419**	0.352**	0.339**
	(0.072)	(0.070)	(0.071)
Antepartum depression	-0.043	-0.019	-0.019
	(0.232)	(0.256)	(0.301)
Maternal mental health problems-Age 3		-0.045	-0.049
		(0.086)	(0.087)
Maternal mental health problems-Age 5		0.261	0.256
		(0.162)	(0.161)
Maternal mental health problems-Age 7		0.730**	0.723**
		(0.212)	(0.207)
N	2673	2673	2673
R^2	0.161	0.186	0.194

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Table 4: Mother Reported SDQ -Total Difficulties Score for girls

	Model 1[i]	Model 2[ii]	Model 3[iii]
	Parent Total Difficulties	Parent Total Difficulties	Parent Total Difficulties
Postpartum depression	0.290**	0.231**	0.221**
	(0.074)	(0.076)	(0.075)
Antepartum depression	0.450	0.442	0.414
	(0.236)	(0.244)	(0.237)
Maternal mental health problems-Age 3		0.055	0.068
		(0.074)	(0.074)
Maternal mental health problems-Age 5		0.281*	0.295*
		(0.117)	(0.116)
Maternal mental health problems-Age 7		0.367**	0.338*
		(0.132)	(0.135)
N	2724	2724	2724
R^2	0.123	0.138	0.146

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Table 5: Child Reported Index for boys

	Model 1[i]	Model 2[ii]	Model 3[iii]
	Child Index (Scores for Factor)	Child Index (Scores for Factor)	Child Index (Scores for Factor)
Postpartum depression	0.100*	0.082	0.076
	(0.049)	(0.049)	(0.049)
Antepartum depression	0.236	0.228	0.228
	(0.454)	(0.430)	(0.417)
Maternal mental health problems-Age 3		-0.036	-0.038
		(0.057)	(0.058)
Maternal mental health problems-Age 5		0.185	0.183
		(0.095)	(0.096)
Maternal mental health problems-Age 7		0.110	0.107
		(0.114)	(0.114)
N	2528	2528	2528
R^2	0.045	0.048	0.054

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Table 6: Child Reported Index for girls

	Model 1[i]	Model 2[ii]	Model 3[iii]
	Child Index (Scores for Factor)	Child Index (Scores for Factor)	Child Index (Scores for Factor)
Postpartum depression	0.059	0.045	0.041
	(0.063)	(0.064)	(0.064)
Antepartum depression	0.194	0.182	0.170
	(0.210)	(0.222)	(0.216)
Maternal mental health problems-Age 3		-0.029	-0.022
		(0.062)	(0.063)
Maternal mental health problems-Age 5		0.008	0.002
		(0.103)	(0.103)
Maternal mental health problems-Age 7		0.226*	0.211
		(0.109)	(0.111)
N	2612	2612	2612
R^2	0.026	0.029	0.033

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Table 7: BAS Verbal Similarities for boys

	Model 1[i]	Model 2[ii]	Model 3[iii]
	BAS Verbal Similarities	BAS Verbal Similarities	BAS Verbal Similarities
Postpartum depression	-0.012	0.009	0.009
	(0.063)	(0.065)	(0.065)
Antepartum depression	-0.039	-0.056	-0.054
	(0.164)	(0.170)	(0.158)
Maternal mental health problems-Age 3		0.010	0.006
		(0.086)	(0.084)
Maternal mental health problems-Age 5		-0.031	-0.007
		(0.115)	(0.115)
Maternal mental health problems-Age 7		-0.283	-0.294
		(0.152)	(0.155)
N	2636	2636	2636
R^2	0.135	0.138	0.148

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Table 8: BAS Verbal Similarities for girls

	Model 1[i]	Model 2[ii]	Model 3[iii]
	BAS Verbal Similarities	BAS Verbal Similarities	BAS Verbal Similarities
Postpartum depression	-0.049	-0.047	-0.041
	(0.055)	(0.057)	(0.058)
Antepartum depression	-0.575	-0.579	-0.557
	(0.492)	(0.488)	(0.478)
Maternal mental health problems-Age 3		-0.028	-0.040
		(0.061)	(0.060)
Maternal mental health problems-Age 5		-0.033	-0.029
		(0.102)	(0.101)
Maternal mental health problems-Age 7		0.057	0.065
		(0.106)	(0.107)
N	2694	2694	2694
R^2	0.127	0.128	0.137

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Table 9: CANTAB Quality of Decision Making for Boys

	Model 1[i]	Model 2[ii]	Model 3[iii]
	Quality of Decision Making	Quality of Decision Making	Quality of Decision Making
Postpartum depression	-0.056	-0.050	-0.043
	(0.066)	(0.065)	(0.066)
Antepartum depression	0.025	0.084	0.118
	(0.161)	(0.171)	(0.194)
Maternal mental health problems-Age 3		-0.049	-0.053
		(0.088)	(0.088)
Maternal mental health problems-Age 5		-0.149	-0.146
		(0.136)	(0.138)
Maternal mental health problems-Age 7		0.115	0.114
		(0.140)	(0.144)
N	2554	2554	2554
R^2	0.054	0.055	0.065

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Table 10: CANTAB Quality of Decision Making for Girls

	Model 1[i]	Model 2[ii]	Model 3[iii]
	Quality of Decision Making	Quality of Decision Making	Quality of Decision Making
Postpartum depression	0.011	-0.004	-0.003
	(0.059)	(0.058)	(0.058)
Antepartum depression	-0.117	-0.107	-0.079
	(0.216)	(0.212)	(0.197)
Maternal mental health problems-Age 3		0.007	-0.001
		(0.073)	(0.071)
Maternal mental health problems-Age 5		0.165	0.174
		(0.100)	(0.100)
Maternal mental health problems-Age 7		-0.010	0.007
		(0.116)	(0.119)
N	2614	2614	2614
R^2	0.052	0.055	0.067

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Table 11: CANTAB Risk Adjustment for Boys

	Model 1[i]	Model 2[ii]	Model 3[iii]
	Risk Adjustment	Risk Adjustment	Risk Adjustment
Postpartum depression	-0.046	-0.057	-0.045
	(0.072)	(0.073)	(0.073)
Antepartum depression	-0.391	-0.493	-0.497
	(0.265)	(0.302)	(0.354)
Maternal mental health problems-Age 3		0.113	0.120
		(0.106)	(0.102)
Maternal mental health problems-Age 5		0.210	0.222
		(0.136)	(0.135)
Maternal mental health problems-Age 7		-0.126	-0.114
		(0.123)	(0.122)
N	2055	2055	2055
R^2	0.052	0.055	0.067

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Table 12: CANTAB Risk Adjustment for Girls

	Model 1[i]	Model 2[ii]	Model 3[iii]
	Risk Adjustment	Risk Adjustment	Risk Adjustment
Postpartum depression	-0.119	-0.098	-0.096
	(0.068)	(0.070)	(0.070)
Antepartum depression	0.508	0.526	0.510
	(0.332)	(0.320)	(0.314)
Maternal mental health problems-Age 3		-0.062	-0.063
		(0.087)	(0.086)
Maternal mental health problems-Age 5		0.012	0.003
		(0.096)	(0.098)
Maternal mental health problems-Age 7		-0.176	-0.184
		(0.112)	(0.111)
N	2058	2058	2058
R^2	0.044	0.046	0.048

Note: Standardised coefficients; Standard errors in parentheses; * p<0.05** p<0.01; All models include controls for maternal age at birth, baby's age in months, baby's weight at birth, tried to breastfeed, baby pre-term, baby post-term, mother born in the UK, ethnicity, attending religious services, baby's father present at birth, mother lived with both parents until 15, baby's father completed questionnaire, regional residency, maternal highest educational qualification and constant term. Model 3 includes controls for the OECD median poverty rate, marriage, maternal longstanding illness, mother smoked, mother consumed alcohol, baby has other siblings.

[i] adjusting for non-time variant predictors and socio-demographics

[ii] adjusting for Model 1 and history of maternal mental illness (ages 3-7)

[iii] adjusting for cohort baby's time variant risk factors at birth

Appendix III Estimations: Using chronic maternal mental health episodes as a robustness check

Table 1: Child Emotional Problems as Reported by Mothers, Teachers and Children: Association with PPD

Postpartum Depression	Model 1	Model 2	Model 3
Teacher Reported SDQ Total Difficulties Boys	0.229*	0.222*	0.211*
	(0.089)	(0.089)	(0.089)
Teacher Reported SDQ Total Difficulties Girls	0.040	0.041	0.036
	(0.057)	(0.056)	(0.056)
Mother Reported SDQ Total Difficulties Boys	0.419**	0.403**	0.388**
	(0.072)	(0.071)	(0.071)
Mother Reported SDQ Total Difficulties Girls	0.290**	0.278**	0.270**
	(0.074)	(0.074)	(0.073)
Child Index Boys	0.100*	0.097*	0.090
	(0.049)	(0.049)	(0.048)
Child Index Girls	0.059	0.056	0.052
	(0.063)	(0.062)	(0.062)

Note: Results from 18 separate OLS estimations. Standardised coefficients; Standard errors in parentheses. *p<0.05 **p<0.01. Dependent variables measured at age 11 (MCS5), mean and standard errors of dependent variables (see Appendix I Table 4); Independent variable measured at age 9 months (MCS1); Model 1 adjusts for time invariant predictors and socio-demographics; Model 2 adjusts for characteristics in Model 1 and persistence of maternal mental illness (ages 3-7); Model 3 adjusts for characteristics in Model 2 and potential time risk factors at birth (see Appendix II for complete tables). Observations: Teacher's SDQ, boys: 2673; Teacher's SDQ, girls: 2724; Mother's SDQ, boys: 2673; Mother's SDQ, girls: 2724; Child Index, boys: 2528; Child Index, girls: 2612.

Table 2: Child Cognitive Outcomes: Association with PPD

Postpartum Depression	Model 1	Model 2	Model 3
British Ability Scales: Verbal Similarities Boys	-0.012	-0.008	-0.007
	(0.063)	(0.063)	(0.062)
British Ability Scales: Verbal Similarities Girls	-0.049	-0.049	-0.044
	(0.055)	(0.056)	(0.057)
CANTAB: Quality of Decision Making Boys	-0.056	-0.056	-0.050
	(0.066)	(0.066)	(0.066)
CANTAB: Quality of Decision Making Girls	0.011	0.003	0.005
	(0.059)	(0.059)	(0.058)
CANTAB: Risk Adjustment Boys	-0.046	-0.047	-0.033
	(0.072)	(0.072)	(0.071)
CANTAB: Risk Adjustment Girls	-0.119	-0.117	-0.116
	(0.068)	(0.068)	(0.068)

Note: Results from 18 separate OLS estimations. Standardised coefficients; Standard errors in parentheses. *p<0.05 **p<0.01. Dependent variables measured at age 11 (MCS5), mean and standard errors of dependent variables (see Appendix I Table 4); Independent variable measured at age 9 months (MCS1); Model 1 adjusts for time invariant predictors and socio-demographics; Model 2 adjusts for characteristics in Model 1 and persistence of maternal mental illness (ages 3-7); Model 3 adjusts for characteristics in Model 2 and potential time risk factors at birth (see Appendix II for complete tables). Observations: BAS, boys: 2636; BAS, girls: 2694; CANTAB Decision Making, boys: 2554; CANTAB Decision Making, girls: 2614; CANTAB Risk Adjustment, boys: 2055; CANTAB Risk Adjustment, girls: 2058.

Appendix IV Estimations: Using full sample as a robustness check

Table 1: Child Emotional Problems as Reported by Mothers and Children: Association with PPD

Postpartum Depression	Model 1	Model 2	Model 3
Mother Reported SDQ Total Difficulties Boys	0.414**	0.329**	0.318**
	(0.056)	(0.057)	(0.057)
Mother Reported SDQ Total Difficulties Girls	0.335**	0.260**	0.252**
	(0.058)	(0.060)	(0.059)
Child Index Boys	0.153**	0.132**	0.125**
	(0.038)	(0.038)	(0.038)
Child Index Girls	0.073	0.056	0.053
	(0.047)	(0.048)	(0.048)

Note: Results from 12 separate OLS estimations. Standardised coefficients; Standard errors in parentheses. *p<0.05 **p<0.01. Dependent variables measured at age 11 (MCS5), mean and standard errors of dependent variables; Independent variable measured at age 9 months (MCS1); Model 1 adjusts for time invariant predictors and socio-demographics; Model 2 adjusts for characteristics in Model 1 and history of maternal mental illness (ages 3-7); Model 3 adjusts for characteristics in Model 2 and potential time risk factors at birth. Observations: Mother's SDQ, boys: 4762; Mother's SDQ, girls: 4790; Child Index, boys: 4458; Child Index, girls: 4569.

Table 2: Child Cognitive Outcomes: Association with PPD

Postpartum Depression	Model 1	Model 2	Model 3
British Ability Scales: Verbal Similarities Boys	-0.035	0.002	-0.000
	(0.051)	(0.051)	(0.052)
British Ability Scales: Verbal Similarities Girls	-0.046	-0.036	-0.027
	(0.042)	(0.042)	(0.043)
CANTAB: Quality of Decision Making Boys	-0.056	-0.046	-0.041
	(0.051)	(0.051)	(0.051)
CANTAB: Quality of Decision Making Girls	0.014	0.001	0.001
	(0.044)	(0.045)	(0.045)
CANTAB: Risk Adjustment Boys	-0.026	-0.021	-0.013
	(0.057)	(0.058)	(0.057)
CANTAB: Risk Adjustment Girls	-0.064	-0.038	-0.034
	(0.052)	(0.054)	(0.055)

Note: Results from 18 separate OLS estimations. Standardised coefficients; Standard errors in parentheses. *p<0.05 **p<0.01. Dependent variables measured at age 11 (MCS5), mean and standard errors of dependent variables; Independent variable measured at age 9 months (MCS1); Model 1 adjusts for time invariant predictors and socio-demographics; Model 2 adjusts for characteristics in Model 1 and history of maternal mental illness (ages 3-7); Model 3 adjusts for characteristics in Model 2 and potential time risk factors at birth. Observations: BAS, boys: 4666; BAS, girls: 4718; CANTAB Decision Making, boys: 4491; CANTAB Decision Making, girls: 4562; CANTAB Risk Adjustment, boys: 3586; CANTAB Risk Adjustment, girls: 3520.

Chapter 5 Conclusion

Health constitutes an important determinant of employment outcomes and economic growth, while poor health reduces the capacity to work with negative impacts on wages, labour force participation, and choice of occupation (Currie and Madrian, 1999). Mental health impairments in particular are considered to have far-reaching consequences, specifically postpartum depression, which is a well-known risk factor to mothers and offspring and, as research evidence indicates, it can make women more vulnerable to a variety of negative outcomes and can affect children's development. Given the female propensity to develop depressive disorders, postpartum depression emerges as a major health issue with potential economic and societal implications.

This thesis focuses on specific difficulties that women face in the UK labour market in the first decade of the 21st century with emphasis on maternal mental health and its influence on women's dual role as labour force participant and as primary child caregiver – investigating issues related to gender equality and economic disparities faced by women at work and issues related to parenthood, the mother-infant relationship and the potential impact of postpartum depression (PPD) on children's developmental outcomes.

Overview of results

By focusing on the long-term impact of PPD on maternal employment outcomes, within the broader consequences of mental disorders on the economy and the marketplace, the present thesis has made a significant contribution to the field – filling an existing gap and opening a new chapter for future research in postpartum health and market outcomes. The empirical research carried out in the thesis shows the long-term impact of postpartum depression on women's employment outcomes mediated through mental and physical health 11 years after

the birth. Overall, the research underlines that women still face wage differences in the formal labour market (Chapter 2), while for a specific group of mothers, depression during the postpartum period makes their position in the labour market more vulnerable by compromising their employment outcomes and the health and future development of their offspring, 11 years after the birth (Chapters 3 and 4). It also provides further empirical support for prior evidence indicating that maternal mental health is highly important for children's socio-emotional developmental outcomes.

Thus, the potential impact of postpartum depression on women's ability to function as labour market participants and as primary child carers constitutes a double disadvantage for this subgroup of mothers at a very sensitive time in their life. There are also significant economic and societal implications given that currently a greater number of women than ever before is participating in the formal labour market and the percentage of mothers with dependent children in work increased from 67% in 1996 to 72% in 2013.[1] The prevalence of postpartum depression in combination with the evidence provided in this thesis regarding the impact of PPD on women's employment (Chapter 3) point to the need for a policy change towards this category of mothers and their offspring. The postpartum period should be accorded priority on policy agendas and in terms of the government's mental health strategies because, for the mother, mental health impairments are likely to diminish future career prospects through long breaks away from the labour market, leading to lower accumulation of work experience and skill depreciation. For the offspring, postpartum depression has the potential to disrupt aspects of caregiving; thus, children born to postpartum depressed mothers are most likely to start their lives at a disadvantage with potentially long-term consequences for their future growth and development.

[1] Office for National Statistics (2013). Full report–Women in the Labour Market. Available at: http://www.ons.gov.uk/ons/dcp171776_328352.pdf

Evaluation of results

In Chapter 2 gender equality at work is examined through the impact of the 2008/9 recession on the UK gender wage gap using the Labour Force Survey (LFS) dataset. The results are broadly in line with previous research findings (Perfect, 2011; Rubery and Rafferty, 2013; Azmat, 2015), demonstrating that women earn significantly less than men in the labour market despite increasing female participation rates in the workforce. The persistence of the gender wage gap suggests that women still face inequalities in the UK labour market, despite the fact that equal pay and anti-discrimination legislation has been in place since the 1970s and the introduction of a set of positive measures designed to promote female integration within the workforce. The observed persistence in the UK gender wage gap supports the hypothesis that intervention through legislation has not been fully successful in reducing pay differentials between men and women (Mumford and Smith, 2009). This position has important implications for policy makers as it touches on wider issues related to economic inequality and to theoretical concepts put forward by political philosophers, as reviewed by Roemer (2009), regarding state intervention and its justification. On the issue of intervention, Gregory (2009) observes that the difficulty lies in identifying whether gender differences in labour market outcomes are the result of unequal treatment or reflect fundamental differences between the sexes.

The family factor (marriage and childrearing) is widely associated with significant economic penalties for women's employment outcomes. Recent reviews on both a national and EU level reveal that mothers rather than fathers still take on the main burden of childcare and the bulk of domestic duties, despite numerous work-life balance policies having been put in place over the last few decades (McRae, 2008; Hirschmann, 2015; European Commission, 2016). In the UK more than four decades of equality legislation and positive action policies has led to great advances in the position of women in the labour market in terms of their level of participation in paid work and choice of occupation

(Twomey, 2002). However, the persistence of the gender wage gap indicates that women still earn less than men. Equality policies and their effectiveness must therefore be reviewed, while also taking into account trends and issues that have emerged as a result of the shock of the latest recession on the UK economy.

In Chapter 3, our findings on the long-term association between postpartum depression and employment outcomes 11 years after the birth of the child, mediated through maternal mental and physical health, has important economic and societal implications, given the female propensity for depressive disorders during the childbearing years (Burke, 2003) and the increased female presence in the workforce. By addressing the issue of maternal depression in the postpartum period from the employment perspective, the main findings of the present study cannot be compared with findings from earlier works. However, we believe that our results contribute to the debate within two areas of research: a) the growing female presence in the labour market and its implications for the economy, productivity and society; and b) the impact of depression within the general population, particularly the consequences of maternal mental health disorders on the economy and the workplace.

Our results indicate that PPD is likely to compromise women's future career outcomes through its long-term impact on maternal health. However, public policies and measures introduced by the government to facilitate mothers' re-entry into the workforce following childbirth (paid maternity leave, paternity leave, and childcare provision) do not take account of the specific difficulties faced by a substantive percentage of mothers who are affected by postpartum depression while trying to reconcile motherhood and paid work.

Mental health constitutes a significant area as regards women's position in the labour market. Research evidence points to the prevalence of depressive disorders within the general population, particularly within the female population (Garber, 2006; Kessler, 2006). Regarding the burden of depression worldwide, the World Health Organization (2001)

estimates that by the year 2020 depression will emerge as one of the leading causes of disability, second only to heart disease. The burden of mental health disorders on the economy is an issue of concern to national governments and international organizations and is the focus of a growing body of research (Knapp, 2003; Thomas and Morris, 2003; Sobocki et al., 2006; McDaid et al., 2008; Walker and Fincham, 2011). As regards the sphere of mental health care in the UK, despite the progress made in the area of treatment and in the area of legal protection for individuals with mental problems, there are concerns about the low rates of detection of mental health problems (Mental Health and Work, 2008). A recent report expresses concerns over the National Health Service's (NHS) fragmented approach and stresses the need for changes (to meet the challenges of the 21st century), characterising the NHS as lacking in qualified staff, deprived of funds and failing to provide adequate care to people with mental health problems, resulting in "hundreds of thousands of lives put on hold or ruined, and thousands of tragic and unnecessary deaths" (Mental Health Taskforce, 2016, p. 3).

In Chapter 4 our findings about the long-term influence of maternal postpartum depression on children's socio-emotional outcomes at age 11, confirm previous findings regarding the importance of early experience in relation to children's development while contributing to the debate about the issue of postpartum depression and its potential influence on cognitive and emotional outcomes at key stages in a child's life. As discussed earlier, age 11 has not been in the interest of research (only three previous studies examined age 11 in relation to maternal postpartum depression). Our findings on cognitive abilities showing no effect on children's outcomes are not in line with the main body of research evidence (Cogill et al, 1986; Sharp et al, 1995; Beck, 1998; Hay et al., 2001; Grace et al., 2003; Murray et al., 2010). However, they reflect evidence produced by two studies: Murray et al. (1996); and Maselko et al. (2015), the former on later cognitive competence by age 5, and the latter on cognitive abilities of 7-year-old children (see Discussion in Chapter 4). Further research is needed on the issue of children's cognitive outcomes at different stages of development, as

such information is highly important to policy makers when designing strategies aimed at enhancing children's learning abilities.

In terms of the emotional sphere, the thesis confirms that maternal mental health is hugely important for children's development and wellbeing. The thesis benefits from the use of multiple informants (mothers, teachers, and children) in identifying the strength of possible associations between maternal PPD and children's outcomes. Furthermore, multiple ratings offer a broader picture of the role of PPD, highlighting the complexity of PPD's influence, whereas the variability observed between the reports can be considered to reflect differences in perceptions of the child's functioning in different contexts (Achenbach et al., 1987) while taking into account the importance of bias in mother reported measures. The findings are broadly in line with evidence from prior studies indicating that socio-emotional outcomes are sensitive to maternal depression in the postpartum period (Campbell and Cohen, 1997; Hay et al., 2001; Josefsson and Sydsjo, 2007; Agnafors et al., 2013). Overall, the findings discussed suggest that the relationship between postpartum depression and child development is far from simple. Children represent the new generation and their future wellbeing must be at the centre of educational and health policies since health and education are two strong influences on human capital and future earnings (Currie and Madrian, 1999).

Viewed broader, our results support the need for changes in the policy agenda, placing more emphasis on strategies that focus on the specific needs of sub-groups in the population, in this case the distinct problems faced by mothers affected by postpartum depression and their offspring. The lack of specialised services catering for the needs of the dyad seems to be partly the result of a non-integrated approach towards maternal mental health issues and issues related to children's wellbeing. Within an integrated approach policy, free childcare provision might be one way to cater for the specific needs of mothers affected by postpartum depression and their offspring. For the affected mother, the availability of free and good quality childcare provision would be expected to reduce some of the burden and

responsibilities of motherhood and also to facilitate an early transition back into employment. For children of affected mothers, good quality childcare provision might help expand and enrich their early environment/experience beyond the family context. Thus, children born into disadvantage must be provided with the means and the tools to succeed in life and overcome the unjust "brute luck" of their birth (Dworkin, 1981 cited in Roemer, 2009, p.29). This can be achieved through policy intervention and equalization of opportunities (Roemer, 2009).

The potential impacts of postpartum depression on women's dual role (motherhood and work) underpin the need for policy agendas to adopt a more innovative approach towards population subgroups and their specific difficulties or characteristics. Policies that do not take into account such difference are bound to fail or be limited in their effectiveness. What makes depression in the postpartum period different from depression at other times of life is the presence of the infant and the dyadic relationship between the infant and the mother, its primary caregiver.[2] The "crippling" effects of the illness (Beck, 2006, p. 40) on maternal mental health can extend beyond the postpartum period with potential and long-term consequences for the mother and the child. This constitutes a disadvantage and inequality for postpartum depressed mothers and their children.

Overall, the findings of the thesis – despite its limitations and shortcomings – have potential implications for policies designed to promote health, gender equality and employment. The results highlight the increased demands on women's experiences as mothers and market participants against a backdrop of inequality and vulnerability. Our results demonstrate that postpartum depression is a major health issue and a problem of enormous importance to society while maternal mental health emerges as a significant determinant of employment

[2] Paykel (1997, p. vii): "Only comparatively recently has there been the realization that another important feature of postpartum depression is that there is a new child"

outcomes and economic growth and plays a crucial role in children's development and future wellbeing.

Further research

The thesis has addressed the issue of postpartum depression in relation to maternal employment outcomes. Chapter 2 would benefit from looking at the impact of the fiscal constraints on the wage gender gap using panel data, for example using the BHPS/UKHLS. The use of panel data would facilitate a re-examination of the research question for individuals at different career and life stages. Chapter 3 would benefit from further exploring additional potential pathways through which PPD can indirectly influence maternal employment. This could be done through using the MCS or another cohort study. Chapter 3 would also benefit from the use of a cohort study that provides information on the intergenerational psychological history of the mother, including grandparents – for example ALSPAC. This would account for the genetic predisposition to maternal depression.

Exploring the research questions posed in Chapter 3 and Chapter 4 through the use of data from a cohort study with a different ethnic composition (for example the Bradford study, which has a high south Asian ethnic composition) would enrich the results. An interesting future research step as regards Chapter 4 would be to explore which of the three types of respondents (mothers, teachers, or children) most accurately evaluated the emotional distress of the MCS children, when those children reach adulthood.

The latest update in Stata that provides structural equation modelling for complex surveys like the MCS, now offers the opportunity to explore a wider number of pathways that can indirectly influence the association between PPD and children's emotional difficulties at age 11. Further research regarding mothers' and teachers' perceptions of the child's cognitive ability could better enhance our understanding of the potential respondent bias in Chapter 4.

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