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Modelling gender pay gaps

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Equal Opportunities Commission

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Introduction

There has been little change in the full-time gender pay gap since the mid 1990s and in the female part-time/male full-time pay gap since the mid 1970s. The gender gap in hourly earnings for those employed full-time in Britain in 2003 was 18 per cent, while that between women working part-time and men working full-time was 40 per cent.

This research uses statistical methods to identify how much of the gender pay gap is associated with different factors. The data set analysed is the British Household Panel Survey, a sample of around 10,000 adults. The data are weighted to be nationally representative.

Broadly, the research finds that gender differences in life-time working patterns account for 36% of the pay gap. Rigidities in the labour market, including those that concentrate women into particular occupations and mean that they are more likely to work in smaller and non-unionised firms, account for a further 18% of the pay gap. 38% is due to direct discrimination and differences in the labour market motivations and preferences of women as compared with men. The remaining 8% is due to women's lesser educational attainment in the past.

In many instances, these factors will of course be related to each other. For example, the occupations with higher female participation in which women are concentrated will sometimes also be those where part-time work is particularly prevalent.

The importance of indirect discrimination and systematic disadvantage is noted. They can affect the labour market motivations and preferences of women; they are part of the causes of labour market rigidities; and they are part of the reasons that particular types of working patterns result in lower wages. It is therefore incorrect to make a simplistic assumption that gender wage differences due to variations in education and working patterns are legitimate because they reflect skills, qualifications and experiences that are relevant to employers.

KEY FINDINGS

Factors affecting wages

The first stage of the analysis was to model how different factors impact on wages for both women and men. Because the BHPS is used, the regression model is able to include the impact of work histories and a particularly wide range of variables. Key findings from this part of the research show that:

- for each year of full-time education, hourly wages increase by 6%;
- for each year of full-time employment, hourly wages increase by 3%;
- for each year of part-time employment, hourly wages decrease by 1% (in addition to missing out on the 3% gain that each year of working full-time brings);
- for each year of interruptions to employment for childcare and family care work, hourly wages decrease by 1% (again, in addition to missing out on the 3% gain from each year of full-time employment);
- for every ten percentage points higher the proportion of men working in an occupation, hourly wages are boosted by 1% (in other words, on average, those occupations with more women working in them are valued less in terms of the wages paid):
- other factors associated with being female have a particularly large impact, reducing hourly wages by 9%. These factors include direct discrimination. They also include the different preferences, motivations and attitudes to the labour market of women as compared with men, which may in part be attributable to indirect discrimination (or systematic disadvantage).

Although some of these percentages sound small, the cumulative effect can be great. For example, ten years spent as a part-time worker would leave someone with hourly earnings more than a third below that of someone who had worked full-time for the same period.

The size of the components of the gender wage gap

The gap in wages between men and women occurs because, on average, the position of women and men in relation to the above factors that affect wages are different. For example, on average, the occupation a man is employed in is 68% male, while that for a woman is 32% male. As stated above, the research shows that the higher the proportion of males in an occupation, the higher the wages, so the fact that women are more commonly in occupations with fewer males means that their average wages are lowered by this factor. Similarly, the fact that women spend more time out of the labour force caring for their family or working part-time and fewer years working full-time also lowers their wages relative to men who spend less time doing so.

Another statistical model (simulation) is used to identify how much of the total pay gap between women and men (the gender wage gap) is accounted for by each of the factors. The most important are:

Employment experience:

- less full-time employment experience (19%);
- more part-time employment experience (3%);
- more experience of interruptions to employment for childcare and other family-care (14%);

Where women work as a result of rigidities in the labour market:

- the concentration of women into occupations with high proportions of female workers (10%);
- other institutional factors, including the greater proportion of women working for smaller firms and the smaller proportion in a union or staff association (8%);

Direct discrimination and different labour market preferences and motivations:

- other factors associated with being female, including direct discrimination and different preferences and motivations (some of which will be attributable to indirect discrimination or systematic disadvantage) (38%);

Education:

- women's lesser education (8%).

Discrimination can affect all components of the pay gap

The components of the gender pay gap listed above include factors that have traditionally been associated with either the development of knowledge and skills (education, employment experience) or with discrimination (occupational segregation; some of the other factors associated with being female). The development of knowledge and skills (human capital) has been seen as a legitimate source of earnings differences because it is made up of skills, qualifications and experiences that are relevant to employers. Moreover, the attainment of human capital has been seen primarily as being determined by an individual. By contrast, discrimination has been seen as a failure in the working of the labour market, and thus a legitimate site of public policy intervention.

This simple distinction between human capital and discrimination is overdrawn and can have misleading implications for policy. This is because women can face indirect

discrimination and systematic disadvantage in acquiring human capital. The acquisition of human capital depends upon women's place in the labour market, as well as on individual decisions.

This can be seen in the case of part-time employment. While working full-time is associated with increased wages, working part-time is not - not even pro-rata. Rather, experience of part-time employment is associated with a slight reduction in wages. The typical assumption in human capital theory, that experience of employment increases human capital and thus increases wages, is challenged by this finding. Rather, whether or not employment experience leads to increases in wages depends on the location of that experience within a differentiated labour market. Some of the reasons that women find themselves in a different labour market, i.e. competing for a different range of jobs than equivalently qualified men, may be thought of as indirect discrimination.

The differential impact of years spent working part-time, as compared with full-time, has serious implications for both women's wages and UK productivity and is worthy of policy intervention, whether or not discrimination is the whole cause of the difference or not. Discriminatory practices, both direct and indirect, may be found not only embedded in factors such as occupational segregation, but also within the processes by which human capital is acquired.

Implications for policy

These findings have implications for two main types of government policy: first, policies concerned with gender justice; and second, policies concerned with the productivity of the UK economy and its capacity for economic growth.

In relation to the latter, this research has found that the acquisition of skills and other forms of human capital is associated not only with education and length of employment experience, but also by the context of that employment experience (whether the experience is full-time or part-time) and by interruptions to it. There is a gendered dimension to the acquisition of human capital, which is affected by the institutional context.

In relation to competition, the research has found that labour markets are not perfectly competitive, and that they contain significant rigidities (such as occupational segregation) and forms of discrimination, which affect women's potential in the labour market.

Future research modelling policy scenarios

The next phase of this research could be to identify specific policies and to model their implications for the gender pay gap and other policy relevant concerns. Examples of such policies are:

- universal childcare;
- training for returners;
- improved flexibility in the workplace;
- anti-discrimination policies.

The analysis will identify the implications of such policies for a range of stakeholders and beneficiaries including the Exchequer and employers as well as the UK economy as a whole and society as a whole.

1. INTRODUCTION

Women working full-time in Britain earned 82 per cent of the average full-time earnings of men in 2003, which meant that the gender pay gap in hourly earnings was 18 per cent. The gender pay gap between the hourly earnings of women working part-time and men working full-time was even wider at 40 per cent. Moreover, there has been virtually no change in the full-time gender pay gap since the mid 1990s and in the female part-time/male full-time pay gap since the mid 1970s (EOC, 2003; 2004).

In view of this situation, the Equal Opportunities Commission (EOC) commissioned new research in July 2003 to examine the economic case for closing the gender pay gap. The key aims of the research project are to:

- quantify the proportion of the UK gender pay gap which can be attributed to a range of specified factors; and

- outline the areas where further work is required to support policy interventions in this area.

1.1 Structure of the report

Chapter 2 begins with a review of the relevant research literature, and then utilises statistical modelling techniques in order to quantify the size of the main components of the gender pay gap (this will need revising, as old Chapter 2 now sub-divided into two chapters). Chapter 3 uses simulation, a statistical modelling technique, to estimate the relative proportions of the gender pay gap that are attributable to different components. Chapter 4 summarises the implications of the research and also outlines how further research could usefully model policy scenarios.

2. QUANTIFYING THE COMPONENTS OF THE GENDER PAY GAP

2.1 Introduction

This chapter begins by identifying the factors that may contribute to the British gender pay gap as outlined in the relevant literature. Next we engage in statistical modelling in order to discover whether, and the extent to which, these are significant and important. This involves applying a number of statistical techniques to data from the selected dataset, the British Household Panel Survey (BHPS), to estimate the proportion of the gender pay gap which can be attributed to particular factors.

2.2 Implications of previous research for our approach

A major part of the previous quantitative analysis of the gender pay gap has been concerned with a distinction between 'human capital' and 'discrimination' components (Anderson et al., 2001; Grimshaw and Rubery, 2001, 2002; Rake, 2000). Human capital is generally seen as a fair and legitimate source of earnings differences, because it is made up of skills and qualifications that are relevant to employers. By contrast, discrimination is seen as constituting a regrettable failure in the working of labour markets (Neumark, 1988). However, this polarisation between components of the gender wage gap is perhaps overdrawn, as we discuss below. Further, the individual level at which these factors are often analysed may obscure some underlying causes of the pay gap. It is important not to assume that if one factor seems to move in tandem with another, that the one necessarily causes the other.

The analysis of human capital elements, developed from early work by Becker (1981, 1993) and Mincer and Polachek (1974), primarily concerns the qualification and skills that people learn and bring to their employers. In more recent analysis, 'generic' and 'specific' forms of human capital are identified, where generic forms are those skills that are transferable between employers, and specific forms are primarily of benefit to the employment situation where they have been developed (England et al., 2000; Johansen, 2002; Tam, 1977). Further, there are distinctions between human capital that is acquired as a result of learning in formal education, such as in schools and universities (Blundell et al., 2000; Elliot et al., 2001), and that which is acquired during employment (Myck and Paull, 2001). The latter can be gained either via formal training, on or off-site, by employers (Blundell et al., 1996) or via informal learning on the job.

One aspect of how people acquire human capital with which gender research has been concerned is whether part-time employment leads to pro-rata acquisition of human capital that is equivalent to full-time employment, or whether it has a detrimental effect on a person's stock of human capital (Blackwell, 2001; Ermisch

and Wright, 1992; Gornick and Jacobs, 1996). This is of particular concern where nearly half of women's employment is part-time, as in the UK. It is well known that the wages of women working part-time are substantially lower than those working full-time in the UK; the question here is whether part-time working also has an additional impact on the accumulation of human capital needed to generate higher wages in the longer-term.

A further question in the human capital literature is the impact of breaks in employment on the accumulation of human capital and on wages. Gregg (1998) has shown that on average those who have been unemployed suffer lower wages when re-employed than other workers. An issue is whether breaks in employment for childcare and other forms of family care have a similar 'scarring' effect on earnings in the way that has been identified for unemployment. Some analysts have identified a 'penalty' for motherhood (Budig and England, 2001). It is argued that gaps in employment for childcare and family care are a problematic interruption to human capital acquisition. Additionally, they may have a negative impact on wages through discrimination (Dex et al., 1998; Joshi et al., 1999; Waldfogel, 1997, 1998), or through a detrimental impact on job search (Manning, 2000). Hence in our analysis we distinguish between years spent employed full-time from those employed part-time, and separately identify interruptions to employment and the reasons for them.

While some human capital theorists have sometimes claimed to explain most, if not the entire, gender pay gap, it is more usual to consider that some of the explanation is a result of discrimination. In a number of analyses, discrimination has been treated as if it were the residual unexplained component of the gap (Joshi and Paci, 1998). This approach has provoked the criticism that the factor labelled 'discrimination' actually includes other factors. There are two types of omissions. First, there are factors associated with the nature of firms and the labour market, or nuances in the forms of human capital (Tam, 1997); second, there are factors associated with individual characteristics. These may include unobserved differences between individuals that are associated with long-run differences in attitude and motivation towards employment (known as 'unobserved individual heterogeneity') (Swaffield, 2000). Either or both of these omissions could mean that the impact of discrimination has been over-estimated.

We engage with these debates in two ways. First, we include a very wide range of factors within the model. This involves nuancing the human capital variable by including different kinds of employment experience and interruptions to it. Second, we engage in 'fixed effects' and 'random effects' modelling (England et al., 1988;

Polachek and Kim, 1994) to unravel some of the complex elements within ‘unobserved heterogeneity’.

Individual level factors do not, however, explain all variations in wage rates. There are significant variations in wages associated with diverse institutional features at the level of the firm, occupation, sector and labour market. These include the size of the firm; whether the firm is in the public or private sector (Grimshaw, 2000); whether the workplace is unionised and whether the workers are in a union; the industrial sector (Carruth et al., 1999); region (Henley and Thomas, 2001); and occupational segregation (Cohen and Huffman, 2003; Cotter et al., 1997; J. Jacobs, 1993; S. Jacobs, 1995; Kilbourne et al., 1994; Tomaskovic-Devey and Skaggs, 2002). Hence we include variables that represent a range of such institutional features.

The conventional modelling of the gender wage gap has drawn heavily upon the distinction between the human capital and discrimination components, often seeking to identify the relative proportions of these two elements. This theoretical approach has been methodologically consolidated by the use of the Oaxaca-Blinder decomposition techniques (Blinder, 1973; Oaxaca, 1973), and continues to underlie even the more sophisticated variations of this type of analysis (Blau and Kahn, 1997; Juhn et al., 1991, 1993; Nielsen, 2000; Oaxaca and Ransom, 1994, 1999). The Oaxaca-Blinder decomposition technique attempts to identify the extent to which the gender pay gap is due to human capital or discrimination. It creates separate regression equations for women and for men, then identifies different gendered rates of return to human capital attributes, and then treats the remainder as discrimination.

In Britain, this approach has been adopted by a number of studies of the gender wage gap (Anderson et al., 2001; Joshi and Paci, 1998; Rake et al., 2000). These studies have been important in pioneering the analysis of the gender wage gap in the UK. We draw from, and build on, the insights in these studies. However, there are a number of limitations in these studies that we seek to go beyond, including first, data limitations, and second, the nature of the decomposition techniques used. First, in respect of the data, we have identified in the literature the potential importance of differences in work histories for earnings. This includes not only the number of years spent employed, but whether this is full-time or part-time, and the extent of interruptions for childcare and other family care. These effects may show most clearly in older rather than younger workers. Despite this, most early studies did not use sources that contained work histories. These included those using the cross-sectional Labour Force Survey (LFS) (Anderson et al., 2001), the Workplace Employment Relations Survey (Anderson et al., 2001) and the General Household Survey (Miller, 1987), or those using cohort studies, such as the National Child Development Study

(NCDS) (Joshi and Paci, 1998; Joshi et al., 1999). This means that, at best, work experienced is treated as if it were equivalent to age minus years of schooling, which does not capture important variations in employment history. As discussed in section 2.4, compared with the BHPS, the preferred data set for this report, both the LFS and NCDS have other disadvantages as well, since they are confined to young women aged 33, who are unlikely to have experienced the full implications of motherhood for their labour market participation.

The second way in which we seek to go beyond many previous British studies of the gender wage gap is by using a different set of techniques for the decomposition. Variations in institutions and in discrimination can lead to variations in the nature of the human capital acquired by individuals, so it is important not to over-polarise the distinction between individual and institutional level factors. We also think that using separate regressions for women and men implies untenable assumptions as to the separation of male and female labour markets. We therefore use a simulation method, building on a more complex but single regression equation, rather than the Oaxaca-Blinder decomposition technique.

2.3 Outline of methods

This review of previous research identifies a very wide range of factors that may be relevant to the gender wage gap. Measures of these factors are identified from those variables available in the dataset (see Appendix A1). The dataset is discussed in detail in the next section. The first technique used to analyse the data, regression modelling, is described in the following section.

2.4 The dataset

The British Household Panel Survey 2001/2 is the main source of data in this study, but some data from the Labour Force Survey are also used. The advantages of the BHPS are that it is large, up-to-date, and contains data on employment experience. It is preferable to cohort surveys in that it is representative of all age groups in the population, not just, as in the case of the NCDS, young women aged 33, many of whom have not yet experienced the full long-term implications of motherhood for employment. It is preferable to the LFS because it contains data on the length of full-time and part-time employment, as well as the nature of interruptions to employment.

An advantage of the present study is that it has also taken into account evidence from six previous rounds of the BHPS. Annual survey data for each respondent have been merged into a longitudinal dataset. The years selected for this panel dataset are 1993, 1994, 1999, 2000, 2001 and 2002. These years reflect a decade of labour market change, whilst also using the maximum available data on work-life histories

from the BHPS. The analysis throughout uses the one-year recall work histories which were gathered annually in the BHPS from 1992/3 onward and which are provided through to 2002. Furthermore, the evidence rests upon the retrospective job-history interviews, which were compiled into work-life history data in 1992/3 and 1993/4. Using annual data, those recall histories have been included each year for continuing respondents in BHPS. This work was done both by the BHPS providers, Halpin (1998a, 1998b, 2000) and by the authors of this report. Having obtained such a detailed data set, proxy variables for the length of the work history have been avoided. As a result, it is possible to make some short-term simulations of alternative policy scenarios without having mis-specification of work experience. Specifically, the use of 'age minus years of formal education' as a proxy for work experience has been avoided here. In summary, the use of longitudinal data and work-life histories is central to our results.

The disadvantage of the BHPS is that the sample of around 10,000 adults is smaller than the LFS (57,000 households). Hence we supplement the BHPS with data from the LFS. The LFS for each selected year was used in calculating the gender composition of occupations. A further potential disadvantage of the BHPS is bias due to attrition from the sample. We address this potential problem by using the weights available to bring the estimates into line with the national population.

The main change in the structure of the labour force over this period is a fall in the percentage of women who report themselves as primarily doing family-care work. This percentage fell from 11% to 6% over the years 1993 to 2002. Meanwhile, the number of self-employed people was constant, the percentage employed rose from 47% to 50%, and unemployment (as recorded in the BHPS) fell from 6% to 2%. The percentage that is students was constant at 5%, but among students there was an increase in the likelihood of simultaneous working. 4% of women and 8% of men full-time students were working full-time in 2002, and the total percentage of full-time students who were employed (mainly part-time) rose from 32% to 42% over the ten year period.

In this study, full-time students were not omitted unless they were 15 years old or under. Self-employed people have been omitted, since it is hard to estimate their wage-rates. Thus a wide remit has been set for the workings of the labour market: all those who compete for part-time or full-time jobs, and are of working age, including employees, those recorded as sick or disabled, those on unemployment benefit, those currently inactive, and students. Retired people have been omitted unless they are under age 65 (age 60 among women) and have re-entered the labour market.

The study thus uses a specialist data set to analyse the impact of work histories on current labour market participation and wages. Whilst recall data can under-count employment experience, a number of checks and corrections are in place to offset this within the BHPS.

2.5 Key employment characteristics

Table 2.1 shows the main features of the working lives of women and men in Britain in 2002 by presenting the averages (means) of key characteristics. This identifies the differences in the typical experiences of men and women, especially in their experience of employment over the life course, and in the institutional characteristics of their workplaces, as well as the closing of the education gap between women and men.

Women have on average four years of family-care work, i.e. unpaid caring work in the home, whereas among men this figure is close to zero. Women have on average significant periods of part-time employment (3.3 years), while men experience very little. Thus men's experience of full-time work is considerable larger than that of women, thirteen years for men compared with eight for women. Despite these differences women and men had stayed in their last job for almost the same length of time, as indicated by the measure on job tenure.

There is considerable gender segregation within occupations so that men are more likely to work with other men and women with women. That is, on average, the occupation a man is employed in is 68% male, while that for a woman is 32% male. Men are more likely than women to work in a large firm. Thus 32% of men work in a firm of 50-499 workers, compared with only 23% of women; and 15% of men work in a firm of 500 or more workers, compared with only 12% of women. Women are much more likely to work in the public sector. Unionisation levels are similar (21% for women and 23% for men).

There has been a substantial reduction in the educational differences between women and men in recent years, especially among those who are in employment, so that employed men have on average only half a year more education than women. While there are some differences in experience of recent education and employer training, these are not substantial.

Further details of the similarities and differences between women and men in employment are provided in Appendices 1 and 3.

Table 2.1 Selected means among women and men, GB, 2001/2

Variable	Women	Men	All
Female			52%
Education (years)	12.31	12.63	12.46
FT work (years)	7.57	13.10	10.20
PT work (years)	3.35	0.26	1.88
Unemployment (months)	4.43	8.37	6.30
Family care (months)	48.57	0.77	25.86
Maternity (months)	2.26		1.18
Insider, >4 years tenure	39%	38%	38%
Outsider, <1 year tenure	30%	31%	30%
Recent education employer funded	16%	17%	17%
Recent education not employer funded	15%	12%	14%
Segregation (male%)	32%	68%	50%
Firm size 500+ workers	12%	15%	13%
Firm size 50-499 workers	23%	32%	27%
Firm size 25-49 (<25 is base case)	11%	11%	11%
In public sector	29%	16%	23%
In union or staff association	21%	23%	22%

Source: British Household Panel Survey, 2001/2.

2.6 The size of the gender pay gap using the BHPS

As Table 2.2 shows, the gender pay gap for hourly wage-rates in 2002 was 24%. Using women's mean wages as a percent of men's full-time mean wages, the pay gap fell from 26% in 1993 to 24% in 2002 (according to the BHPS data). The male average rate of pay was £10.21 per hour and that of females £7.93 in 2002. The overall pay gap was £2.28 per hour. The part-time pay gap is much larger. As identified by the BHPS, women's part-time pay was 32% lower than men's full-time pay. According to the BHPS data, this figure had risen from 29% in 1992/3 and was thus worsening rather than improving.

Table 2.2 The gender pay gap in hourly earnings, GB, 2002

	Female	Male	The full-time pay gap	The part-time pay gap	Overall pay gap
	Pounds		Per cent		
Full-time employees	8.43	10.37	**19**		
Part-time employees, <30 hours per week	7.10	7.87		**32**	
All employees	7.93	10.21			**24**

Notes: Overtime payments and paid overtime hours have been included. The full-time pay gap is defined as the percentage difference between full-time women's and full-time men's hourly earnings. The part-time pay gap is defined as the percentage difference between part-time women's and full-time men's hourly earnings. The overall pay gap is defined as the percentage difference between all women's hourly earnings and full-time men's hourly earnings.

Source: British Household Panel Survey, 2001/2.

In calculating these figures, unpaid overtime has been ignored, but paid overtime has been included. Recall of wages over the month and week preceding the survey is the main source of the wage earnings data, and the hours worked are the usual hours worked in a week. The data used here refer to Great Britain.

2.7 Comparing the gender pay gap in the BHPS, LFS and NES

The pay gap figures derived from the BHPS can be compared with those derived from other national data sets, the Labour Force Survey (LFS) and New Earnings Survey (NES) (see Table 2.3). The overall gender pay gap is very similar whichever data source is used (24% or 25%). However, the size of the contributing full-time and part-time components varies a little between sources.

Table 2.3 Gender pay gaps in different surveys, 2002

	Per cent		
Data source	**Full-time pay pap**	**Part-time pay gap**	**Overall pay gap**
BHPS	19	32	24
LFS	16	37	25
NES	19	41	25

Sources: British Household Panel Survey, 2001/2; Labour Force Survey, Spring 2002; New Earnings Survey, 2002.

Table 2.3 shows that there was a smaller full-time pay gap in the LFS (for Spring 2002) than in the BHPS in 2002, but comparable results for the overall gap once women working part-time had been included. According to LFS data, women employed full-time earned 16% less than men who did so on average, while women employed part-time earned 37% less than that of men's full-time hourly rate on average. The greater difference in the part-time pay gap in the LFS than in the BHPS was because average hourly earnings were both lower in the LFS for women working part-time (£6.89, compared with £7.10 in the BHPS), and higher for men working full-time (£10.92, compared with £10.37 in the BHPS). In contrast, average hourly earnings for women working full-time were higher in the LFS (£9.56) than in the BHPS (£8.43) (Office for National Statistics, 2004a). These factors largely balanced each other, so that the overall gender pay gap of 25% in the LFS was very similar to that in the BHPS. There is a slightly different split between the share of full-timers and part-timers within the two samples, resulting from their different ways of identifying women employed part-time. In the LFS, 43% of women and 9% of men are reported as working part-time, whereas in the BHPS 2002, the corresponding figures were 38% and 6%.

The LFS figures include paid overtime if it is part of the 'usual hours' and included in gross pay (Office for National Statistics, 2004b). One of the possible sources of difference between the BHPS and the LFS concerns the definition of part-time used by the survey. In the LFS, the decision as to whether a job is described as part-time or full-time is made by the respondent, whereas in the BHPS, the boundary is that of a selected fixed cut-off of 30 hours per week.

Analysis of the third major source, the New Earnings Survey (NES) 2002, finds a larger part-time pay gap, and comparable pay gaps for both full-time employees and overall. The full-time pay gap in the NES data was 19% in April 2002 (Bulman, 2002). Men working full-time earned £12.59 per hour on average, while the equivalent figures for women working full-time and part-time were £10.22 and £7.42 per hour respectively. This produces a 41% part-time pay gap and an overall pay gap of 25%. This is based upon calculations which omit overtime hours and overtime pay. The NES is based on a 1% survey of employees who are members of Pay-As-You-Earn income tax schemes; their employers are required to fill in a questionnaire about each selected employee. The NES survey omits certain workers who are not on 'adult' rates of pay, and in 2002 this implies that those on the special minimum wage for ages 18-22, as well as all under age 18, are omitted from the NES data. This difference may explain why the part-time pay gap found in this survey is so much larger; the part-time workers in the NES survey have had their job for at least one

year and are 'adults' in this particular sense. The students who have been included in the BHPS estimates would have been omitted from the NES data.

The average rates of pay for all women reflect a merger of the part-time and full-time working women's wages. In Table 2.3, the part-time pay gap is much larger using the NES than using the BHPS, yet the merged figures are not very different (25% compared with 24%). The distribution of rates of pay for full-time and part-time workers overlap, and a detailed analysis of the original NES pay data would be needed to clarify the differences between them and the BHPS results.

2.8 Analysis using regression techniques

The first stage in analysing the data is to use a regression analysis. This is a statistical technique that allows the independent impact of each factor influencing a particular outcome to be identified separately. The outcome that the analysis is seeking to explain is known as the 'dependent' variable, because it is dependent on each of the factors that affect it. In this case, the dependent variable is the hourly wage rate. Each factor that affects the dependent variable is known as an 'explanatory' variable - because it is a factor, such as years in education, that explains our dependent variable of wages. The equation that adds up what changes in each explanatory variable lead to a unit change in the dependent variable is known as the regression equation. This equation might show, for example, that for every year extra in education, wages increase by 6%. This is normally expressed as a regression coefficient for years in education of 0.06.

Table 2.4 lists the results of the regression equation, showing these coefficients for each of the factors that were found to be statistically significant in explaining the variation in wages.

In analysing wage-rates among men and women jointly, we use a model which includes individual and institutional factors, gender, gender-related factors, and background factors. The full definitions of the variables and their mean values are provided in Appendix 1.

Table 2.4 The main factors influencing wage rates for women and men

Variable	Impact on the wage-rate[a]	Regression coefficient
Female	8.9% lower wages if female	-0.0891
Education (years)	5.7% higher wages for each year of FT education	0.0565
Years of full-time employment (curved)[1]	2.6% higher wages for each year of FT work	0.0259
Years of part-time employment (curved)[1]	0.8% lower wages for each year of PT work	-0.0078
Unemployment (years)	2.2% lower wages per year of unemployment	-0.0218
Family care (years)	0.8% lower wages for each year of interruptions to employment for childcare and other family care	-0.0082
Recent education not employer funded	5.9% lower among those funding their own training	-0.0591
Segregation (male percent x10)	1.3% higher wages per 10% more males in that occupation	0.0127
Firm size 500+ workers	11.7% higher wages if firm size is over 500 workers[b]	0.1171
Firm size 50-499 workers	6.2% higher wages if firm size is 50-499 workers[b]	0.0620
In public sector[2]	8.0% higher wages if working in public sector	0.0800
In union or staff association	6.2% higher wages if union member	0.0620

Notes: This table presents the regression results only.

All these variables are statistically significant at the very high 99% (p<1%) probability level, except for years of part-time employment which is statistically significant at the 90% (p<10%) level.

[1] The effect is 'curved' because the increase tails off, being a larger increase during the first few years, and a much smaller increase in later years.

[2] The higher wage rates in the public sector occur after other factors have been taken into account. The definition of public sector may vary between different surveys producing different findings on its impact on wages.

See Appendix 2 for the correlations and Appendix 3 for further details of the regression equation.

[a] The regression coefficient corresponds to a percentage change for a unit change in the associated variable. The estimates are corrected for selectivity bias.

[b] The percentage rise is relative to the base case, which is firms having less than 25 employees.

Source: British Household Panel Survey, 2001/2.

The model seeks to explain variation in wages - the dependent variable.[1] Table 2.4 shows the key factors - the explanatory variables - that the model suggests accounts for this variation.

Weekly pay diverged considerably by gender, with men earning £418 per week on average in the BHPS in 2001/2, while women earned £248 per week on average. This gives a weekly gender pay gap of 41%. The greater divergence of weekly as compared with hourly earnings arises partly because of the wage-rate differences, and partly because men worked 41 hours per week on average in 2002, while women worked only 31. The distribution of hours worked is widely spread among both men and women, with 5% of working-age men and 27% of working-age women employed part-time (defined as less than 30 hours per week). Among those working in 2002, 38% of women and 6% of men were working part-time. Weekly pay rates diverge even more than do hourly pay rates because women's hours are so different from men's. However, in most of this report we focus on the hourly, rather than the weekly, rates of pay. The hourly rates of pay are considered a direct indicator of productivity, whereas the weekly rates of pay also reflect the total input of a worker's time to production. If productivity is to be aggregated to the national level, the weekly figures are needed, but hereafter the hourly rates of pay are central.

A number of technical adjustments have been made, following current best practice, in order to improve the accuracy of the estimates provided by the model. These are of three major kinds: first, weighting the BHPS to make it representative of the British population; second, controlling for a number of factors, in particular region and industry; and third, adjustments to allow for those not currently in the labour force and household and demographic factors that affect the propensity of people to be employed (see Appendix 3 for details).

2.9 Main findings

While some of the findings are consistent with previous research, there are some additional findings. The findings of the regression analysis are reported here; those from the regression equation (summarised in Table 2.3) are presented first. Chapter 3 uses those findings to 'decompose' the gender pay gap.

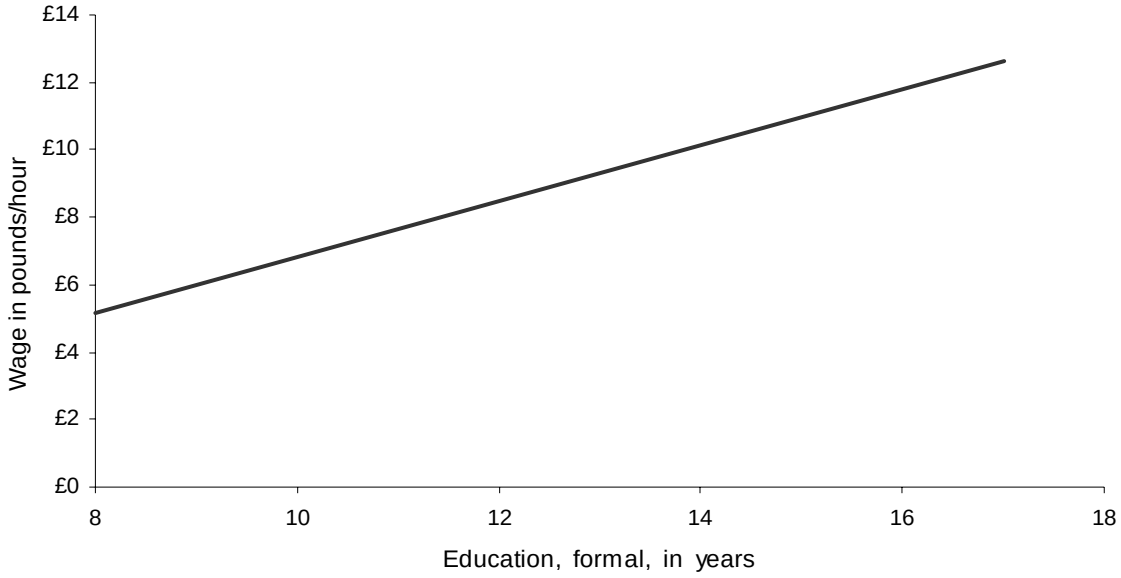
Education

As expected, there is an association between wage rates and 'human capital' factors such as education and length of full-time employment (as shown by the relatively high coefficient and statistical significance of these variables in Table 2.4).

[1] The dependent variable is measured by the logarithm of hourly gross pay (logwage).

Formal education measured in years has a strong direct association with wage-rates (Figure 2.1). Each year of education is associated with a wage increase of 5.7% per year (coefficient of 0.57 in Table 2.3) after allowing for the other factors in the model.

Figure 2.1 Wage rates (predicted by model) and formal education



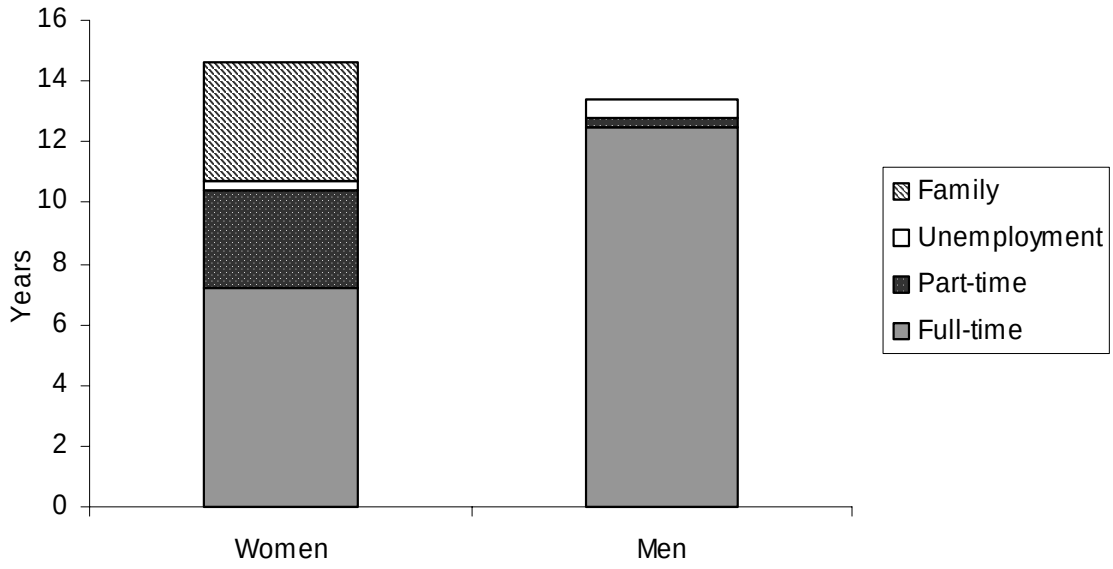
Source: British Household Panel Survey, 2001/2.

Non-employer funded education and training, such as self-funded study at college, appears to be associated with lower current wages. This is probably because those receiving this are disproportionately students or in similar transitory statuses, whose current employer is not the expected beneficiary of the training, and where employment may be casual and temporary. Additionally the model cannot capture any future long-term wage rewards to this training.

Life-time working time patterns

There are three main components of life-time working time patterns: years of full-time employment; years of part-time employment; years out of employment due to caring for children and other family members. The differences between women and men of working age are shown in Figure 2.2.

Figure 2.2 Life-time working patterns of women and men of working age



Source: British Household Panel Survey, 2001/2.

The length of full-time employment (here measured in years) is associated with higher wages. The raw association is especially strongly positive (see Figure 2.3).[2] Each year of full-time employment is associated with 2.6% higher wages. In our regression model, the effect diminishes with increasing years. This produces curvature in detailed graphing (not shown here). There is a negative association of experience of unemployment on wage-rates. This is a 'scarring' impact, in the sense that it has a long term effect on wages (the annualised rate of reduced wage-rates for unemployment is 2.2% per year). There is a 'raw' association of the length of tenure in current job (being an 'insider' with more than four years' job tenure) with higher wages, but this effect disappears once the work history is included in the model, suggesting that work history is the encompassing factor here (see Appendix 3 for details).

[2] The raw association means that other factors have not been taken into account.

Figure 2.3 Actual wages, work experience and years spent on family care

Source: British Household Panel Survey, 2001/2.

The most important new findings to note are those concerning the effects of part-time employment and interruptions to employment for family care. Although we are not the first to note the importance of these aspects of women's work histories, much conventional modelling does not include these distinctions. Often this is because the data set used does not contain the required information. Here we have a model that fully incorporates detailed information on work histories. We find that:

- Part-time employment experience is not associated with increased wages, not even on a pro-rata basis; but rather each additional year of part-time employment is associated with a slightly lower level of wages.

- An interruption to paid employment for family care, such as to have children, reduces the future wage; wage-rates go down by 0.8% for each year spent this way. This effect is additional to that associated with the simple reduction in the number of years of employment which follows from time spent out of the labour market.

These findings are represented in Figure 2.2 by the negative slopes shown for part-time work experience and the years spent on unpaid family care work.

It is well known that part-time jobs on average have lower wages than full-time jobs. In some accounts (e.g. Warren, 2000; Burchell et al., 1997; Harkness, 1996: 25-32), it is suggested that it is the status of a job as either part-time or full-time that explains the lower wages, perhaps through discrimination. Others (e.g. Miller, 1987; Kidd and Shannon, 2001) have argued that the lower wages associated with part-time employment can be wholly or partly attributed to the lower 'human capital' (e.g. education) of the women who work in part-time jobs.

The analysis shows that the longer a woman is employed in part-time employment, the lower her wages are likely to be. The additional negative effect per year is relatively small. However, if she had been employed full-time, each additional year's work would have contributed substantially and positively to her wage. So, to the negative cumulative effect of part-time work, the loss of increase in earnings that are associated with full-time employment needs to be added.

Once the *history* of part-time working (and the range of other variables relating to life-time working patterns in the full model) have been taken into account, there is no additional significant effect on wages associated with *current* part-time employment. (In models that do not distinguish between full-time and part-time employment histories, it appears as if current part-time working has a negative impact.) The specific effect of part-time employment on wages is better understood as a cumulative negative one on a woman's earning capacity than the simple effect of a job being part-time.

In addition, there are two further issues concerning part-time pay: those in part-time employment typically have less 'human capital' than those in full-time jobs; and part-time employment is institutionally located in the less well paying parts of the economy (e.g. smaller firms, more sex segregated occupations). The explanation of the negative cumulative effect of part-time employment cannot be simply derived from the model, but it may, perhaps, be associated with the lower level of training provided in jobs in the part-time sector. The two types of factors are introduced merely to explain why current part-time wages are lower than full-time wages. They are not an explanation of the cumulative impact.

While the finding that interrupting employment in order to spend time on childcare and other forms of family care was associated with lower wage-rates is expected, we found this effect to be especially severe. The negative effect on wages of interruptions for childcare or other family care is additional to that associated with the reduction in the number of years of full-time employment experience. This means there is an additive sum of two disadvantages for women who take time out of

employment to raise children: they lose years of full-time work (2.6% lower wages for each year), and they also fall backwards due to their time out of the labour market for family care (another 0.8% per year).

For every year that better flexible working arrangements allows part-time work to be replaced by full-time work, a 3.4% increase in wages results. This figure includes 2.6% extra for the year worked full-time as well as 0.8% reward for having a lower part-time penalty. (Table A3.1 in Appendix 3 provides the basis for this result, and shows that after very long work careers, these effects are reduced in scope, since wages have a curved relation to the years worked).

In other words, the productivity level of the worker, in human-capital terms, appears to be 3.4% higher for full-time work than for part-time work, and this productivity differential is compounded year by year, with some falling-off of the effect after long periods of full-time work. A ten-year career as a part-time worker would imply approximately a 34% lower level of hourly earnings, compared with the same person having a full-time work career. These results are specific to the UK in the time period 1992-2002, and the part-time productivity differential could potentially be reduced in future. The estimates show a dramatic difference in the rewards to human capital acquisition for full-time versus part-time workers over this particular period.

If mothers work part-time, their wage disadvantage is less over time than if they are completely unpaid home workers.

In summary, in this section examining life-time working patterns, we have developed the conventional models by introducing distinctions between full-time and part-time employment and by treating interruptions as factors additional to their implications for reduced years of employment. In Britain, part-time employment has been shown to have a cumulative negative association with wages, while even a small break from employment for children has significant negative associations with wages.

Institutions are key in shaping the implications of different work histories for wage outcomes. In particular, the institutional form of part-time employment in the UK is widely recognised as distinctive and different from that found in many other countries. In the following section, the focus is on other institutional factors that cause rigidities and imperfections in the labour market.

Labour market rigidities and imperfections

Institutional factors are structural, contractual or organizational phenomena that structure employment relations and the labour market. They can cause rigidities in

the labour market that prevent it from working in a perfectly smooth way. These are often associated with wage-rate differences, for both men and women. They include: occupational segregation, the size of firm, whether the firm is in the public or private sector, whether the workplace is unionised, industrial sector, and region. Segregation is one of the most important forms of labour market rigidity, separating the labour market into segments that limit the mobility of labour between occupations. There is a range of further institutional factors that segment the labour market in different kinds of ways, similarly limiting the full mobility of labour. The distinction between full-time and part-time work may, under certain circumstances, operate in a similar way, limiting mobility between different types of work. The institutional factors associated with labour market rigidity can overlap. For example, the divisions in the labour market associated with segregation and the boundary between full- and part-time employment may be linked together. The large number of variables in our model has effects on the size of the wage gap found to be associated with segregation. In our very detailed model, some of the effect of labour market rigidities, which are found in other studies to be associated with segregation, is here shown to be associated with other forms of labour market segmentation. This does not mean that segregation is unimportant, but rather that we are able to differentiate between different forms of segregation and segmentation that are elsewhere grouped together.

Occupational segregation is here operationalised as the percentage male in each occupation. There were 77 main categories of occupations using the Standard Occupational Classification (SOC), in the Labour Force Survey. For every 10% rise in the percentage male, there is a corresponding 1.3% (statistically significant) rise in the wage-rate. This effect is mainly located among women, as will be discussed later.

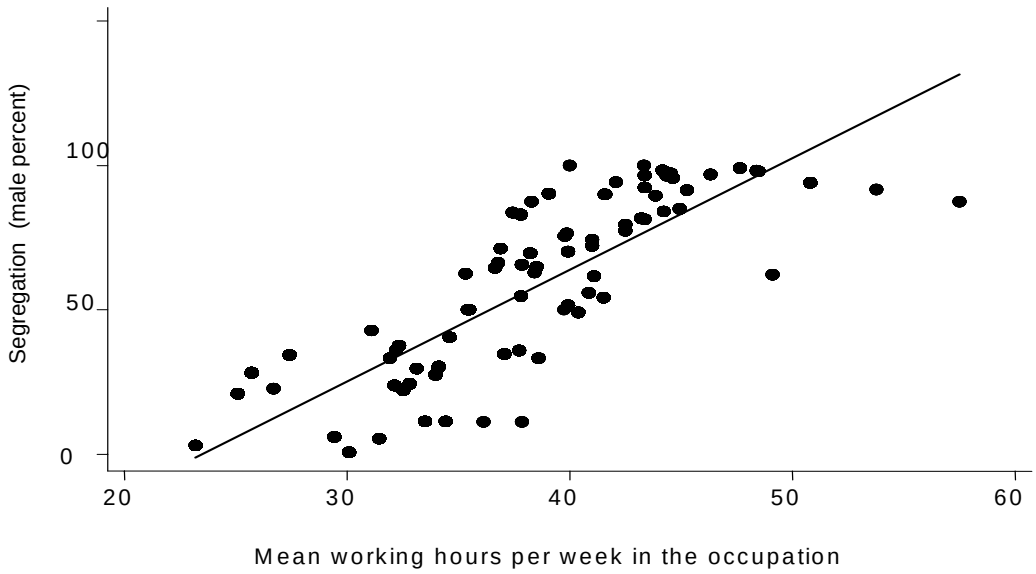
Firm size is captured by a four-fold categorisation of firms by their numbers of employees. The larger firms have notably higher wage-rates than the smaller and middle sized firms. As the coefficients in Table 2.3 show, compared with small firms of 1-25 employees, wages are 11.7% higher for the firms of 500+ employees and 5.9% higher for those of 50-499 employees. Rates of pay are similar in firms of 25-49 employees.

Those employed in a public sector organisation have 8.0% higher wages than those employed in the private sector, while those who are in a union or staff association have 6.2% higher wages than those who are not. The inclusion of several institutional factors in the equation at the same time leads to the possibility that some factors are related to each other, distorting their apparent 'independent' effect. In particular, this may exist between the variables for public sector work and unionised work.

Men and women typically work with people of the same sex. In this sample, men were typically in occupations in which 67% of the workers were men, while women were on average in occupations in which 31% of the workers were men (i.e. 69% female). Occupations with higher proportions of men have higher rates of pay, so an association of gender segregation with wages is to be expected. Employment in a male-dominated occupation is associated with higher wages for women. If a woman were able to move from an occupation in which 50% of the workers were men to one in which 60% were men, her associated increase in wages is estimated at 1.3%.

Occupational sex segregation is especially concentrated among those who are employed part-time. Figure 2.4 illustrates the measurement of the gender segregation variable, plotting, for each worker, the degree of segregation of their working environment against their weekly working hours. The resulting pattern among 77 main occupations is visible as a strongly sloped line in the figure. The higher the percentage of men in the occupation, the stronger is the tendency to work full-time or even longer hours, in the UK.

Figure 2.4 Occupational segregation and hours



Source: British Household Panel Survey, 2001/2.

Gender and discrimination

The effect of gender on wage rates is distributed across all of the variables in our model. Each of the variables on education, life-time working-time patterns, and labour market rigidities contains a gender dimension. Yet, despite including a very large range of variables in the model, there remains an association of wages with a further variable of ‘other gender’. This variable ‘other gender’ contains factors associated

with gender that are not neatly captured by education, patterns of working time, or the major forms of institutional organisation of employment.

'Other gender' may be regarded in some ways as an institutional factor. It includes a series of factors that include, but are not confined to, discrimination. Discrimination is likely to be an important component in the variable. A variety of factors are embedded in ‘other female’, including:

- discrimination;
- preferences (such as for particular types of work);
- motivation (such as what priority is given to working hard).

In this model, being female is associated with an additional 8.9% reduction in the hourly wage-rate.

Discrimination against women is hard to measure. While some aspects of discrimination may be included within the variable ‘other gender’, it may take place at several levels and it may appear within the variables and the regression in several different places. For instance, discrimination in the screening of applicants for jobs might appear in the type of occupation into which women get admitted, and hence may partly be embedded in the gender segregation variable. Further, the penalty associated with years of working part-time may be associated with employer decisions to offer less training for those in part-time jobs because of out-moded gendered stereotypes of the workers concerned. Finally, the scale of the wage penalty associated with a short break for maternity must raise questions as to the extent to which this reflects human capital effects and the extent to which it contains a discriminatory element.

Since discrimination takes a variety of direct and indirect forms, these do not directly map onto the 9% wage reduction that is associated with ‘other gender’. Direct discrimination is a component of the ‘other gender’ coefficient of -9%. However, this 9% may also incorporate some elements of motivations or preferences, such as differentials that compensate for unobserved advantages of a particular low-paid job. Many of the institutions relevant to the labour market are indirectly gendered in some way, and thus may contain forms of indirect discrimination. Thus 9% is the upper limit on the component of gender discrimination that is direct discrimination, whilst indirect gender discrimination, which may have a huge effect on wages, is associated in some way with many of the variables in the model.

In summary, the regression analysis of the factors associated with wage rates confirms some of the same basic findings from previous research. However, our findings provide a greater depth of understanding of the implications of employment history, in particular by differentiating between the effects of years spent working full-time and part-time, and the additional effect of interruptions to employment for childcare and other forms of family care.

3. SIMULATING THE COMPONENTS OF THE GENDER PAY GAP

3.1 Introduction

The analysis so far has estimated the relative importance of factors associated with different levels of wages for both men and women by the use of the regression technique. The percentages presented represent the relative importance of these factors for wage levels for all people. The next step of the analysis is to focus more specifically on the nature of the gender pay gap. This stage estimates the relative proportions of the gender pay gap that are attributable to different components. The analysis rests on the findings of the regression (summarised in Table 2.4 and presented in detail in Appendix 3) and applies them to the gender pay gap. The percentages in this section represent the proportions of the gender pay gap that are attributable to different components.

A factor that may be important in the determination of wage levels overall may or may not be associated with a gender wage gap. For example, while education is very importantly associated with wage levels overall, its importance for the gender wage gap is less marked because levels of education of men and women have almost converged. In a further example, while a 9% fall in wages is associated with being female, 38% of the gap in pay between women and men is associated with being female, as will be shown later in this chapter.

There are several ways to decompose (i.e. to break down into constituent components) the gender pay gap and a review of these is provided in Appendix 4. The technique used here is that of simulation. The advantages of the simulation method over more traditional methods, such as the Oaxaca technique described in Appendix 4, are that:

- It brings all the factors relevant to policy into the limelight, pushing controls into the background.

- It removes the potential confusion that might result from including offsetting factors that are not centrally relevant.

- It allows the gender component (including direct discrimination) to be made visible and its importance compared with the other factors. A comparison with estimates from earlier work by Walby and Olsen (2002) may also be found in Appendix 4.

Simulation is based on the regression equation described above that assumes a common labour market for both men and women (since assumptions of separate labour markets for men and women are today untenable). The sizes of the main components of the pay gap are estimated by simulating the hypothetical changes needed to bring women's levels of these components into line with those of men. The simulation approach multiplies the hypothesised change in a variable by the coefficient from the above regression analysis that corresponds to that variable. Simulation creates an equation in which the individual terms add up to the overall gender pay gap.

3.2 The components of the gender pay gap

Each of the main components of the gender wage gap, discovered from the regression (reported in Table 2.4) is hypothetically changed so as to bring women's levels of the variable up to those of men.

The hypothetical changes in the simulation exercise include:

Education:

- A small increase in years of education among women.

Life-time working patterns:

- Years of full-time employment raised, among women, from 7.6 years to 13.1 years, i.e. from the women's average level to the men's average level.
- Years of part-time employment among women reduced to the male average.
- Months of interruptions for family care leave reduced to the male average.

Labour market rigidities:

- The gender composition of occupations is made more even, so as to reduce occupational segregation by sex, by raising the percentage of men in the occupations where women are employed from 31% male to 50% male.
- Increasing the size of firm where women typically work to the level experienced by men.

Other female:

- Removing the other implications of being male not female, that is, removing the negative effect associated with being female.

Two examples illustrate the procedure. We consider firstly segregation, and secondly gender itself.

In the simulation, segregation is measured by the male percentage in each occupation. Among women, the male percentage is raised from 31% (the average, as shown in Table 2.1) to 50%, i.e. to the point where jobs are equally distributed among women and men in each occupation. The raised segregation level (19 percentage points) among women is multiplied by its coefficient of 0.013. In other words, the logwage[3] is raised by 1.3% for every 10% more males in the occupation (see Table 2.4). Since the simulation raises the segregation level from 31% to 50%, i.e. by nearly 20%, a change of approximately 2.6% occurs in the wage-rate. If the segregation index, that is, the percentage of men in an occupation where women are employed, were to rise from 31% to 50% there would be approximately a 2.6% rise in the women's wage-rate. Examine Table A4.1 to see that this change represents 10% of the pay gap, and therefore is equivalent to 22 pence per hour rise among women.[4]

The second illustration considers the apparent residual impact of being female. Here the 'value' of the variable is considered hypothetically to fall from 'one' to 'zero', as if the females were no longer female. This change is multiplied by the coefficient of -.09, giving a logwage rise of 9%. This 9% rise is 38% of the overall pay gap, and hence can be seen as equivalent to 87 pence/hour (Table A4.1).

In Table 3.1, the gender pay gap of £2.28 per hour in 2002 (see Table 2.1) is broken down into the main factors associated with gendered wages. The contribution of each to the overall pay gap is shown, while the underlying assumptions are spelt out in Appendix 4. Control variables such as region and industry are ignored. In the decomposition calculations, elements of the pay gap arising from the control factors have been left out. The pay gap arising from the 15 elements, which are considered here, was 0.23 logwage units, or about 23%. Further research could explore the differentials in pay across industries, and their contribution to the pay gap, more fully. However, the decomposition used here is focused on the specific elements chosen for attention because of their policy relevance.

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[3] See note 1 on p. 13 on the logwage. It is used rather than 'wage' for technical reasons.

[4] Note that the measurement units used for segregation in Table A4.1 are increased by a factor of ten, so that instead of .31 rising to .50, 3.15 is raised to 5.00, increasing the value by 1.85 units; the coefficient of 0.01 allows for this choice of measurement unit, whereby a 1.00 increase represents a 10% rise in the percent male in the occupation. In this way, the regression analysis gives a usable coefficient.

Table 3.1 Simulation decomposition of the GB hourly gender pay gap, 2002

Variable	£ per hour	Per cent
Education:	*0.18*	*8*
- Education (years)	0.18	8
Life-time working-time patterns:	*0.84*	*36*
- Years of full-time employment	0.44	19
- Years of part-time employment	0.08	3
- Years of family care	0.32	14
Labour market institutions:	*0.39*	*18*
- Segregation (male% x 10)	0.22	10
- Firm size 500+ workers	0.04	2
- Firm size 50+ workers	0.05	2
- In union or staff association	0.01	1
- Other institutional factors[1]	0.07	3
Other female:	*0.87*	*38*
- Other female	0.87	38
Total gender pay gap	**2.28**	**100**

Notes: [1] This refers to 'currently mothering' and 'recent training not employer funding' in Table A4.1.

Source: British Household Panel Survey, 2001/2.

The findings from the simulation, shown in Table 3.1, reveal that of the gender pay gap, one third (36%) is accounted for by life-time working-patterns, one fifth (18%) by labour market rigidities, one tenth (8%) by formal education and over one third (38%) by other factors associated with being female, including discrimination. These percentage gaps mean that of the total £2.28 per hour gender wage gap, 84p is associated with life-time working-time patterns, 39p with labour market rigidities, 18p with education and 87p with other factors associated with being female, including discrimination. (The multiplication and conversion to pounds are presented in Appendix 4).

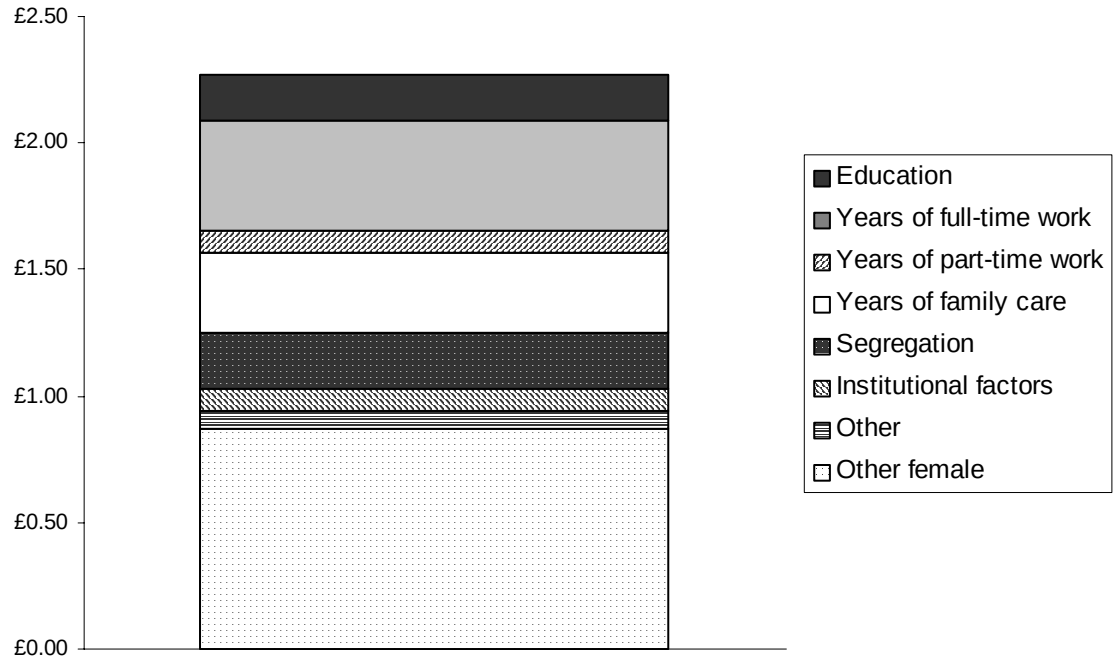
The portion of the gender wage gap associated with life-time working-time patterns may be broken down into its component elements. More than half of this (44p out of 84p) is associated with women being in full-time employment for a smaller proportion of their working lives than men, either because they are not employed but busy caring for children and other family members, or they are employed part-time. There is an additional pay penalty associated with interruptions to employment that is over and above that associated with fewer years full-time employment, which accounts for

32p of the 84p gap associated with life-time working-time patterns. Being employed part-time does not add pro-rata to wages, but rather results in an additional pay penalty of 8p. The comparison of men's and women's life-time working-time patterns can be seen in Figure 3.2. This shows the much greater proportion of a working-life that is spent in full-time employment for men as compared with women. Men on average spend thirteen years employed full-time, while women spend eight years. This is because women on average spend more time employed part-time and caring for children.

The component of the gender wage gap associated with labour market rigidities may also be broken down into its components. The most important component is occupational segregation, which accounts for more than half of this (22p out of 39p per hour), while other labour market institutions, which differentiate and segment the labour market, account for the rest.

A diagrammatic representation of the components of the gender pay gap is provided in Figure 3.1. This illustrates the decomposition by showing the size of the improvement for women that would occur if each factor contributing to the pay gap was eliminated. It should be noted that the outcome of the simulation method does not differ radically from the estimates obtained by using more traditional methods, such as the Oaxaca technique, described in Appendix 4.

Figure 3.1 The gender pay gap



Notes: In this chart, the vertical axis is in £/hour wage units. The overall wage gap is £2.28. It is measured with reference to the male wage, so that £2.28 at the top refers to a female mean wage matching that of an average man. £0 at the bottom refers to the women's mean wage without any simulated changes. Data are for 2002.

Source: British Household Panel Survey, 2001/2.

3.3 Comparison with other findings

The proportion of the gender pay gap that is associated with different components is a little different from that found in previous analyses. The reasons for these differences include: better information available in this data set; the wider range of variables included in our model; and the nature of the technical adjustments that are made, for instance to address the non-employed people in the sample.

One important reason for differences between this analysis and others is the inclusion of detailed work history information within our model. This approach is not possible for analyses, such as that by Anderson et al. (2001), which are based on cross-sectional surveys such as the Labour Force Survey and the Workplace Employment Relations Survey (WERS). It is unsurprising that Anderson et al. find human capital factors less important and institutional workplace factors more important than is the case in this analysis because of the data and variables used in their model. They use age as a proxy for work experience (since WERS does not include information on actual work experience), so they are necessarily unable fully to identify the extent to which the actual length and different types of employment

experience are associated with wages. The WERS also lacks measures of the reductions of labour market experience typically associated with motherhood.

The results here also differ somewhat from those presented in previous work by Walby and Olsen (2002). One of the reasons for the difference is that the earlier work did not use a selectivity-adjusted wage equation for the simulation exercise. The current work uses a Heckman-type adjustment (widely regarded as best practice) to deal with the differential propensity of women to be in employment. One of the main differences in results is that the current ones show a smaller impact of part-time employment on women's pay compared with this earlier work. For further discussion of this point, see Walby and Olsen (2002: 97-100; 104).

The results presented here are therefore based on a consideration of a wider range of factors than in the work of Anderson et al. (2001) because the work histories available in the BHPS are not available in WERS. The results should also be considered an improvement on Walby and Olsen (2002) as a result of the inclusion of the Heckman sample selection adjustment, and the use of more up-to-date data.[5]

3.4 Conclusion

The following are the most important factors associated with the pay gap: 38% for being female; 18% for full-time work experience; 14% for interruptions to employment for childcare and other family-care; 10% for gender segregation; 8% for education; 4% for firm size; and 3% for years of part-time working.

Thus it is important to differentiate between the types of employment experience. In particular, while additional years of full-time employment experience typically had a strong positive association with wages, additional years of part-time employment were not associated with higher wages, but rather with a small reduction. Further, interruptions to employment to take care of children and other family members had a substantial negative association with wages over and above their effect on reducing years of full-time employment experience.

[5] Another difference between the studies is that one was based on BHPS data for the year 2000 and the other on BHPS data for the year 2002. In the more recent data set for 2002, the work-history data have been extended for the cases remaining in the sample over time, whilst additional cases have also entered into the study through natural replacement processes (mainly marriage and the coming of age of children). In the BHPS, numerous cases were also added in Wales and Scotland through a 'booster sample', and these had not been included in the analysis of the year 2000 data. For these cases, only short work histories are available, varying in length from one year to several years (see Appendix 1 for details); the full retrospective work-history interviews done in the early 1990s are not available for them. However, their impact on the overall averages is small, because by using weights to adjust the data, the booster sample's impact is reduced to the proportions normally due to Wales and Scotland respectively.

4. CONCLUSIONS AND FURTHER RESEARCH

4.1 Conceptualising the components of the gender pay gap

The components of the gender pay gap include factors that have traditionally been associated with either human capital (education, employment experience) or with discrimination (occupational segregation, some of the factors associated with being female). Human capital has been seen as a legitimate source of earnings differences because it is made up of skills, qualifications and experiences that are relevant to employers. Moreover, the attainment of human capital has been seen primarily as an individual attribute. By contrast, discrimination has been seen as a failure in the working of the labour market, and thus a legitimate site of public policy intervention.

The argument here is that this dichotomy is overdrawn and can have misleading implications for policy. This is because women face systematic disadvantage in the acquisition of human capital. The acquisition of human capital depends upon the location of women within labour market institutions, as well as on individual decisions.

This can be seen particularly clearly in the case of part-time employment. While years spent working full-time are associated with increased wages, working part-time is not - not even pro-rata. Rather experience of part-time employment is associated with a slight reduction in wages. The typical assumption in human capital theory is that experience of employment increases human capital and thus increases wages, but this assumption is challenged by this finding. Rather, whether or not employment experience leads to increases in wages depends on the location of the employment experience within a differentiated labour market.

While it is sometimes assumed that differences in length of employment experience may lead to differences in pay as a consequence of variations in human capital, this is at best an over simplistic assumption. While differences in employment experience may be associated with the differential acquisition of human capital, such as those working part-time being institutionally provided with less training than those working full-time, they may also be signals that lead to discriminatory practices. They may perhaps result from inappropriate stereotypes of mothers, or they may be indicative of labour market rigidities and failures, perhaps because of insufficient flexibility to allow a continuous attachment with an employer over childbirth. Further, discrimination and other failures within institutions may affect the amount of human capital that it is possible to accumulate. The analysis presented here provides the most robust and accurate quantitative analysis of the size of the associated effects, but it does not remove the need for consideration of the nature of causal pathways.

Some of the reasons that women find themselves in a different labour market, i.e. competing for a different range of jobs than equivalently qualified men, may be thought of as indirect discrimination. The differential impact of years spent working part-time, as compared with full-time, has serious implications for both women's wages and UK productivity and is worthy of policy intervention, whether or not discrimination is the whole cause of the difference or not. Discriminatory practices, both direct and indirect, may be found not only embedded in factors such as occupational segregation, but also within the processes by which human capital is acquired.

The model presented here is a much fuller model than is often presented, in the sense of including an unusually wide range of variables. It is as full a model as it is possible to construct with available data. It is frequently thought that the more factors that are included in a model, the less variance in wages will remain to be associated with gender and/or with discrimination. Indeed, we have captured within this model sources of variance in gendered wages additional to those of other models, especially those associated with distinguishing between different kinds of employment experience, particularly those forms that often accompany childcare (e.g. part-time working). Nevertheless, there remains a very large component of the gender wage gap that is associated with gender. More than a third (38%) of the gender pay gap is associated with being female, even after so many of the factors associated with being female have been separately accounted for in the model.

4.2 Implications of the findings for policy

These findings on the composition of the gender pay gap have implications for two main types of government policy: first, policies concerned with gender justice, especially those related to fair pay for women and men and the reduction of the gender pay gap; and second, policies concerned with the productivity of the UK economy and its capacity for economic growth. These two types of policy are closely connected (Kingsmill, 2001; Walby and Olsen, 2002). In the context of these policy issues, the findings have implications for a range of stakeholders, including HM Treasury, because of its concern to reduce the cost to the country of the tax/benefit system; individual employers, because of the potential to reduce labour turnover and thus their costs; and society as a whole, because of the potential to reduce child poverty.

An important HM Treasury policy objective is to raise the productivity of the UK economy and its rate of economic growth. In order to achieve this, a range of drivers has been identified as targets for policy: investment, innovation, skills, enterprise and

competition (HM Treasury and DTI, 2004). The findings in this report are relevant to the concern with skills and with competition.

This research has found that the acquisition of skills and other forms of human capital is associated not only with education and length of employment experience, but also by the context of that employment experience (whether the experience is full-time or part-time) and by interruptions to it. There is a gendered dimension to the acquisition of human capital, which is affected by the institutional context.

The research has found that labour markets are not perfectly competitive, and that they contain significant rigidities (such as occupational segregation) and forms of discrimination, which affect women's potential in the labour market.

The decomposition of the gender pay gap into its component elements enables the more precise connections to be made between particular policy interventions and their consequences for the gender pay gap.

4.3 Future modelling of policy scenarios

The next phase of the research is to identify specific policies and to model their implications for the gender pay gap. Examples of such policies would be: universal childcare; training for returners; improved flexibility in the workplace; and, possibly, anti-discrimination policies. In the UK, these policies are already undergoing active development. Each policy change implies altered work careers for women and other associated changes. Modelling policy scenarios allows the net impact of changes in work careers on wage-rates to be measured in exact terms. From there, the impact on the gender wage gap and productivity can be predicted. The details of the entire distribution of wage-rates are entered into micro-simulation so that the wage-distribution, tax/benefit, and relative effects on men and women can be estimated with some accuracy.

Universal childcare

Childcare provision makes an impact on the three components of the gender wage gap concerned with the length and nature of employment and interruptions to the paid work career. There is already a government National ChildCare Strategy.

Training for returners

Women returning to employment after a break for intensive childcare are one of the lowest earning groups as a result of the cumulation of several forms of disadvantage. These include low qualifications and low skills, which are compounded by the effect of an absence from employment. The policy of concern here would be similar to a

development of policies within the New Deal, so that mothers returning to employment have systematic access to training, which is at least as good as that offered to the unemployed returning to employment.

Improved flexibility in the workplace

The difficulty of combining employment and caring is widely noted. An increase in flexibility in the workplace so as to support work-life balance may increase women's ability to engage in employment, especially that which is more productive and well paid.

Additional anti-discrimination polices

The continuing stream of legal cases through the courts provides evidence that discriminatory practices still exist in the workplace. There are new developments in anti-discrimination policies and practices, from equal pay audits. Increased investment in the personnel time, training, procedures and institutions may reduce this discrimination and narrow the gender pay gap.

These policies might be expected to have implications for a range of stakeholders and beneficiaries including the Exchequer and employers as well as the UK economy as a whole and society as a whole.

The Exchequer: taxes and benefits

The Exchequer is a major stakeholder because of the significance of the gender pay gap for taxes and benefits. There would be a reduction in payments of benefits and tax credits provided to ensure that women and children do not live in poverty. There would also be a gain to the Exchequer of potential taxes, specifically income tax and national insurance, as a result of an increase in women's earnings.

Individual employers: re-hiring and re-training

There would be a reduction in labour turnover associated with women leaving the labour market for childcare. This would be the result of an increased financial incentive for women to stay employed and the provision of childcare. This would lead to a reduction in the cost of re-hiring and re-training.

UK economy as a whole

Reducing the gendered skill and human capital gap and improving the effective and competitive functioning of labour markets are likely to increase the productivity of the UK economy.

Society as a whole: child poverty reduction

Child poverty has long-term negative consequences for society as a whole. When mothers live in poverty, so do their children. The narrowing of the gender pay gap is likely to reduce child poverty.

BIBLIOGRAPHY

Anderson, T., Forth, J., Metcalf, H. and Kirby, S. (2001) *The Gender Pay Gap*. Report for the Women and Equality Unit. London: Cabinet Office.

Beblo, M., Beninger, D., Heinze, A. and Laisney, F. (2003a) *Methodological Issues Related to the Analysis of Gender Gaps in Employment, Earnings and Career Progression*. Mannheim: European Commission, Employment and Social Affairs DG.

Beblo, M., Beninger, D., Heinze, A. and Laisney, F. (2003b) 'Measuring selectivity-corrected gender wage gaps in the EU'. Mimeo: Mannheim.

Becker, G.S. (1981) *A Treatise on the Family*. Cambridge, Mass.: Harvard University Press.

Becker, G.S. (1993) *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*. 3rd edition. Chicago: Chicago University Press.

Blackwell, L. (2001) 'Occupational sex segregation and part-time work in modern Britain', *Gender, Work and Organization*, 8, 2: 146-63.

Blau, F. and Kahn, L. (1997) 'Swimming upstream: trends in the gender wage gap differential in the 1980s', *Journal of Labor Economics*, 15, 1: 1-42.

Blinder, A.S. (1973) 'Wage discrimination: reduced form and structural variables', *Journal of Human Resources*, 8: 436-65.

Blundell, R., Dearden, L. and Meghir, C. (1996) *The Determinants and Effects of Work Related Training in Britain*. London: Institute for Fiscal Studies.

Blundell, R., Dearden, L., Goodman, A. and Reed, H. (2000) 'The returns to higher education in Britain: evidence from a British cohort', *The Economic Journal*, 110, February: F82-99.

Budig, M.J. and England, P. (2001) 'The wage penalty for motherhood', *American Sociological Review*, 66, 2: 204-25.

Bulman, J. (2002) 'Patterns of pay: results of the 2002 New Earnings Survey', *Labour Market Trends*, December, pp. 643-55.

Burchell, B.J. and Dale, A. and Joshi, H. (1997) 'Part-time work among British women', in Blossfeld, H-P. and Hakim, C. (eds) *Between Equalisation and Marginalisation: Women Working Part-time in Europe and the United States of America*. Oxford: Oxford University Press.

Carruth, A., Collier, W. and Dickerson, A. (1999) *Inter-Industry Wage Differences and Individual Heterogeneity: How Competitive is Wage Setting in the UK?* Department of Economics Discussion Paper 99/14. Canterbury: University of Kent at Canterbury.

Chartered Institute of Personnel and Development (CIPD) (2002a) *Labour Turnover 2002: Survey Report*. London: CIPD.

Chartered Institute of Personnel and Development (CIPD) (2002b) *Work, Parenting and Careers: Survey Report*. London: CIPD.

Cohen, P.N. and Huffman, M.L. (2003) 'Occupational segregation and the devaluation of women's work across U.S. labor markets', *Social Forces*, 81, 3: 881-908.

Cotter, D.A., Defiore, J.A., Hermsen, J.M., Marsteller Kowaleski, B. and Vanneman, R. (1997) 'All women benefit: the macro-level effect of occupational integration on gender earnings inequality', *American Sociological Review*, 62: 714-34.

Department for Work and Pensions (2002) *New Deal for Young People and Long-Term Unemployed People Aged 25+: Statistics to December 2001.* National Statistics. Accessed at:
http://www.dwp.gov.uk/asd/asd1/new_deal/new_deal_young_feb2002.asp

Department of Trade and Industry (DTI) (2001a) *Regulatory Impact Assessment: Employment Bill 2001.* Accessed at: http://www.dti.gov.uk/er/employ/ria.pdf

Department of Trade and Industry (DTI) (2001b) *Regulatory Impact Assessment of a duty on employers to consider seriously requests for flexible working from the parents of young and disabled children.*
Accessed at: http://www.dti.gov.uk/er/fworkingRIA.pdf

Department of Trade and Industry (DTI) (2004) National Minimum Wage, http://www.dti.gov.uk/er/nmw/gtmw.pdf, downloaded 10 February, 2004.

Dex, S., Joshi, H., Macran, S. and McCulloch, A. (1998) 'Women's employment transitions around child bearing', *Oxford Bulletin of Economics and Statistics*, 60, 1: 79-98.

Elliot, J., Dale, A. and Egerton, M. (2001) 'The influence of qualifications on women's work histories, employment status and earnings at age 33', *European Sociological Review*, 17, 2: 145-68.

England, P. (1993) 'The separative self: androcentric bias in neoclassical assumptions' *in* Ferber, M.A. and Nelson, J.A. (eds) *Beyond Economic Man: Feminist Theory and Economics*. Chicago: University of Chicago Press.

England, P., Farkas, G. Kilbourne, B.S. and Dou, T. (1988) 'Explaining occupational sex segregation and wages: findings from a model with fixed effects', *American Sociological Review*, 53: 544-58.

England, P., Mermsen, J.M. and Cotter, D.A. (2000) 'The devaluation of women's work: a comment on Tam', *American Journal of Sociology*, 105, 6: 1741-60.

Ermisch, J.F. and Wright, R.E. (1992) 'Differential returns to human capital in full-time and part-time employment', in Folbre, N. et al. (ed.) *Women's Work in the World Economy*. London: Macmillan.

Freed Taylor, M. (ed), Brice, J. Buck, N. and Prentice-Lane, E. (2001) *British Household Panel Survey user manual volume B: codebook*. Colchester: University of Essex.

Gornick, J.C. and Jacobs, J.A. (1996) 'A cross-national analysis of the wages of part-time workers: evidence from the United States, the United Kingdom, Canada and Australia', *Work, Employment and Society*, 10, 1: 1-27.

Gregg, P. (1998) 'The impact of unemployment and job loss on future earnings', in HM Treasury, *Persistent Poverty and Lifetime Inequality: The Evidence*. Occasional Paper no. 10. London: HM Treasury. (also CASE Report 5, LSE March 1999), 89-96.

Grimshaw, D. (2000) 'Public sector employment, wage inequality and the gender pay ratio in the UK', *International Review of Applied Economics*, 14, 4: 427-48.

Grimshaw, D. and Rubery, J. (2001) *The Gender Pay Gap: A Research Review*. EOC Research Discussion Series. Manchester: Equal Opportunities Commission.

Grimshaw, D. and Rubery, J. (2002) 'The adjusted gender pay gap: a critical appraisal of standard decomposition techniques'. Part of the work of the Group of Experts on Gender and Employment commissioned by the Equal Opportunities Unit in the European Commission.
Accessed at: http://www2.umist.ac.uk/management/ewerc/

Halpin, B. (1998a) *Unified BHPS Work-life Histories: Combining Multiple Sources into a User-friendly Format*. Technical Paper 13. Colchester: ESRC Research Centre on Micro-social Change, University of Essex.

Halpin, B. (1998b) 'Unified BHPS work-life histories: combining multiple sources into a user-friendly format', *Bulletin de Méthodologie Sociologique*, no. 60.

Halpin, B. (2000) 'The BHPS Work-Life History Project, web update'. Located at www.iser.essex.ac.uk/~brendan/ltr/index.html.

Harkness, S. (1996) 'The gender earnings gap: Evidence from the UK', *Fiscal Studies* 17: 1-36.

Henley, A. and Thomas, D. (2001) 'Public service employment and the public-private wage differential in British regions', *Regional Studies*, 35, 3: 229-40.

HM Treasury and Department of Trade and Industry (2004) *Productivity in the UK 5: Benchmarking UK Productivity Performance*. London: HM Treasury.

Jacobs, J. (1993) 'Theoretical and measurement issues in the study of sex segregation in the workplace: Research note', *European Sociological Review*, 9, 3: 325-30.

Jacobs, S. (1995) 'Changing patterns of sex segregated occupations throughout the life-course', *European Sociological Review*, 11, 2: 157-71.

Johansen, L-H. (2002) 'Transferable training as a collective good', *European Sociological Review*, 18, 3: 301-14.

Joshi, H. and Paci. P. (1998) *Unequal Pay for Women and Men: Evidence from the British Birth Cohort Studies*. Cambridge, Mass.: MIT Press.

Joshi, H., Paci, P. and Waldfogel, J. (1999) 'The wages of motherhood: better or worse?', *Cambridge Journal of Economics*, 23: 543-64.

Juhn, C., Murphy, K.M. and Pierce, B. (1991) 'Accounting for the slowdown in black-white wage convergence', in Kosters, M. (ed.) *Workers and Their Wages*. Washington, D.C.: The AEI Press.

Juhn, C., Murphy, K.M. and Pierce, B. (1993) 'Wage inequality and the rise in returns to skill', *Journal of Political Economy*, 101, 3: 410-42.

Kidd, M.P. and Shannon, M. (2001) 'Convergence in the gender wage gap in Australia over the 1980s: identifying the role of counteracting forces via the Juhn, Murphy and Pierce decomposition', *Applied Economics* 33,7: 929-36.

Kilbourne, B.S, England, P., Farkas, G., Beron, K. and Weir, D. (1994) 'Returns to skill, compensating differentials, and gender bias: Effects of occupational characteristics on the wages of white women and men', *American Journal of Sociology*, 100, 3: 689-719.

Kingsmill, D. (2001) *A Review of Women's Employment and Pay*. London: Women and Equality Unit.

Kunze, A. (2000). *The Determination of Wages and the Gender Wage Gap: A Survey*. Discussion Paper no. 193. Bonn: Institute for the Study of Labor (IZA).

Layard, R. (2001) *Welfare-to-Work and the New Deal*. Centre for Economic Performance Occasional Paper no. 15. London: London School of Economics.

Manning, A. (2000) 'Movin' on up: interpreting the earnings-experience profile', *Bulletin of Economic Research*, 52, 4: 261-93.

Miller, P.W. (1987) 'The wage effect of the occupational segregation of women in Britain', *The Economic Journal*, 97: 885-96.

Mincer, J. and Polachek, S. (1974) 'Family investments in human capital: earnings of women', *Journal of Political Economy*, 82, 2: S76-108.

Myck, M. and Paull, G. (2001) *The Role of Employment Experience in Explaining the Gender Wage Gap*. Working Paper 01/18. London: Institute for Fiscal Studies.

National Audit Office (2002) *The New Deal for Young People*. Report HC 639. London: The Stationery Office.

Neumark, D. (1988) ‘Employers’ discriminatory behavior and the estimation of wage discrimination’, *Journal of Human Resources*, 23: 279-98.

Nielsen, H.S. (2000) ‘Wage discrimination in Zambia: an extension of the Oaxaca-Blinder decomposition’, *Applied Economics Letters*, 7: 405-08.

Oaxaca, R.L. (1973) ‘Male-female wage differentials in urban labor markets’, *International Economic Review*, 14, 3: 693-709.

Oaxaca, R.L. and Ransom, M.R. (1994) ‘On discrimination and the decomposition of wage differentials’, *Journal of Econometrics*, 61: 5-21.

Oaxaca, R.L. and Ransom, M.R. (1999) ‘Identification in detailed wage decompositions’, *Review of Economics and Statistics*, 81, 1: 154-57.

Oaxaca, R.L. and Ransom, M.R. (1988) 'Searching for the effect of unionism on the wages of union and nonunion workers', *Journal of Labor Research*, 9: 139-48.

Office for National Statistics (2002) 'Census 2001'. Press release. Accessed at: http://www.statistics.gov.uk/census2001/press_release_uk.asp

Office for National Statistics (2004a) *Labour Force Survey Historical Quarterly Supplement.* London: National Statistics.

Office for National Statistics (2004b) *Labour Force Quarterly Supplement*, Autumn 2003. London: National Statistics.

Olsen, R.N. and Coppin, A. (2001) 'The determinants of gender differentials in income in Trinidad and Tobago', *Journal of Development Studies*, 37: 31-56.

Polachek, S.W., and M-K. Kim (1994) ‘Panel estimates of the gender earnings gap’, *Journal of Econometrics*, 61: 23-42.

PricewaterhouseCoopers (2003) *Universal childcare provision in the UK - towards a cost-benefit analysis*. Accessed at: http://www.pwcglobal.com/extweb/ncpressrelease.nsf/docid/A442ECD064507EBD80256D8F005D89E1

Rake, K. (ed) (2000) *Women’s Incomes Over the Lifetime*. London: The Stationery Office.

Rice, P. (1999) *Gender Earnings Differentials: The European Experience*. Policy Research Report on Gender and Development. Washington, DC: IBRD.

Riley, R. and Young, G. (2000) *The New Deal for Young People: Implications for Employment and the Public Finances*. Employment Service Report ESR62. Sheffield: Employment Service.

Swaffield, J. (2000) *Gender, Motivation, Experience and Wages*. Centre for Economic Performance Discussion Paper no. 457. London: London School of Economics.

Tam, T. (1997) 'Sex segregation and occupational gender inequality in the United States: Devaluation or specialized training?', *American Journal of Sociology*, 102, 6: 1652-92.

Tomaskovic-Devey, D. and Skaggs, S. (2002) 'Sex segregation, labor process organization, and gender earnings inequality', *American Journal of Sociology*, 108, 1: 102-28.

Walby, S. and Olsen, W.K. (2002). *The Impact of Women's Position in the Labour Market on Current UK Productivity and Implications for Future Productivity Growth*. Report for the Department of Trade and Industry, Women and Equality Unit. London: HMSO.

Waldfogel, J. (1997) 'The effect of children on women's wages', *American Sociological Review*, 62: 209-17.

Waldfogel, J. (1998) 'The family gap for young women in the United States and Britain: can maternity leave make a difference?', *Journal of Labor Economics*, 16, 3: 505-45.

Warren, T. (2000) 'Women in low status part-time jobs: a class and gender analysis', *Sociological Research Online*, 4: 4.

Work and Parents Taskforce (2001) *About Time: Flexible Working*. London: DTI.

Wright, R.E. and Ermisch, J.F. (1991) 'Gender discrimination in the British labour market: a reassessment', *The Economic Journal*, 101: 508-22.

Data sets:

British Household Panel Survey [computer file] principal investigator, ESRC Research Centre on Micro-social Change. Colchester: The Data Archive (distributor), 1991/2 to 2001/2.

APPENDIX 1: DEFINITIONS, MEANS AND CORRELATIONS OF THE VARIABLES

In this appendix, the definition of each variable is given, and tables of all means and correlations are provided.

The means tables are broken down into groups: means for part-time and full-time workers are provided together; means for all potential workers are provided; and means for part-time workers only are provided.

The means and correlation matrix all use cross-sectional survey weights.

Variables used to develop the expanded explanation of wage differences
This section describes the variables used in the analysis that follows. The section covers both the wage-rate and the related explanatory variables. We first offer a list of the variable abbreviations, detailed labels, and a brief description of how variables were derived or defined.

The current work has similarities with earlier work for Great Britain (Walby and Olsen, 2002). The present study covers two additional years and takes into account a wider range of explanatory factors. The innovations in both studies include allowing for paid overtime, allowing for the person's actual reported life-history when measuring career interruptions and work experience, and taking account of causal factors at several levels (individual, household, occupation-specific, and social levels). The innovations specific to the new report include measurement of gender effects using panel-data, up-dating of working life histories to the year 2002, measures of job-specific training versus generic training, and controls for ill health in the labour-force participation decision.

Dependent variable
hourlypay, lnhourlyrealpay
PAY PER HOUR: The algorithm is complex. In the BHPS, we first look for last week's weekly rate of pay. If it is given there, we record it and adjust it to give the last week's hourly pay. The 'hours of work' are the sum of (a) usual hours of work in the current job plus (b) the hours usually worked as paid overtime. We don't include unpaid overtime. In some cases, the last week's pay was an hourly pay-rate, and we place that directly as hourly pay.

After working out the hourly equivalent of weekly pay, we adjust to clarify cases with missing data. Where data on hourly pay are missing, but hours are present, the usual pay rate per week can be used. This item is obtained in two parts: usual hours and usual pay per week. Therefore we take both together, still adding paid overtime to usual hours if the overtime figure exists. Hourly pay is then the ratio of usual pay per week to the total usual hours.

This figure is used if last week's actual payrate was not stated.

Real pay is obtained by multiplying older rates of pay by the inverse of the retail price index for each year, relative to 2002. E.g. if the retail price index was 0.80 relative to its base of 1.00 in 2002, the data are increased by a factor of 1.25 which is 1/0.80.

LOG OF HOURLY PAY. The log of hourly pay exists in every case except where hours were zero or missing. When hours were zero or missing, the person must be considered not to have been working. In that case their 'employment status' should have been one of the inactive or unemployed statuses, but in some cases a wage is nevertheless reported. This can occur because of (a) temporary layoff, e.g. sick days, or (b) reporting usual-pay but not hours, because usual pay is a habitual report, but the person has changed their employment status, e.g. recently retired.

In such cases, where there is pay but not an hours figure, the pay-per-hour figure fails to register. We register such a person as potentially in the labour market (given their age and sex) but currently not employed.

Finally, there is a back-up datum on the basic rate of pay and basic rate of overtime pay. This datum is used if there is no answer to any of the previous pay questions. In the few cases of this sort, we then calculated hourly pay by dividing the weekly basic pay figure by JOBHOURS after adjusting each for usual overtime hours.

Because some overtime pay is neither counted nor paid, it is easy to misinterpret pay-rate studies as not reflecting overtime pay. In the present case, a clear distinction between paid and unpaid overtime in the BHPS questionnaires makes it possible to allow for the former in working out current hourly pay-rates.

In Waves 10 and 11, we adjusted for the entry of tax credits onto the pay slips. The gross pay, net of tax credits, is lower than the net pay. Allowance is made by using subtraction to obtain the gross pay before tax credits. The credits included explicitly here are Working Families Tax Credit, Working Tax Credit, and Disability Tax Credit. Other benefits, such as child benefit, are received separately from the wage-slip and do not affect hourly pay measures.

We report in Appendix 1 the mean of real pay per hour, the mean of the log of real hourly pay, real weekly earnings from the main job, and nominal pay per hour.

Independent variables

The main independent variables come under two headings: those derived from the annual cross-sectional data, and those derived from the BHPS Work-Life Histories Study and the annual ‘Job History Update’ interview. We take the work-life history variables first, then the main set of annual variables.

Work-life history variables

These are cumulative sums of the time spent in each occupational status. Details of their derivation can be found in Halpin (1998a), and the guidelines set out by Halpin have been used to upgrade the original data for 2000 to include the years 2001 and 2002.

In Walby and Olsen (2002), there was testing for possible bias due to dropouts and bias due to late entrants lacking a life-time work history. These tests showed no bias in the wage regression results from including the late entrants. The dropout issue is taken care of in two ways by the BHPS structure itself. Firstly, annual cross-sectional weights are used to adjust for annual non-response of individuals and households. By weighting selected cases upwards to compensate for those types that failed to respond adequately, the BHPS remains representative. Both for averages and for comparisons of groups, which are essential ingredients for regression analysis, the annual weighted data are representative. Secondly, in addition, for those who are late entrants brought into BHPS either through marriage, by coming of age, or by household merger/migration, some recall data are available. The next paragraph describes how these recall data are obtained, showing that there are limitations to the work-life histories for late entrants, but not for young entrants who come of age and thus enter the survey.

The interviews of BHPS began during 1991 and Wave 1 refers to the years 1991-1992. In Wave 2 a retrospective work history interview gave recall data over each respondent's life-time, classifying their episodes of work into major categories. A further, more detailed interview about the employment statuses was then conducted in Wave 3 for all respondents who gave full interviews that year. Both recall interviews covered non-work statuses (retirement, sick and disability leave, maternity leave, and family care leave) as discrete statuses which were mutually exclusive of employment. When students worked, their episodes of work were counted in the work-history interviews; otherwise their status as 'full-time student' was recorded. Details of minor work categories such as the armed forces and government training schemes were also covered; these two count as full-time work.

In each year after Wave 3, participants whose work status had changed in any way were re-interviewed using a special 'job history' module. Analysts used the job-history module and the current-job information to link together full details of episodes of work and non-work over the entire period up to the specified date (the 'reference date') to which the BHPS refers. This combining of the BHPS Work-Life History dataset with the annual dataset has involved regular updating effort and the current BHPS Work-Life History dataset has been updated to include Wave 9, 2000. However the job-history module interviews carried on into Waves 10 and 11, and the methods of Halpin (1998a, 1998b, 2000) were used to create a fully up to date combined list of the episodes and their durations for each respondent.

The methods used to combine these data can be summarised briefly as follows. If a person has a life-time recall history, those data are used; they are updated by each year's reports as well. The annual reports are in general considered to override the long-term recall data if there is any overlap of dates. The reference year for each year's updates runs for 12 months ending 1 September of the year preceding the BHPS interviews. Since BHPS interviews take place over several months beginning in September, the reference period often thus does not include the precise month of the BHPS interview, e.g. October. If a person joins the survey and lacks a Wave 2 and/or Wave 3 recall interview, their job-history interview for the year includes records of all jobs in the reference period and up to the date of interview, as well as details of the

specific episode which ended at the earliest point in the reference year. If a person is unavailable for interview for one year, this single-episode recall data can fill in the gap that is left. Proxy interviews do not include the job-history module. For this reason only respondents who have 'full interviews' in each year are included in this study. The weighting systems allows for the exclusion of proxy interviews (by placing their weights at zero) in any case. However, in the panel data set, efforts have been made both by Halpin (2000) and ourselves to fill in gaps in the work history using the backdating episodes. Finally, if a person has a Wave 2 or Wave 3 recall interview, but lacks a specific year's job-history module, implying that their old employment status was continuing unchanged, the current job or current status is considered to have been carried on for a 12 month period. The addition of these components leads to a set of summed 'durations' of the combined episodes under each category. For these variables the 'base category' includes both full-time student status, retired status, and out of the labour force but not covered by these categories. The remaining variables measuring the career are:

FULLYEAR, years of full-time employment; work is considered full-time unless there is specific evidence that hours were part-time. Full-time hours are 30+ in this study.

PARTYEAR, years of part-time employment. The years spent working part-time are considered to be those which involved work at part-time hours from between 0.5 and 29.9 hours/week. Self-employment was included in the measures of both part-time work and full-time work experience, in the work-life histories, along with waged and salaried employment.

MONTHSFAM, months of leave to take care of family members.

MONTHSMAT, months of maternity leave. In the work-life history, separate recording of maternity leave from family care leave gives an appearance of accuracy, whereas in reality there may have been lack of clarity about whether someone had been on 'maternity leave' or not in the past. We report here the data as recorded in the Work-Life History files. In a previous study, we tested whether it made any difference for maternity leave to be recoded as a dummy variable, or as a continuous variable. Because the periods of time involved are in general so short, it made little difference which way this variable was recorded.

MONTHSSICK, months of sick or disability conditions leading to their main status being inactive in the labour market.

MONTHSUNEM, months of unemployment interruptions.

We summed up the time spent in each main status over the working life-time, including full-time employment, part-time employment, unemployment, family-care interruption, sick or disabled leave interruption, and maternity leave. The notion of an 'interruption' is defined specifically as a spell of non-employment which occurs directly before a spell of employment (such an event is called an 'episode' by Halpin, 2000). The variable measuring family care leave (in months or years), MONTHSFAM, is defined as an

episode out of employment in order to care for children or for another household member. In Walby and Olsen (2002), the variable representing other labour-market interruptions was the total number of years of absence from employment for reasons of unemployment, sickness or other reason. However in the present report, we keep unemployment separate from sickness and disability. Sickness and disability as a main employment status are measured over the life history (in months or years), and unemployment is a separate status. In addition, the person's current health situation - irrespective of their labour-market status - is measured using a classic indicator of 'limiting long-term illness' (LLTI), but this is not a work-history variable and LLTI is described in a separate section below. We found many people reporting LLTI who were nevertheless working; their illness or disability was not impairing them from working entirely but rather affected their ability to do *some* forms of work.

Annual variables

Most of these are gathered for six years (1993, 1994, 1999, 2000, 2001, 2002), i.e. Waves B, C, H, I, J, and K of BHPS. These are listed below.

Marital status (*spouse)*

People who are cohabiting as a couple are recorded here as *having a spouse* along with those who are legally married.

Education (*education*)

We use two different procedures in order to construct variables for education in the sense of formal qualifications. First, we created a scale in which a single point is roughly equivalent to one year's education; second, we constructed a set of dummy variables each of which represents a particular level of educational achievement. The scale of education levels was constructed using a points system approximating one point per year of full-time education. Eight points were assigned for those who left school at the minimum leaving age without qualifications, and 8.5 points for those who received City & Guilds certificates, a clerical or commercial qualification, or had completed an apprenticeship. The scale awarded 10 points for CSEs and SCEs, 11 points for GCSEs at any level and for GNVQ (no level is specified in the BHPS so a level is assumed, equivalent to GCSE). There are 13 points for A-levels, 16 points for a university degree, and 17 points for a higher degree. In addition, if a person had a nursing qualification (but no degree), a university diploma (but no degree), or a teaching qualification without a degree, they were given 14.5 points.

To create the binary variables for each level of education, we used these qualification categories: having a degree, having other higher qualifications, having A levels, having O levels, having CSEs, and having any other qualifications. This enables the relative size of the effect of each qualification to emerge rather than assuming even effects for each year of study, as occurs when education years are represented as a scale.

In the main regression equations, we have used the scale rather than the several variables for specific levels in order to be able to estimate the implications of a typical extra year of education. Table A.1 is a summary of the scale that we used and its relationship to the highest qualifications binary variables.

Table A1.1 Education scale

Summary of the education scale (approximating years of full-time education)	**Highest qualification:**	**Points assigned in the scale:**
	Degrees	Higher degree 17; degree 16
	Other higher qualifications	Teaching, nursing, and other higher 14.5
	A-levels	A-levels 13
	O-levels	O-levels 11
	CSEs	CSE 10
	Other qualifications, e.g. apprenticeship	Apprenticeship 8; commercial 8.5; other qualification 8; still in school (but working) 8
	No qualification	No qualifications 8

Source: British Household Panel Survey, variable WQFEDHI.

Training

In the BHPS each year, respondents are asked whether they had received a qualification from full-time study during the past year, and separately whether they had received a qualification from part-time or other study or training (e.g. Open University) during the past year. These two possibilities are combined into the indicator *newqual* which refers to having a new qualification of either type during the previous year. As elsewhere in BHPS, the reference period for this question goes back to 1 September of the previous year, with interviews concentrated in the September-November period, but ranging for some people into the new year.

We supplemented the variable *newqual* with whether the employer had financed the study during the past year. If there was a *newqual* and the employer had funded or been the location of the training, i.e. had paid the fees or provided it, then *workqual* took the value 1. A range of training possibilities fed into this variable, since in each case the respondent was asked separately who paid for the training. The variable *workqual* refers to a subset of cases which have a *newqual.*

Finally we also recorded education, both full and part-time, during the past year. This variable, *neweduc,* records training which may or may not be leading to any qualification. Again, if the employer paid for or provided any training, then a second variable *workeduc* (which refers to a subset of *neweduc*) records this possibility.

Mothering

We used all six Waves of BHPS to record any evidence of mothering, and we recorded separately whether a woman was presently responsible for a child in the household, and whether a woman had ever had a natural born child. The question on natural born

children was only asked in some Waves, and we therefore checked all 11 Waves seeking this evidence of ever-motherhood (*formother* referring to having ever mothered as a mutually exclusive variable with *mothering* which means mothering now). In some Waves there was no direct questioning about natural parenting. In other cases, people who had been in the survey previously were not asked this question due to routing decisions. Given all the evidence that could be garnered, we have created the two alternative variables for mothering which, if anything, would perhaps be an under-representation of mothering. More accurate records are kept of having a child in the household (*mothering*), and such children need not be the natural child of the respondent to count here.

Tenure in the current job (*insider, outsider, yearsjob)*
The respondent who is currently working reported their years of experience in the present job (in days). This variable is simplified into three categories: insider, intermediate, and outsider. The intermediate category acts as the base category, and insider status is defined as having four years or more in the current job. Outsider status is defined as having been in this job for just one year or less. As seen elsewhere, the person's tenure affects their ability to achieve wage increases from within the enterprise. The continuous scale of years of tenure is an alternative specification which we tested and found to be of similar levels of significance.

Segregation (*segpoint)*
Occupational segregation by sex is widely understood to have a negative impact on women's employment, so we built a variable to capture this. Segregation is really a collective rather than an individual attribute. We constructed a variable to measure the extent to which an individual was experiencing segregation, i.e. the degree to which person was employed in an occupational group that was more or less peopled by men in the aggregate. The higher the proportion of men in the occupational group in which our individual respondent was employed, the greater the value of the segregation variable. Segregation is measured as ten times the ratio of the percent male among all workers in a given occupational grouping. We use the two-digit level of the Standard Occupational Classification. The level of segregation of a particular occupation is obtained from the larger Labour Force Survey, rather than the smaller BHPS data set, and then applied to the individual. This ratio is designed to capture a specific dimension of segregation, that is, the extent to which men are predominant. The Standard Occupational Classification was revised in 2001, giving a much lower number of main categories with less detail and larger numbers in each. We have not used this new system of classification, although it is available in the BHPS from 2002 onward for comparison.

Labour market and industry
Part-time: we constructed a simple Boolean variable showing whether individuals (men and women) were employed full-time (30 or more hours per week) or part-time (less than 30 hours per week).

Region: we tested for the significance of a regional effect in each of the regions. The indicators for London and the South East were significantly positive, and the indicators

for certain central English regions and the Welsh region were significantly negative. The base case is chosen as the 'rest of West Midlands' outside the Birmingham conurbation.

The full list of regions is given below:

1. Inner London
2. Outer London
3. Rest of South East
4. South West
5. East Anglia
6. East Midlands
7. West Midlands Conurbation
8. Rest of West Midlands
9. Greater Manchester
10. Merseyside
11. Rest of North West
12. South Yorkshire
13. West Yorkshire
14. Rest of Yorkshire and Humber
15. Tyne and Wear
16. Rest of North
17. Wales
18. Scotland

[Northern Ireland is available for the year 2002 but we did not use these data.]

Industry: we include information on industrial sector by Standard Industrial Classification 1980 (SIC) at one-digit level. We constructed dummy variables for each industrial sector, taking SIC 7 (transport and communications) as the base case.

The full list of SIC categories is:

0. Agriculture, forestry and fishing
1. Energy and water supplies
2. Extraction of minerals … manufacturing … and chemicals
3. Metal, engineering, and auto industries
4. Other manufacturing industries
5. Construction
6. Distribution, hotels, catering, repairs
7. Transport and communication
8. Banking, finance, insurance, and business services and leasing
9. Other services

Since 1992, a fresh SIC categorisation has been available, but this one is not used here.

Public sector: we created a dummy variable to capture whether people were working in the public or private sector.

Firm size: in order to capture whether people were working in firms of 50 or more workers, we created a dummy variable. We also have a dummy variable for people working in firms of 25-49 people, leaving the smallest firms as the base case.

Unions: in the BHPS, two dummy variables show unionisation. First, whether the respondent was in a union or staff association (*inunion*), and second whether there was a union or staff association at the respondent's place of work (*haveunion)*. Since only the first was significant in the wage regressions, the second variable was dropped.

Travel to work
We tested the *timetowork* in wage regressions. This variable measures the usual time taken to get to work in minutes. Travel time is highly correlated with pay and is very closely associated (indeed endogenous) with being well educated and professional.

Household and demographics
Children: in order to test whether or not the presence of children in the household was important, we created two dummy variables, one for how many children were in the household (*nkids*) and a second for whether there were any children aged 0-2 in the household (*haskidu2*).

Caring: in order to ensure that we have fully captured the range of unpaid care work, for instance, elder care, we created an additional dummy variable as to whether the respondent undertook any unpaid care work such as looking after a handicapped or ill relative. We allowed for unpaid care work that was being done outside the home, too, and, in addition, if a respondent said that they would 'nurse a sick child' themselves (as opposed to 'partner' or 'both' doing it) we recorded *docaring*=1.

Long-term limiting illness
We use BHPS questions about health and illness to create an indicator for sickness or disability which affects the ability to carry out work. Although the question wording varied slightly from year to year, BHPS does record once per person per year whether they felt they were unable due to sickness or disability to do some forms of work.

Minority ethnicities (nonwhite)
The BHPS is notable for its incomplete coverage of the minority ethnic groups of the UK. In weighted terms 4.7% of the survey respondents are non-white, which is lower overall than the national average. We do not wish to draw attention to the ethnicity effects in the wage equation since other survey data would be preferable to the BHPS for this purpose, but we did test an indicator variable *nonwhite* which controlled for possible ethnic cultural difference and/or discrimination.

Table A1.2 2002 means

All potential workers	*Women*		*Men*		*All potential workers*	
	a	b	a	b	a	b
Variable name	MEAN	STD ERR	MEAN	STD ERR	MEAN	STD ERR
Hourly real pay (£)	7.92	0.10	10.21	0.14	9.07	0.09
Log of hourly real pay (£)	1.91	0.01	2.16	0.01	2.04	0.01
Pay per week (£)	247.67	3.72	415.00	5.67	332.06	3.62
Hours worked per week	30.53	0.23	41.34	0.23	35.98	0.18
Current hours are part-time (<30)	0.27	0.01	0.05	0.00	0.17	0.00
Age of respondent this year	37.89	0.21	37.97	0.25	37.93	0.16
Whether married, i.e. have spouse	0.64	0.01	0.63	0.01	0.63	0.01
Whether ever a parent	0.07	0.00	0.08	0.00	0.07	0.00
Currently mothering	0.42	0.01	0.00	0.00	0.22	0.00
Formerly was mother	0.27	0.01	0.00	0.00	0.14	0.00
Education in years	12.26	0.05	12.60	0.05	12.42	0.03
New qualification in last 12 months	0.11	0.01	0.11	0.01	0.11	0.00
New qualification in last 12 months funded by workplace	0.05	0.00	0.06	0.00	0.06	0.00
New educational activity in last 12 months	0.30	0.01	0.29	0.01	0.30	0.01
New educational activity funded by workplace	0.16	0.01	0.17	0.01	0.16	0.00
Years worked full-time	7.20	0.14	12.51	0.25	9.72	0.14
Years worked part-time	3.19	0.10	0.25	0.02	1.80	0.06
Months of family care	46.24	1.38	0.81	0.20	24.71	0.80
Months of maternity	2.14	0.18	0.00	0.00	1.12	0.10
Months of unemployment	4.19	0.28	7.99	0.42	5.99	0.25
Months on sick leave	3.34	0.36	4.16	0.39	3.73	0.26
Years in the current job	5.25	0.11	5.13	0.12	5.19	0.08
Whether insider (>4 years in this job)	0.40	0.01	0.38	0.01	0.39	0.01
Whether outsider (<1 year in this job)	0.29	0.01	0.31	0.01	0.30	0.01
Segregation (SOC2 male %x10)	3.18	0.04	6.70	0.06	4.96	0.04
Segregation (SOC3 male %x10)	2.82	0.05	7.13	0.06	5.00	0.05
Segregation (ISCO 4 male %x10)	2.93	0.05	7.06	0.06	5.02	0.05
Firm size 500+	0.11	0.01	0.15	0.01	0.13	0.00
Firm size 50-499	0.23	0.01	0.32	0.01	0.27	0.01
Firm size 25-49 Workers	0.11	0.01	0.12	0.01	0.11	0.00
Public sector	0.29	0.01	0.16	0.01	0.23	0.01
Is in union or association	0.21	0.01	0.23	0.01	0.22	0.01
Union or association exists	0.35	0.01	0.37	0.01	0.36	0.01
Time to get to work (minutes)	15.07	0.31	20.46	0.46	17.63	0.27
Have a condition that inhibits work	0.15	0.01	0.13	0.01	0.14	0.00
Whether they do unpaid caring	0.23	0.01	0.08	0.01	0.16	0.00
Number of kids 16 or less in household	0.75	0.02	0.65	0.02	0.70	0.01
Have a child under 2 in household	0.06	0.00	0.05	0.00	0.05	0.00
Age of youngest child	7.27	0.12	7.40	0.14	7.32	0.09
Age of respondent	37.89	0.21	37.97	0.25	37.93	0.16
Household income (£ per year)	31907.49	341.10	34505.52	375.43	33138.90	253.35
Whether nonwhite ethnicity	0.05	0.00	0.05	0.00	0.05	0.00

Table A1.2 (continued)

Those currently employed	*Women*		*Men*		*All potential workers*	
	a	b	a	b	a	b
Variable name	MEAN	STD ERR	MEAN	STD ERR	MEAN	STD ERR
Hourly real pay (£)	7.93	0.10	10.21	0.14	9.08	0.09
Log of hourly real pay (£)	1.91	0.01	2.16	0.01	2.04	0.01
Pay per week (£)	246.40	3.78	416.22	5.76	332.30	3.69
Hours worked per week	30.50	0.23	41.35	0.23	35.99	0.18
Current hours are part-time (<30)	0.38	0.01	0.06	0.01	0.22	0.01
Age of respondent this year	37.94	0.25	38.43	0.27	38.19	0.18
Whether married, i.e. have spouse	0.66	0.01	0.68	0.01	0.67	0.01
Whether ever a parent	0.06	0.00	0.07	0.00	0.07	0.00
Currently mothering	0.37	0.01	0.00	0.00	0.18	0.01
Formerly was mother	0.28	0.01	0.00	0.00	0.14	0.01
Education in years	12.67	0.05	12.92	0.05	12.79	0.04
New qualification in last 12 months	0.12	0.01	0.11	0.01	0.12	0.00
New qualification in last 12 months funded by workplace	0.06	0.00	0.07	0.01	0.07	0.00
New educational activity in last 12 months	0.36	0.01	0.32	0.01	0.34	0.01
New educational activity funded by workplace	0.21	0.01	0.20	0.01	0.20	0.01
Years worked full-time	8.16	0.18	13.81	0.27	11.02	0.17
Years worked part-time	3.78	0.13	0.28	0.03	2.01	0.07
Months of family care	34.24	1.30	0.45	0.21	17.15	0.71
Months of maternity	2.21	0.22	0.00	0.00	1.09	0.11
Months of unemployment	3.36	0.23	5.52	0.33	4.46	0.20
Months on sick leave	0.66	0.18	0.43	0.09	0.54	0.10
Years in the current job	4.33	0.11	5.06	0.14	4.70	0.09
Whether insider (>4 years in this job)	0.34	0.01	0.36	0.01	0.35	0.01
Whether outsider (<1 year in this job)	0.32	0.01	0.31	0.01	0.31	0.01
Segregation (SOC2 male %x10)	3.18	0.04	6.70	0.06	4.96	0.04
Segregation (SOC3 male %x10)	2.82	0.05	7.13	0.06	5.00	0.05
Segregation (ISCO 4 male %x10)	2.93	0.05	7.06	0.06	5.02	0.05
Firm size 500+	0.16	0.01	0.19	0.01	0.17	0.01
Firm size 50-499	0.32	0.01	0.39	0.01	0.35	0.01
Firm size 25-49 Workers	0.15	0.01	0.14	0.01	0.14	0.01
Public sector	0.39	0.01	0.20	0.01	0.29	0.01
Is in union or association	0.29	0.01	0.29	0.01	0.29	0.01
Union or association exists	0.48	0.01	0.46	0.01	0.47	0.01
Time to get to work (minutes)	20.78	0.38	25.18	0.52	23.01	0.33
Have a condition that inhibits work	0.10	0.01	0.08	0.01	0.09	0.00
Whether they do unpaid caring	0.24	0.01	0.08	0.01	0.16	0.01
Number of kids 16 or less in household	0.61	0.02	0.66	0.02	0.63	0.01
Have a child under 2 in household	0.04	0.00	0.05	0.00	0.05	0.00
Age of youngest child	7.74	0.15	7.27	0.16	7.50	0.11
Age of respondent	37.94	0.25	38.43	0.27	38.19	0.18
Household income (£ per year)	34875.20	406.66	37427.46	413.73	36166.24	290.88
Whether nonwhite ethnicity	0.04	0.00	0.04	0.00	0.04	0.00

Table A1.2 (continued)

Those currently employed part-time	*Women*		*Men*		*All potential workers*	
	a	b	a	b	a	b
Variable name	MEAN	STD ERR	MEAN	STD ERR	MEAN	STD ERR
Hourly real pay (£)	8.43	0.13	10.37	0.14	9.61	0.10
Log of hourly real pay (£)	1.99	0.01	2.19	0.01	2.11	0.01
Pay per week (£)	319.85	4.81	436.28	5.75	390.47	4.09
Hours worked per week	38.23	0.14	43.10	0.18	41.18	0.13
Current hours are part-time (<30)	0.00	0.00	0.00	0.00	0.00	0.00
Age of respondent this year	37.43	0.31	39.13	0.26	38.46	0.20
Whether married, i.e. have spouse	0.60	0.01	0.71	0.01	0.67	0.01
Whether ever a parent	0.05	0.00	0.07	0.00	0.07	0.00
Currently mothering	0.27	0.01	0.00	0.00	0.10	0.00
Formerly was mother	0.27	0.01	0.00	0.00	0.11	0.01
Education in years	13.01	0.07	12.96	0.06	12.98	0.04
New qualification in last 12 months	0.12	0.01	0.10	0.01	0.11	0.01
New qualification in last 12 months funded by workplace	0.08	0.01	0.07	0.01	0.07	0.00
New educational activity In last 12 months	0.40	0.01	0.32	0.01	0.35	0.01
New educational activity funded by workplace	0.25	0.01	0.20	0.01	0.22	0.01
Years worked full-time	9.51	0.24	14.38	0.28	12.46	0.20
Years worked part-time	2.44	0.13	0.21	0.03	1.09	0.06
Months of family care	24.55	1.38	0.46	0.23	9.94	0.60
Months of maternity	1.59	0.25	0.00	0.00	0.63	0.10
Months of unemployment	3.09	0.26	5.45	0.34	4.52	0.23
Months on sick leave	0.60	0.25	0.35	0.07	0.45	0.11
Years in the current job	4.22	0.14	5.27	0.15	4.86	0.11
Whether insider (>4 years in this job)	0.33	0.01	0.38	0.01	0.36	0.01
Whether outsider (<1 year in this job)	0.32	0.01	0.29	0.01	0.30	0.01
Segregation (SOC2 male %x10)	3.49	0.06	6.90	0.05	5.56	0.05
Segregation (SOC3 male %x10)	3.14	0.06	7.34	0.06	5.69	0.05
Segregation (ISCO 4 male %x10)	3.23	0.06	7.27	0.06	5.69	0.05
Firm size 500+	0.19	0.01	0.19	0.01	0.19	0.01
Firm size 50-499	0.36	0.01	0.39	0.01	0.38	0.01
Firm size 25-49 Workers	0.15	0.01	0.14	0.01	0.14	0.01
Public sector	0.39	0.01	0.20	0.01	0.27	0.01
Is in union or association	0.33	0.01	0.30	0.01	0.31	0.01
Union or association exists	0.52	0.01	0.47	0.01	0.49	0.01
Time to get to work (minutes)	23.58	0.51	25.63	0.53	24.83	0.38
Have a condition that inhibits work	0.09	0.01	0.07	0.01	0.08	0.00
Whether they do unpaid caring	0.20	0.01	0.08	0.01	0.13	0.01
Number of kids 16 or less in household	0.40	0.02	0.66	0.02	0.56	0.01
Have a child under 2 in household	0.03	0.00	0.06	0.00	0.04	0.00
Age of youngest child	8.41	0.22	7.05	0.16	7.47	0.13
Age of respondent	37.43	0.31	39.13	0.26	38.46	0.20
Household income (£ per year)	36897.67	532.53	37724.05	428.70	37398.88	334.05
Whether nonwhite ethnicity	0.05	0.01	0.04	0.00	0.04	0.00

Table A1.2 (continued)

Those currently employed full-time	*Women*		*Men*		*All potential workers*	
	a	b	a	b	a	b
Variable name	MEAN	STD ERR	MEAN	STD ERD	MEAN	STD ERR
Hourly real pay (£)	7.10	0.17	7.87	0.75	7.22	0.18
Log of hourly real pay (£)	1.78	0.02	1.77	0.06	1.78	0.02
Pay per week (£)	125.90	3.26	125.26	18.54	125.81	3.91
Hours worked per week	17.84	0.22	15.94	0.61	17.55	0.21
Current hours are part-time (<30)	1.00	0.00	1.00	0.00	1.00	0.00
Age of respondent this year	38.78	0.42	28.23	1.34	37.22	0.43
Whether married, i.e. have spouse	0.74	0.01	0.25	0.04	0.67	0.01
Whether ever a parent	0.07	0.00	0.04	0.01	0.06	0.00
Currently mothering	0.54	0.02	0.00	0.00	0.46	0.02
Formerly was mother	0.29	0.02	0.00	0.00	0.24	0.01
Education in years	12.12	0.09	12.32	0.20	12.15	0.08
New qualification in last 12 months	0.12	0.01	0.24	0.04	0.14	0.01
New qualification in last 12 months funded by workplace	0.04	0.01	0.04	0.02	0.04	0.01
New educational activity in last 12 months	0.29	0.02	0.30	0.04	0.29	0.01
New educational activity funded by workplace	0.13	0.01	0.11	0.03	0.13	0.01
Years worked full-time	5.94	0.23	5.49	0.92	5.87	0.24
Years worked part-time	5.98	0.25	1.21	0.28	5.27	0.22
Months of family care	50.14	2.46	0.30	0.19	42.74	2.19
Months of maternity	3.22	0.39	0.00	0.00	2.74	0.34
Months of unemployment	3.81	0.43	6.63	1.36	4.23	0.42
Months on sick leave	0.75	0.24	1.58	0.87	0.88	0.24
Years in the current job	4.50	0.20	1.93	0.30	4.12	0.17
Whether insider (>4 years in this job)	0.36	0.02	0.11	0.03	0.32	0.01
Whether outsider (<1 year in this job)	0.33	0.02	0.51	0.04	0.36	0.01
Segregation (SOC2 male %x10)	2.66	0.06	3.85	0.21	2.84	0.06
Segregation (SOC3 male %x10)	2.28	0.06	4.05	0.23	2.54	0.07
Segregation (ISCO 4 male %x10)	2.43	0.06	4.02	0.24	2.67	0.07
Firm size 500+	0.10	0.01	0.09	0.02	0.10	0.01
Firm size 50-499	0.25	0.01	0.34	0.04	0.26	0.01
Firm size 25-49 Workers	0.15	0.01	0.14	0.03	0.15	0.01
Public sector	0.40	0.02	0.19	0.03	0.37	0.01
Is in union or association	0.22	0.01	0.13	0.03	0.20	0.01
Union or association exists	0.42	0.02	0.28	0.04	0.40	0.02
Time to get to work (minutes)	16.18	0.48	18.69	2.55	16.56	0.56
Have a condition that inhibits work	0.12	0.01	0.13	0.03	0.12	0.01
Whether they do unpaid caring	0.31	0.02	0.05	0.02	0.27	0.01
Number of kids 16 or less in household	0.96	0.03	0.60	0.08	0.90	0.03
Have a child under 2 in household	0.06	0.01	0.03	0.01	0.06	0.01
Age of youngest child	7.23	0.19	10.26	0.57	7.57	0.19
Age of respondent	38.78	0.42	28.23	1.34	37.22	0.43
Household income (£ per year)	31557.56	611.69	33126.46	1560.05	31790.50	570.67
Whether nonwhite ethnicity	0.03	0.01	0.08	0.03	0.03	0.01

Source: British Household Panel Survey, 2001/2.

APPENDIX 2: CROSS-CORRELATIONS OF VARIABLES

Table A2.1 Correlation matrix of all variables among potential workers

	kln~lpay	kfemale	kedscale	kfully~r	kfully~q	kparty~r	kparty~2
klnhourlyr~y	1.0000						
kfemale	-0.2475	1.0000					
kedscale	0.4131	-0.1016	1.0000				
kfullyear	0.1402	-0.3880	-0.0537	1.0000			
kfullyrsq	0.0797	-0.3446	-0.0718	0.9374	1.0000		
kpartyear	-0.2306	0.4047	-0.1481	-0.2246	-0.2043	1.0000	
kpartyear2	-0.1689	0.2711	-0.1355	-0.1632	-0.1460	0.9202	1.0000
kmonthfam	-0.2947	0.4454	-0.2789	-0.2823	-0.2311	0.1981	0.1313
kmonthunem	-0.1313	-0.1647	-0.1299	-0.1092	-0.0772	-0.0966	-0.0791
kinside	-0.0096	0.0200	-0.1738	0.0969	0.0697	0.0709	0.0935
koutside	0.0206	-0.0187	0.1079	-0.0253	-0.0051	-0.0325	-0.0466
kworkeduc	0.1641	-0.0156	0.2544	0.0151	-0.0064	0.0323	-0.0313
kneweduc	0.1343	0.0197	0.3089	-0.0134	-0.0269	0.0022	-0.0100
ksegpoint	0.2131	-0.6240	0.0302	0.2827	0.2495	-0.3620	-0.2525
kfirm500	0.1605	-0.0664	0.1157	0.0675	0.0413	-0.0470	-0.0411
kfirm50	0.0847	-0.1277	0.1055	0.1178	0.0903	-0.0561	-0.0456
kfirm2549	-0.0310	0.0049	0.0625	0.0254	0.0193	0.0123	0.0039
kpublic	0.1137	0.1522	0.2357	0.0109	-0.0079	0.1441	0.1014
kinunion	0.1800	-0.0383	0.1723	0.1381	0.0885	-0.0159	-0.0167
kdocaring	-0.1164	0.2310	-0.0353	-0.0696	-0.0455	0.1519	0.0808
khavekidu2	0.0327	-0.0291	0.0670	-0.1040	-0.0955	-0.0845	-0.0669
knkids	-0.0068	0.0443	0.0439	-0.2404	-0.2167	-0.1137	-0.1342
kage	-0.0370	0.0041	-0.2506	0.5352	0.4738	0.2922	0.2820
kage2	-0.0563	0.0022	-0.2546	0.5076	0.4621	0.2843	0.2825
kllti	-0.0950	0.0375	-0.1808	-0.0239	-0.0139	0.0234	0.0132
khousinc	0.4535	-0.0492	0.3016	0.0832	0.0336	-0.0423	-0.0458
khousinc2	0.3267	-0.0135	0.2083	0.0499	0.0167	-0.0368	-0.0342
kspousern	0.0343	0.2047	0.1246	-0.0788	-0.0951	0.0834	0.0331
kspousern2	0.0315	0.1199	0.0502	-0.0459	-0.0547	0.0338	0.0116

	kmont~am	kmont~em	kinside	koutside	kworke~c	kneweduc	ksegpo~t
kmonthfam	1.0000						
kmonthunem	-0.0851	1.0000					
kinside	0.1302	-0.0200	1.0000				
koutside	-0.0830	0.0336	-0.4950	1.0000			
kworkeduc	-0.0997	-0.0638	-0.0736	0.0649	1.0000		
kneweduc	-0.0974	-0.0733	-0.0774	0.0922	0.7220	1.0000	
ksegpoint	-0.3525	0.0891	0.0199	-0.0135	-0.0120	-0.0526	1.0000
kfirm500	-0.1228	-0.0664	-0.0402	0.0457	0.0882	0.0866	0.0300
kfirm50	-0.1503	-0.0537	-0.0376	0.0140	0.0688	0.0599	0.1289
kfirm2549	-0.0466	-0.0122	-0.0496	0.0293	0.0470	0.0429	-0.0249
kpublic	-0.0629	-0.0958	0.0147	-0.0270	0.1863	0.2078	-0.2894
kinunion	-0.1640	-0.1039	0.1489	-0.0875	0.1661	0.1717	0.0059
kdocaring	0.1122	-0.0099	0.0260	-0.0249	-0.0028	0.0306	-0.2119
khavekidu2	-0.0878	0.0008	-0.0785	0.0480	-0.0070	-0.0221	0.0298
knkids	-0.0080	0.0338	-0.0536	0.0457	-0.0499	-0.0205	0.0015
kage	0.3325	-0.0231	0.2937	-0.2058	-0.0826	-0.0979	-0.0338

Table A2.1 (continued)

kage2	0.3487	-0.0255	0.2825	-0.1976	-0.0901	-0.1037	-0.0340
kllti	0.1417	0.1091	0.0958	-0.0871	-0.0951	-0.0908	-0.0683
khousinc	-0.1364	-0.1841	-0.0079	0.0544	0.1680	0.1597	0.0463
khousinc2	-0.0808	-0.1165	-0.0124	0.0499	0.1099	0.0990	0.0124
kspousern	0.0016	-0.1262	0.0046	0.0053	0.0636	0.0858	-0.1889
kspousern2	0.0119	-0.0516	0.0300	-0.0141	0.0227	0.0341	-0.1013

	kfirm500	kfirm50	kfi~2549	kpublic	kinunion	kdocar~g	khavek~2
kfirm500	1.0000						
kfirm50	-0.2505	1.0000					
kfirm2549	-0.1397	-0.1665	1.0000				
kpublic	0.1448	0.0841	0.1141	1.0000			
kinunion	0.1777	0.1770	0.0696	0.4469	1.0000		
kdocaring	-0.0222	-0.0362	-0.0034	0.0845	0.0012	1.0000	
khavekidu2	-0.0080	0.0035	-0.0093	0.0125	0.0270	-0.0584	1.0000
knkids	-0.0285	-0.0175	-0.0191	-0.0256	-0.0252	0.1465	0.2688
kage	-0.0581	-0.0443	-0.0198	0.0312	-0.0075	0.0459	-0.2124
kage2	-0.0612	-0.0540	-0.0228	0.0151	-0.0268	0.0319	-0.1978
kllti	-0.0731	-0.1383	-0.0739	-0.0983	-0.1215	0.0296	-0.0534
khousinc	0.1047	0.1186	0.0096	0.1061	0.1327	-0.0288	0.0334
khousinc2	0.0569	0.0894	-0.0102	0.0600	0.0554	-0.0246	0.0176
kspousern	0.0030	0.0282	-0.0091	0.0882	0.0435	0.0855	0.0459
kspousern2	-0.0143	0.0015	-0.0060	0.0276	0.0030	0.0603	0.0248

	knkids	kage	kage2	kllti	khousinc	khousi~2	kspous~n
knkids	1.0000						
kage	-0.3245	1.0000					
kage2	-0.3448	0.9877	1.0000				
kllti	-0.0555	0.1886	0.1934	1.0000			
khousinc	-0.0218	-0.0507	-0.0695	-0.1727	1.0000		
khousinc2	-0.0337	-0.0292	-0.0397	-0.1101	0.8703	1.0000	
kspousern	0.1069	-0.0661	-0.0874	-0.1010	0.5350	0.4533	1.0000
kspousern2	0.0514	-0.0228	-0.0326	-0.0410	0.3842	0.4606	0.7195

Notes: These are weighted Pearson's R values.

Source: British Household Panel Survey, 2001/2, Wave K.

Table A2.2 Correlation of the IMR, the individual heterogeneity, and other variables

	u[i]	u[i] by KE et al.	IMR	weight	mothering	former mother	currently part-time	time to work	newqual	neweduc	workqual
u[i]	**1**										
u[i] by KE et al.	**0.9678**	1									
Imr	**-0.2664**	-0.2589	**1**								
Wgt	**-0.1495**	-0.1243	**-0.0443**	1							
mothering	**-0.0347**	-0.157	**0.0564**	-0.0782	1						
formother	**-0.1467**	-0.2248	**0.0306**	0.0394	-0.2223	1					
part-time	**-0.0804**	-0.166	**0.0278**	0.0063	0.2592	0.1146	1				
timetowork	**0.1878**	0.1992	**-0.2867**	0.0608	-0.138	-0.0716	-0.0031	1			
newqual	**0.0308**	0.0268	**-0.043**	0.0045	-0.0227	-0.0589	0.0096	0.0269	1		
neweduc	**0.114**	0.0996	**-0.1342**	0.0332	-0.0306	-0.0548	-0.0046	0.0951	0.5292	1	
workqual	**0.0432**	0.0434	**-0.0743**	-0.0042	-0.0385	-0.031	-0.028	0.0599	0.7085	0.3997	1
workeduc	**0.1187**	0.1131	**-0.1591**	0.021	-0.0576	-0.0268	-0.0447	0.1284	0.3904	0.6618	0.6045

Notes: u[i] refers to the casewise residual in the fixed-effects model

u[i] by KE et al. refers to the casewise residual in the model following the Kilbourne-England et al. method of using gender interaction effects.

IMR refers to the inverse Mills ratio, also known as the non-selection hazard or risk of not being selected into the labour market.

For all other variables, please refer to the list provided.

The factors reported here correspond to the six year panel after conducting fixed-effects analyses. See Appendix 5 for more details.

Source: British Household Panel Survey, 1991/2 to 2001/2.

APPENDIX 3: REGRESSION EQUATION

In this appendix the detailed regression results are presented. We provide three technical comments before presenting the regression coefficients.

Technical adjustments to the model
First, the BHPS sample is weighted so as to bring it into line with the British population.

Second, a number of controls were included in the model, which are not shown in the summary table (Table 2.4). The most important of these were region and industrial sector (see Appendix A1 for details). The regions of Great Britain each have slightly differing labour market conditions, and we have controlled for these differences. The vacancy rates and unemployment rates are different; the London Weighting raises wages in that region; and the industrial and political history of Scotland and Wales, as well as of the English regions, may cause labour markets to vary. The regional variables are significant, with London and South East wages being higher, and certain other areas having lower wages than the Midlands base case.

Controls for industrial sector were also included. We used the Standard Industrial Classification (1980) indicators at the one-digit level, and SIC 7 as the base case. Some of these have positive or negative and significant associations with the wage rate, for instance finance (SIC 8) has a positive and significant association with the wage rate. The reasons include technical and capital inputs to production processes; different ways of managing labour, which are relatively specific to each industry; the role of international firms versus local firms; and the public versus the private sector, in each industry. To the extent that a sector has a notable wage differential, we have extracted it. We keep these control variables in the wage equations throughout this report.

Third, the wage regression has been adjusted for those not currently participating in the labour market. The regression analysis of the wage rates additionally includes an adjustment that accounts for the different propensities of women to be in employment. This Heckman-type adjustment contains a number of demographic and household variables that are known to affect participation in employment. The adjustment for employment participation improves the accuracy of the wage model.

Several factors affect whether women join the labour market.[6] They include demographic characteristics and factors associated with spouse's and household income. These are shown in detail in Table A3.1 and in a summary format in Table A3.2. Increased age initially increases the likelihood of being in employment, but the effect is 'curved', so that the oldest people of working age have lesser likelihood of employment. The number of children, especially very young children, reduces the likelihood of employment. Having a higher household income is initially associated with a greater likelihood of being employed, but again the relationship is curved, so it tails off at high incomes, with the highest levels of household income associated with very slightly lower levels of employment. Having a high earning spouse is associated with a reduced

[6] The probit model has as its outcome the probability of being employed in 2002.

likelihood of employment, though again the effect is curved. Unsurprisingly, having a long-term limiting illness reduces the likelihood of employment.

Regression results

Table A3.1 Details of the regression (Model 1)

Dependent variable is the log wage among all potential workers				
	Coefficient	**Standard error**	**T-Statistic**	**Significance**
The Wage Equation (Table 3.1):				
female	-0.0891	0.0231	-3.86	0.00
formerly a mother	-0.0233	0.0284	-0.82	0.41
mothering currently	0.0109	0.0254	0.43	0.67
education, FT, scaled (years)	0.0565	0.0029	19.38	0.00
full-time years in the work history	0.0259	0.0018	14.65	0.00
full-time years, squared	0.0000	0.0000	-10.97	0.00
part-time years in the work history	-0.0078	0.0041	-1.89	0.06
part-time years, squared	0.0004	0.0002	2.09	0.04
months of unemployment	-0.0018	0.0005	-3.49	0.00
months of family care	-0.0007	0.0002	-4.15	0.00
months of maternity leave	0.0004	0.0008	0.55	0.59
insider (job tenure >4 years)	-0.0035	0.0168	-0.21	0.83
outside (job tenure <1 year)	-0.0300	0.0180	-1.67	0.10
recent education funded by employer	0.0229	0.0178	1.29	0.20
recent education non-work funded	-0.0591	0.0221	-2.68	0.01
segregation (male %x10)	0.0127	0.0032	4.03	0.00
firm size 500+	0.1171	0.0195	6.02	0.00
firm size 50-499	0.0620	0.0172	3.61	0.00
firm size 25-49	-0.0063	0.0213	-0.30	0.77
public	0.0820	0.0252	3.26	0.00
Inunion	0.0633	0.0160	3.96	0.00
region_1	0.1772	0.0561	3.16	0.00
region_2	0.0998	0.0464	2.15	0.03
region_3	0.0712	0.0392	1.81	0.07
region_4	-0.0450	0.0421	-1.07	0.29
region_5	-0.0742	0.0469	-1.58	0.11
region_6	-0.0597	0.0415	-1.44	0.15
region_7	-0.0995	0.0471	-2.11	0.04

Table A3.1 (continued)	Coefficient	Standard error	T-Statistic	Significance
region_9	0.0130	0.0539	0.24	0.81
region_10	-0.0695	0.0543	-1.28	0.20
region_11	-0.0493	0.0547	-0.90	0.37
region_12	-0.0876	0.0495	-1.77	0.08
region_13	-0.0441	0.0501	-0.88	0.38
region_14	-0.0512	0.0522	-0.98	0.33
region_15	-0.0276	0.0565	-0.49	0.63
region_16	-0.0788	0.0469	-1.68	0.09
region_17	-0.0410	0.0390	-1.05	0.29
region_18	-0.0041	0.0381	-0.11	0.91
SIC 0 Agriculture, forestry & fishing	-0.0097	0.1090	-0.09	0.93
SIC 1 Energy and water supplies	0.2134	0.0587	3.63	0.00
SIC 2 Extraction of minerals … manufacturing … and chemicals	0.1926	0.0419	4.60	0.00
SIC 3 Metal, engineering, and auto industries	0.1372	0.0327	4.19	0.00
SIC 4 Other manufacturing industries	0.0168	0.0347	0.49	0.63
SIC 5 Construction	0.0826	0.0409	2.02	0.04
SIC 6 Distribution, hotels, catering, repairs	-0.0430	0.0319	-1.35	0.18
SIC 8 Banking, finance, insurance, business services etc	0.2746	0.0332	8.27	0.00
SIC 9 Other services	0.0891	0.0339	2.62	0.01
Constant	1.1133	0.0705	15.78	0.00
The Probit Equation (Table 2.4)				
do unremunerated caring	-0.0461	0.0282	-1.64	0.10
have child age 0-2	-0.1000	0.0421	-2.38	0.02
number of children in household	-0.1807	0.0125	-14.43	0.00
age	0.1451	0.0066	21.90	0.00
age squared	-0.0018	0.0001	-21.56	0.00
long-term limiting illness	-0.6600	0.0411	-16.06	0.00
household income	0.0000	0.0000	23.92	0.00
household income, squared	0.0000	0.0000	-10.25	0.00
spouse’s earnings, gross £/month	-0.0001	0.0000	-6.16	0.00
spouse’s earnings, squared	0.0000	0.0000	0.27	0.78
Constant in the probit equation	-2.6333	0.1241	-21.22	0.00

Table A3.1 (continued)	**Coefficient**	**Standard error**	**T-Statistic**	**Significance**
Rho	-0.6825	0.0340		
Sigma	0.4978	0.0117		
Lambda (the coefficient on the non-selection hazard)	-0.3397	0.0224		

Notes: Please see Appendix 1 for details of the variables, including the regions' names by number.

Source: British Household Panel Survey, 2001/2.

In this regression, the IMR value or non-selection hazard averaged .43 among men and .47 among women, illustrating that working-age women had a higher probability of non-participation in the labour market. There were 9,365 weighted cases based upon 10,543 raw individuals of working age.

APPENDIX 4: DECOMPOSITION BY ALTERNATIVE METHODS

This section presents details of the main decomposition of the gender wage gap and compares the results with those obtained using more traditional techniques. We begin with the simulation approach to decomposition, and then describe the two-term and three-term Oaxaca decomposition results using the same data.

The simulation approach multiplies a hypothesised change in an independent variable by the coefficient that corresponds to that variable. The equation represented in the gross decomposition by simulation is the sum of a series of terms, each denoted $\beta \cdot \Delta X$, such that the sum of the terms is equal to the gender pay gap. In this study, the gender pay gap is £2.28, and the proportionate effect of each hypothesised change can be represented as a percentage of this gap. Each term $\beta \cdot \Delta X$ refers to the slope, β, multiplied by the change in X. Each ΔX (described in Box 2.1 of the main text) is a difference of two means, e.g. the women's full-time work years is raised by 5.53 years, since women's full-time years averaged 7.57 and the men's averaged 13.10 years. Note that β is the slope obtained from a wage regression with men and women included. Table A4-1 ('change factor' column) shows the precise changes in the X variables that correspond to Box 2.1. The simulation effect is the product of β and this change factor.

The base for the calculation of the simulation effects, in percentages, is shown as 0.23 at the bottom of column 6 of Table A4-1. This figure is the sum of the simulation effects, taking into account only those items which are of interest. Factors which are assumed not to change, factors which are female-advantaging rather than male-advantaging, and factors which are in the 'control' group of variables have been omitted from this part. For instance, the female-advantaging 'public sector' variable is omitted from consideration here. Another example is that 'region' dummies, which are significant in the wage regression but not strongly gendered, are ignored for the purpose of the simulation. Further simulation analysis could explore the SIC controls or other variables, and would produce varying results based upon fresh assumptions. The sum of the simulation components is broken down into percentages of the actual pay gap, which is £2.28 or 25% of the men's mean wage. See Table A4-1, columns 6 and 7.

The only negative components in column 6 of Table A4-1 reflect the changed sign on a variable's squared value. These negative values lessen the impact of the variable at the mean, and give a curved response of the wage to the variable (e.g. work experience). Any term that reflects female advantage, instead of male advantage, is omitted from the simulation.

In the more traditional decomposition methods, the components which are being summed include both positive and negative (offsetting) components. The rest of this section explains this anomaly and explores the results that would have been obtained using a traditional decomposition method.

In the rest of this section, we explore the main decomposition methods further, providing the equations that make it possible to compare them. In comparing them, the 'negative'

components, i.e. female advantage components, turn out to be very important. We have defined the simulation decomposition in a way that deliberately avoids the problem of negative, offsetting components. That way the summing up is transparent and is sure to sum up to the gender pay gap. An apparent anomaly, which is that negative components appear when an effect is curved, is deliberately used to allow the mathematics to show the tailing-off of an effect at higher levels of that variable.

Table A4.1 Details of the decomposition by simulation

	Men's average	Women's average	ΔX	β	$\beta \cdot \Delta X$	Simulated change as a % of the pay gap	Pence/hour £ equivalent
			Change factor	Overall coefficient	Simulation effect		
Female	0.00	1.00	-1.00	-0.09	0.09	0.38	0.87
Currently mothering	0.00	0.28	-0.28	-0.02	0.01	0.03	0.06
Education (years)	12.63	12.31	+.32	0.06	0.02	0.08	0.18
Years of full-time work	13.10	7.57	+5.53	0.026	0.14	0.61	1.40
Years of full-time work squared	4035.90	1476.88		-0.00004	-0.10	-0.42	-0.96
Years of part-time work	0.26	3.35	-3.09	-0.008	0.02	0.10	0.24
Years of part-time work squared	1.95	42.52		0.00041	-0.02	-0.07	-0.16
Months of unemployment	8.37	4.43		-0.0018		0.00	0.00
Months of family care	0.77	48.57	-47.8	-0.00069	0.03	0.14	0.32
Months on maternity	0.00	2.26		0.00		0.00	0.00
Insider, >4 years tenure in job	0.38	0.39		0.00	0.00	0.00	0.00
Outsider, <1 year tenure in job	0.31	0.30		-0.03	0.00	0.00	0.00
Recent education employer funded	0.17	0.16		0.02	0.00	0.00	0.00
Recent education not employer funded	0.12	0.15		-0.06	0.00	0.01	0.01
Segregation (male% x 10)	6.79	3.15	+1.85	0.01	-0.02	0.10	0.22
Firm size 500+ workers	0.15	0.12	+0.03	0.12	0.00	0.02	0.04
Firm size 50+ workers	0.32	0.23	+0.09	0.06	0.01	0.02	0.05
Firm size 25-49 (<25 is base case)	0.11	0.11	no change	-0.01	0.00	0.00	0.00
In public sector	0.16	0.29	no change				
In union or staff association	0.23	0.21	no change	0.06	0.00	0.01	0.02
Selectivity term	0.39	0.51		-0.34	0.04		0.00
Constant in the wage equation	1.00	1.00		1.11	0.00		
					Sum of components	Sum	Sum (£/hr)
					0.23	1.00	2.28

Notes: Terms reflecting the region and the SIC industry were included as controls.

Source: British Household Panel Survey, 2001/2.

The overall conclusion is that the results from competing methodologies are broadly similar, as long as we only consider the 'explained components' of the traditional Oaxaca technique. However, the results differ considerably if the remaining components of the Oaxaca technique are taken into account. For the purposes of this report, the Oaxaca components thought to reflect 'discrimination' are all located in the unexplained components of the gender wage gap decomposition. The gender component of discrimination is completely hidden in the older Oaxaca-Blinder approach so there is an *a priori* reason to prefer some modified version. The newer Oaxaca-Ransom approach partially solves the problem, but still has deep difficulties with the 'unexplained' part of the gender pay gap. Therefore, the use of the Oaxaca two-term approaches is incoherent and does not contribute sensible findings to the analysis of the gender pay gap. In particular, the slope coefficient differences are inter-dependent with the intercept differences of two separate equations (men's and women's wage equations); and the constant terms of these two equations differ considerably.

The decomposition of the causes of the gender wage gap presented in the report was based upon a simulation approach. The simulation approach to decomposition was described in Walby and Olsen (2002). We estimate the change in hourly wage returns that would occur if women's conditions changed to reflect the best or the average situation among men.

According to the method of Oaxaca-Blinder, however, the full decomposition of the wage gap is offered by:

$$\ln\left(\frac{w_m}{w_f}\right) = \ln w_m - \ln w_f = (\overline{X}_m - \overline{X}_f)\,\beta_m + (\beta_m - \beta_f)\,\overline{X}_f \quad \text{(Eq. 1)}$$

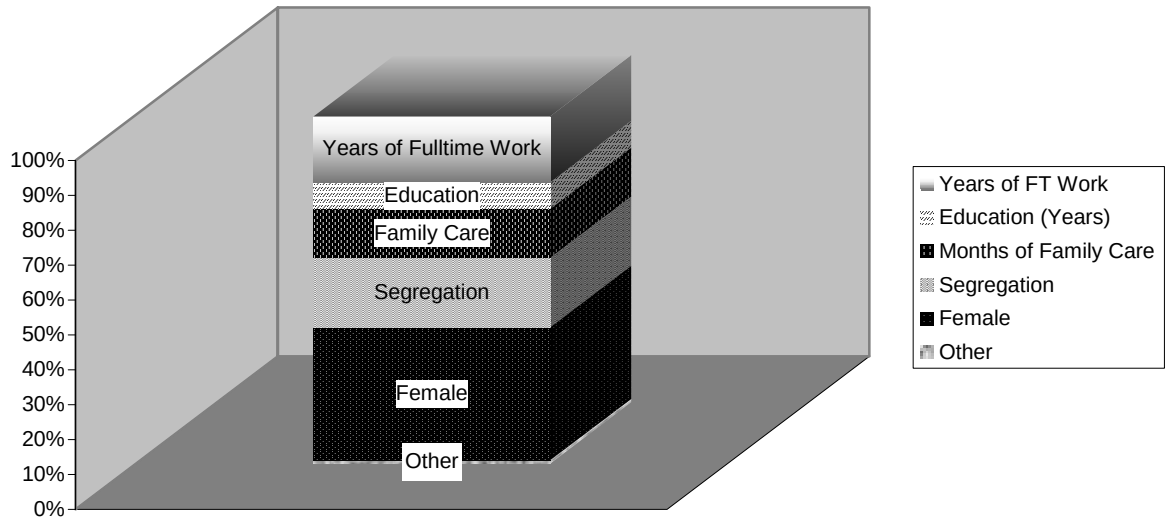
In this equation men's and women's wages are logged and compared on the left. The effects on productivity of gendered differences in levels of the variables are shown in the first term on the right. The second term is considered to represent the discrimination element in wage determination, since if the men's slope coefficient exceeds that for women, then a male advantage appears.

Oaxaca and Ransom (1999) shifted to the labels 'endowments' (Term 1) and 'entitlements' (Term 2). Other authors use slightly varying terminology. An alternative specification, corresponding to the work of Oaxaca-Ransom (1988, 1994), can allow for male-female difference whilst recognising the huge size of women's labour-force involvement in Britain's relatively integrated labour market. There are now three terms:

$$\ln(\text{Gap}+1) = \ln\left(\frac{w_m}{w_f}\right) = (\beta_m - \beta^*)\,\overline{X}_m + (\beta^* - \beta_f)\,\overline{X}_f + (\overline{X}_m - \overline{X}_f)\,\beta^* \quad \text{(Eq. 2)}$$

This three-term equation uses both the single-sex equations and the whole labour-market wage equation, the coefficients of which are denoted here with ß*. Positive values of each term are argued to represent male wage advantage, and negative terms female wage disadvantage (see Oaxaca and Ransom, 1988, 1994; Neilsen, 2000). For an illustration, see Olsen and Coppin (2001).

Figure A4.1 Decomposition for 2002 based upon three-term Oaxaca and Ransom method



Notes: The y-axis here is again in logwage units, i.e. % of the male wage.

Source: British Household Panel Survey, 2001/2.

The explained component of both Oaxaca decompositions would be based upon differences in the means for men and women of each independent variable. The 3-term method makes the separate men's and women's wage equation estimates less central. The intercept term (i.e. the 'constant') in the regressions underlying equations 1 and 2 has been seen as part of the unexplained component of the gender pay gap. In the three-term method, the male and female intercept terms are less important because an overall wage equation is also estimated. In a comparison of the decomposition of the gender pay gap over time, it is necessary to avoid having different portions of the gap remaining 'unexplained' by being placed (differentially) in the men's and women's intercepts at each time-point. Thus the 3-term Oaxaca-Ransom method is somewhat better than the 2-term Oaxaca-Blinder method.

The simulation method also assumes an integrated labour market in which men and women compete for the same jobs. It places the intercept for the wage equation as part of the joint wage explanation for both men and women together. Thus, there is a gender component of the gender pay gap which could not arise in the two-term Oaxaca-Blinder decomposition. For an illustration, please refer to Walby and Olsen (2002).

By contrast, the results from a Oaxaca-Ransom analysis are confused by off-setting male advantage and female disadvantage terms. 'Female advantage' appears to be common when decompositions are calculated for Britain (Table A4-2). These appearances are somewhat anomalous. For instance, the effect of working in the public sector *is* positive for women, but in many other cases, notably the effect of gender segregation, there is a false appearance of women having a higher slope and therefore more positive labour market experiences. Instead this apparent slope differential is intimately tied up with the differential intercepts of the 'women's' and 'men's' equations. The slope of a line is not easily distinguishable from the intercept

of that line (i.e. technically, the slope and intercept are not additively separable). However, the Oaxaca methods assume that when the slopes change, the resulting intercept change does not matter. As long as women's regression lines are estimated separately from men's, the intercept change implies a slippery basis for comparing slope differentials, and vice versa.

Table A4.2 Gender wage gap decomposition components for 2002 using Oaxaca-Ransom three-term method

	Male wage advantage	Female wage advantage	'Productivity differential'		Productivity differential as a % of gender wage gap
	Term 1	Term 2	Term 3	Sum	Per cent
Female	0.0000	-0.0891	0.0891	0.0000	38
Currently mothering	0.0000	-0.0011	0.0065	0.0055	3
Formerly was a mother	0.0000	-0.0073	-0.0045	-0.0118	-2
Education (years)	0.0142	0.0780	0.0180	0.1102	8
Years of full-time work	-0.0129	-0.0028	0.1429	0.1272	61
Years of full-time work squared	0.0065	0.0025	-0.0988	-0.0898	-42
Years of part-time work	-0.0001	-0.0023	0.0241	0.0216	10
Years of part-time work squared	0.0002	0.0012	-0.0166	-0.0152	-7
Months of unemployment	0.0018	0.0017	-0.0072	-0.0037	-3
Months of family care	-0.0008	-0.0041	0.0328	0.0279	14
Months on maternity	0.0000	-0.0006	-0.0010	-0.0015	0
Insider, >4 years tenure in job	0.0109	0.0087	0.0000	0.0196	0
Outsider, <1 year tenure in job	0.0013	0.0058	-0.0003	0.0067	0
Recent education employer funded	-0.0004	-0.0009	0.0002	-0.0011	0
Recent education not employer funded	-0.0005	-0.0004	0.0013	0.0003	1
Segregation (male% x 10)	-0.0796	-0.0555	0.0464	-0.0887	20
Firm size 500+ workers	0.0088	0.0075	0.0043	0.0206	2
Firm size 50+ workers	-0.0009	-0.0012	0.0055	0.0034	2
Firm size 25-49 (<25 is base case)	-0.0009	-0.0008	0.0000	-0.0017	0
In public sector	-0.0111	-0.0084	-0.0103	-0.0298	-4
In union or staff association	-0.0119	-0.0136	0.0016	-0.0239	1
Selectivity term	-0.0034	-0.0324	0.0397	0.0039	
Constant term	0.0650	0.0829	0.0000	0.1478	

Source: British Household Panel Survey, 2001/2.

The simulation decomposition has much in common with standardised regression coefficients. The use of a standardised regression coefficient emphasises the relative effect on the wage of a one-standard-deviation change in any particular X value. However, when binary variables are used, the idea of a one-standard-deviation unit change in the X variable is untenable and unrealistic. Instead, a full unit change in X is expected (from presence to absence, or vice versa) as seen here in the elimination of a residual gender effect. Therefore an explicit simulation, in which each variable is treated substantively and is examined to see how far a reasonable hypothetical change would affect the outcome, is even better than beta coefficients.

In discussions of this matter, some researchers have proposed that a closer examination of the distribution of wages at the lower and upper ends of the wage-spectrum be conducted (Rice, 1999; Beblo et al.., 2003a and 2003b). A methodology that compares the cumulative distribution of women's and men's wages (taken separately) allows for comparisons across the whole spectrum (Juhn et al.., 1993).

The decomposition that arises from the simulation method integrates the whole regression equation – constant, slopes and all – instead of trying to separate them. Like the Oaxaca-Ransom (1994, 1999) technique, but unlike the earlier Oaxaca (1973) technique, it uses the integrated labour market slopes, β^*, instead of trying to distinguish the β_f from the β_m. The simulation method refers directly to the labour market as it now operates, and hypothetically moves the market in ways that equalise men's and women's experiences. The elasticity of response to each X factor, which in several cases is not linear, will make the simulation method gradually further from reality as the hypothetical movement goes further from the existing situation. For this reason, in using simulation to see the effects of policy on the whole market [in Chapters 3-4 of this report], we isolate women so that the point estimates refer to the same population whose values are being changed.

Comparison of estimate with Walby and Olsen (2002)

A detailed comparison of the decompositions on the 2000 and 2002 BHPS data sets can be seen in Table A4.3.

Table A4.3 Components of the pay and productivity gap

Component	Women's average level compared with men's (cumulative up to 2000; 2002)	% of gap (2000)	% of gap (2002)	Component
Education	-0.3 years	-0.3 years	6%	7%
Full-time employment experience	-7.7 years~	-5.6 years~	26%	18%
Part-time employment experience	+4.1 years~	+3.8 years~	12%	3%*
Interruptions due to family care	+3.2 years~	+2.9 years~	15%	14%
Occupational segregation by gender (% male)	34% male vs. 70%	32% male vs. 67%	13%	10%
Firm size		Omitted from the decomposition; see Walby and Olsen, 2002: 107, for details	9%	
Mothering currently		Omitted from the analysis	3%	
Public sector		Omitted from the decomposition; see Walby and Olsen, 2002: 107, for details	Omitted from the decomposition but present in the regression^	
Being female		29%	38%	
Adjustment for labour-market participation		Not included*	Included*	
Total			100%	100%
Sources:			Walby and Olsen (2002: 67)	*Table 2.5 and Table A4-1 in this report*

APPENDIX 5: FIXED EFFECT MODEL DETAILS

In this section, we review the prospects for using a fixed effects model to tease out wage differentials that are specific to persons over time. The fixed effects model, presented in full in the second half of this Appendix, is primarily a supplement to the main gender pay gap results (not a substitute for them). The results reinforce the point that there is a residual 9% gender pay gap in wage-rates, all else having been allowed for.

A fixed-effects model offers an overview of the movement of wage-rates for individuals over the period 1992-2002. A fixed-effects model is a time-series regression in which every case (each person) is considered to have a series of different observations. Thus it uses the panel data structure that is available in the BHPS. By examining data from six points over a ten-year period, we found that wages rose on average by 2% per year in real terms. All of this change was accounted for by factors in the models, so there was no residual effect of time. In other words, the real wage rose to allow for productivity growth as measured by the human capital variables and the industrial sector control variables.

The fixed-effects model gives attention only to variables whose value changes (for the individual) over the period. Factors that are constant over time, such as gender, do not appear in the basic fixed-effects model.

Later in the Appendix we call the basic fixed-effects model Stage 1, corresponding to the existing literature. In Table A5-1, we review the propensity for variables' values to stay constant over time. If a person had a value repeated for at least two years, and for up to six years, they are seen as a 'stayer' for that variable in the fixed effects model. The measurement of the wage-response to a change in X values can only take account of the 'movers' – those who experience a change in an X value between two years. The movers plus the stayers add up to 100% of the cases in the time-series data.

Table A5.1 Movers and stayers in the 1991-2002 panel data

Age group	Education (years)	Full-time years	Part-time years	Segregation (male %)	Firm size 50-499
16-35 years	45/55*	74/26	36/64	98.8/1.2	38/62
36-49 years	24/65	67/33	31/69	99.5/0.5	29/71
50+ years	22/78	67/33	33/67	99.6/0.4	28/72

Notes: * 45/55 indicates 45% movers and 55% stayers.

Source: British Household Panel Survey, 1991/2 - 2001/2.

Since wages are estimated through a complex routine involving the most recent gross pay (e.g. a payslip), as well as hours worked, as recorded during each yearly interview visit, the wage values change for every worker in every year. The ratio of movers to stayers is shown in Table 2.5 for five explanatory variables across three age groups. For instance among the younger group, 45% of cases have a changed

level of education and 55% had a fixed level of education (across all six years of data). Naturally the number of 'movers' is much lower (22%) in the elder age group. The percentage who are movers with respect to the size of firm is similarly biased toward the young. The 38% shown as 'movers' have either joined or left a firm sized 50-499 workers (moving to either a smaller or larger firm) over time.

The number of movers is nearly 100% for the segregation variable, because its values were calculated afresh for each year (see Appendix 1 for details). The percentage male changed slightly in each occupation in each year, as it was estimated by matching Labour Force Survey results into the BHPS for each person's Standard Occupational Classification group in that year.

The number of raw cases in the time series analysis is 33,668, reflecting the pooled data for 11,622 different people over six years. On average, each person had three observations with a valid wage rate. Potential workers who are inactive in a given year were not used in the fixed-effects model, but their data were used in a preliminary stage to make an adjustment for labour force participation. As in the cross-sectional regressions which came earlier, a variable is created to allow for people entering and leaving the labour market. During their times of 'economic inactivity', people still make a labour force participation decision. Their re-entry into the labour market may provide a wage-rate which allows us to consider them as panel respondents in the wage regressions.

The variable used here to allow for people entering and leaving actually represents a range of demographic factors: doing unpaid caring work (either inside the household or outside it), having kids aged 0-2, the number of children in the household, age and age squared, whether health inhibits the ability to do work, household income and income squared, the spouse's gross monthly earnings (zero if no spouse) and spouse's earnings squared. The details of this are later in the Appendix. The technique of Heckman adjustment was thus carried through into the time series stage.

The implication of Table A5-1 is that some explanatory variables' effects are underestimated in the fixed effects model because there are so many 'stayers' - e.g. those who have completed their formal education.

The highest educational qualification is likely to remain constant over ten years for a range of people beyond school age. For such a variable, the coefficients in fixed-effects regression exist but are much lower than in cross-sectional regression. The reason is the range of variation of such variables is limited and the number of cases having such variation is much smaller than the sample size. Thus, as Kilbourne et al. (1994) point out, the basic fixed-effects model is a model of 'movers' not stayers.

Fixed-effects models are generally used in order to find out what constant differences there are between persons over time. To make fixed-effects estimates, it can be assumed that the true model of the wage is one in which wages vary according to annual changes in some factors, plus a longer-term difference that remains constant over time.

The constant part of the model has a component known as the individual heterogeneity, so that the fixed-effects model teases out the wage differential that is specific to each person and invariant to time after it has measured the Stage 1 wage responses over time. We turn now to the results.

Time Series Model Results

Having made allowance for those entering and leaving the labour force, and for individual heterogeneity, the variation in wages from year to year is analysed using a regression equation. In this equation, the variation in wages is the dependent variable. The coefficients in that model (see Table A5-2) suggest that over the short term:

- An extra year's formal education raises the wage-rate by 2.6%.
- An extra year of full-time employment experience raises the wage-rate by 4.5%.
- An extra year of part-time employment experience raises the wage-rate by less than 1%.
- Moving to a large firm (50 to 499) workers has a 5% or greater effect (7% for a move to a firm of 500+ workers).

The fixed-effects regression also suggests that a large amount of the variation in wages that does not change over time is due to a gender effect. Table A5-3 shows how the long-term model relates the long-term average wages to their underlying human capital and institutional causal processes. Five factors deserve attention here.

- Gender is associated with a 9% wage difference – the same factor uncovered in the 2002 cross-sectional analysis.
- Higher levels of formal education appear to be associated with 4% higher wages.
- Longer histories of full-time work experience appear to be associated with lower wages (1% per year).[7]
- Institutional factors have the expected large additional effect. Central here are firm size, public sector jobs, and union membership. The corresponding wage rises are estimated as +5% for large firms, +6% for public sector jobs, and +5% for union membership.
- Segregation is associated with higher wages (another 1% higher wages per 10% more men in a given occupation).

[7] This effect disappears if age is put into the model, showing that older workers get lower pay for reasons not explored here (see Rake, 2000: 77, for an exploration of the complex processes that relate the demographic factors to the earnings cycle over the life-time).

These results from Stage 2 can in principle be added to the Stage 1 ‘movers’ model. Such a method was used by Polachek and Kim (1994) to examine the long-term gender residual, which in this model is -9% (Table A5-3).

The r-squared for the Stage 2 regression is 26%, showing that 26% of the long-term cross-sectional wage variation has been explained. In addition, the case-wise residual (described in detail later in the Appendix) has been decomposed. The techniques used here are rooted in existing literature but may be seen as exploratory since they take up the causal patterns associated with both movers and stayers over time.

Occupational segregation as an example

A detailed exploration of occupational segregation illustrates what can be learned from this time-series approach. The data indicate strong gender differentiation of the impact of gender segregation. In Table A5-4, the interaction of each explanatory variable with gender has been measured (following Kilbourne et al.., 1994). The results are as follows. Among men, moving into a job with 10% more men in it would cause a 0.2% wage rise. Among women, the rise is 0.5% and the effect is strongly statistically significant. Thus if a woman moved from a 100% female-dominated job to one that was 50% male, her wage would rise by 2.5%.

Furthermore we have in Table A5-3 a longer-term segregation effect of 1%. On the whole, the analysis indicates that among the institutional sources of indirect gender discrimination, occupational segregation deserves close attention. The segregation factor needs to be explored. For instance, it might be possible to simulate differentiated policy scenarios, with one type of policy scenario influencing women’s long-term mean values, and another type of policy change influencing labour market institutions in the short run. The fixed-effects model provides an opportunity for a detailed simulation exercise but there are many complexities that need to be addressed, such as handling the underlying demographics.

The gender pay gap’s main underlying mechanisms have been shown to include gender itself as well as other factors. The gender component of the ‘individual heterogeneity’ is very large, comprising 9% of wage rates. This amounts to 71p per hour on the women’s average wage of £7.93 per hour. (As described in Table 2.6, the same 9% is 87p of the mean wage of £9.61/hour. See Appendix 1 for the overall mean wage rates.) A discussion of why this figure is so large is needed.

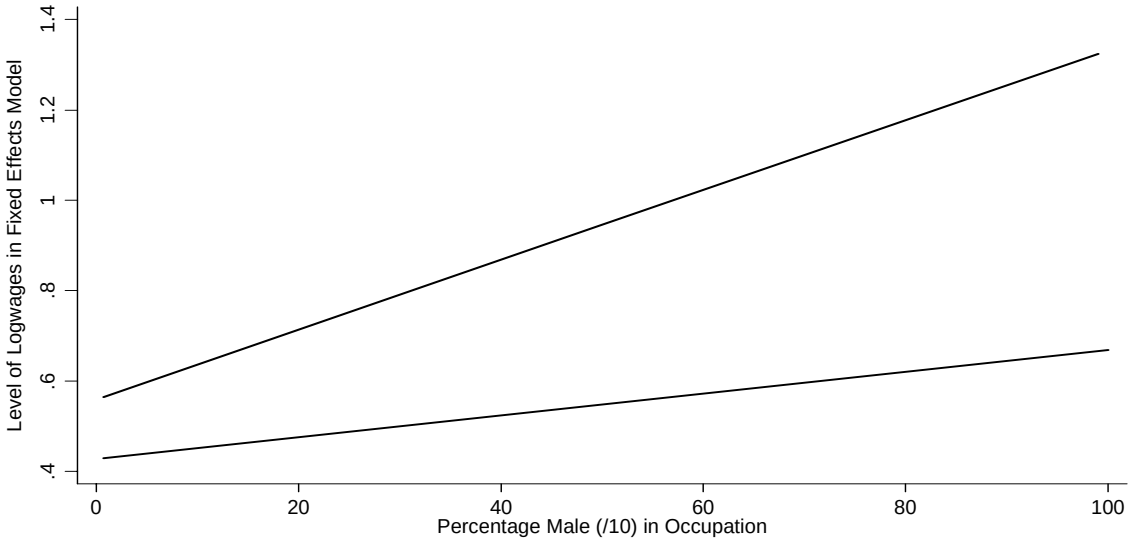
The 'individual heterogeneity' component includes a gender difference which has two causes: first, motivations and attitudes to the labour market as discussed in Chapter 2; and, second, any other gender difference in wages that remains constant for a person over ten years.

However, other factors may also operate. A second explanation is that of self-screening by applicants. Women and men may avoid male-dominated occupations or consider that they might fit better into a low-paid occupation. Preferences interact with both motivation and self-screening; one may see it as a ‘choice’ that appears to involve indirect gender discrimination. A third is that discrimination against female applicants, or discrimination during the career such that a woman does not get training or promotion, affects the difference in wages. Fourthly, women may accept

lower wages than men, over time, due to compensations which reward them in non-monetary terms. For instance, if a woman gets benefits from home caring work, and therefore does not search for a new job to improve her prospects, but rather accepts local low-paid work, then she is thought to be voluntarily accepting low pay (relative to those with different preferences). Some economists tend to think of these differentials in terms of the caring constraint (Folbre, 1995), whilst others tend to think of them in terms of choice (Swaffield, 2000). It is important to recognise that this component of observed wage differentials cannot be attributed to direct discrimination. Fifthly, underlying social factors may be involved. The occupational structure develops over a long period, and the differentiation by gender of specific occupations is associated with a higher social valuation of certain jobs. The benefits to the workers in those jobs can go to women, but at present these are often male-dominated occupations. Therefore the persistent wage differential over the time period of the panel data is not a gendered factor with a single cause. It has at least five causes, and these causes are only indirectly measured here.

The Kilbourne (et al., 1994) model separately measures women's and men's returns from their 'endowment' of personal characteristics. The return is found to be different for men and women, and this is illustrated in Figure 2.6. The gender segregation variable is on the horizontal axis and the wage predictions on the vertical axis. The equation for the wage shown in Table A5-2 includes the terms representing the men's versus women's wage response to a change in segregation. Specifically, if the male per cent in a worker's occupation rose by 10%, then a man's wage would rise imperceptibly (coefficient .002), but a woman's wage would rise by a statistically significant amount (.005 in log-wage units). The first coefficient is not significant, but the second one is, implying that among women there is a positive slope response of the wage to the percentage male in the woman's occupation. Figure A5-1 illustrates this gender difference.

Figure A5.1 Women's and men's wage response to Gender Segregation Index



Source: BHPS, 1991/2 to 2001/2, fixed effects model. The **upper line shows women's** predicted wages responding to the percentage male in their occupation over time, and the **lower line is that for men**. The slope differential is statistically significant. The y-axis is measured here in logwages The lines are fitted to the predictions of the fixed-effects Heckman adjusted model with gender interaction terms.

According to this dataset for Great Britain, women would gain higher wages if they were to move to a more male-dominated occupation, but men would neither gain nor lose from joining a female-dominated occupation. Figure A5-1 shows the women's line responding more strongly to gender segregation than does the men's line.

Two main findings arise from the analysis of the fixed effects model. Firstly, that the unchanging element of the wage differences over time refers not only to personal characteristics, but also to long-term gender differentiation, which is socially determined and not reflective of personal choice. Therefore to call it motivation would be too individualistic, and to call it discrimination would offer too strong a mono-causal interpretation.

Secondly, the unchanging wage difference between women and men is at least 9% among women as compared with men. The estimate is 9% for 2002 in a cross-sectional data context and 9% in a time-series data context 1991-2002. The fixed effects models are not perfect, since they ignore data about people whose job and characteristics were constant over a long period. The models do reinforce and supplement findings from the cross-sectional regressions.

Technical aspects of fixed effects models

The fixed effects model is used to illustrate how changes over time in a woman's position affect wages. We have constructed both an integrated wage equation and a sex-differentiated wage equation. The integrated wage equation can be represented as:

$$y_{it} = b_0 + \Sigma b_k X_{kit} + e_{it} \qquad \text{(Eq. 1)}$$

where

$$e_{it} = u_i + v_t + r_{it} \qquad \text{(Eq. 2)}$$

and the r_{it} represent residual errors. The time component v_t dropped out as insignificant since real wages were used. A Heckman selectivity adjustment allowed for a changing level of non-selectivity hazard each year, for each person. This factor is denoted here as λ_{it} for each person. These terms, measured cross-sectionally in each year, reflect the person's relative tendency to enter the labour market. Each λ_{it} is considered to be independent of the λ_{it} of person *i* in other years. The coefficient for this inverse Mills ratio (IMR) is found using the fixed-effects model, such that revised equations are:

$$y_{it} = b_0 + \Sigma b_k X_{kit} + g \cdot \lambda_{it} + e_{it} \qquad \text{(Eq. 3)}$$

where the IMR is the non-selection hazard term $\lambda_{it,}$
g is the coefficient on the IMR, and the residuals are decomposed as before.

Equation 3 is the fixed-effects model, labelled Model 2 in the results Tables so that it can be compared with the cross-sectional regression (Model 1) which was presented in Appendix 3.

This equation suggests that the selectivity part of the equation is a sum of money to be added to the expected wage rate. However, the way we calculate our estimates, the adjusted equation also allows all the coefficients to change. In other words the main effects estimates are un-biased whereas without the λ_{it} term they would be considered to be biased. We can decompose the term $g \cdot \lambda_{it}$ by gender, but it has a nonlinear form (Neumann and Oaxaca, 1998). Care should be taken in looking at the selectivity adjustment term since it is bound up with the revised coefficients. In our case, this term stays in the background of the main analysis.

Having made the selectivity adjustment, the individual heterogeneity term u_i is decomposed in two ways. Firstly, we can use interaction terms to examine its connection with gender. This follows an application of interaction terms by Kilbourne et al. (1994). In the results tables, this analysis appears as Model 3.

Secondly, we can take the u_i and regress that upon gender. From this second route we would have:

$$u_i = \mathbf{q} \cdot SEX + r'_{it} \qquad \text{(Eq. 4)}$$

where the variable SEX is coded 1 = female, 0 = male, as is the variable *female* in the regressions.

The parameter **q** represents the gender difference in the casewise residuals. The parameter **q** measures gender-differentiated individual heterogeneity. The factor **q** can be thought of as the PK effect (Polachek and Kim, 1994). The u_i do not have a 'time' subscript, $_t$, precisely because they do not vary over time.

Taking this logic further, it is possible to decompose (by regression) the u_i using the whole range of explanatory factors. If we denote these explanatory factors as the X_{it}, leaving out gender, then the equation for Stage 2 of the fixed-effects model is:

$$u_i = \mathbf{q} \cdot SEX + \Sigma \beta_k x_{itk} + r'_{it} \qquad \text{(Eq. 5)}$$

Stage 1 is Equation 3. Stage 2 is Equation 5. The results from Stage 1 (movers' model) and Stage 2 (grand means model, referring to variation which is constant across the whole time-period) are presented in Tables below.

The summation Σ is carried out over the set of k independent variables, such as education, regional dummies, etc. We estimate the Stage 2 model for the casewise heterogeneity using weighted ordinary least squares regression.

We can interpret **q** as the effect on wages of being a woman, having allowed for wage movements and changes in underlying conditions over time. To know which causal mechanisms influence q upward, we have to look at the literature on gender pay gaps. Here several explanations are offered. Primary among these is the notion that people have long-term motivation differences, and therefore behave differently at work. Their payoff in wage terms appears as a constant term u_i.

When gender is coded as 1 = female and 0 = male, the negative **q** for women implies a higher predicted wage than that actually received. The differences in this equation

are linear, but the wage is logged, so the actual impact on wages in £/hour is curved. It is widely recognised that changes in log wages roughly equate to percentage changes in actual wages. If the gender coefficient is -0.10, the women's predicted wage is thus 10% higher than their actual wage received (on average over the period 1992-2002).

The figure we arrive at for the **q** coefficient using the Polachek-Kim method is smaller than that which they obtained using US data for the years 1976-1987. We have used the estimation method recommended by Polachek and Kim to make our estimates, accepting their point that OLS pooled regression and other modes of estimation would over-estimate the gender-related component of the error terms. The association of u_i with gender and other variables is available in Appendix 2 as a correlation matrix.

The results of the basic fixed effects model are shown in Table A5-2, and the results of the model with gender interaction effects are shown in Table A5-3.

Table A5.2 Fixed-effects regression results (Model 2, Stage 1)

	Coefficient	Significance
Female	(see model 2, stage 2)	
Education (years)	0.0260	***
Years of full-time work	0.0448	***
Years of full-time work squared	-0.0001	***
Years of part-time work	0.0090	***
Years of part-time work squared	0.0000	
Months of unemployment	-0.0012	
Months of family care	-0.0008	**
Months on maternity	0.0018	
Segregation (male % x 10)	0.0051	***
Firm size 500+ workers	0.0689	***
Firm size 50+ workers	0.0456	***
Firm size 25-49 (<25 is base case)	0.0038	
In public sector	0.0227	***
In union or staff association	-0.0015	
Insider, >4 years tenure in job	0.0253	***
Outsider, <1 year tenure in job	-0.0207	***
Recent education employer funded	-0.0017	
Recent education not employer funded	-0.0228	***
IMR	-0.2339	
Controls for region and industry are also in the model		
Significance levels are <.01 = ***; <.05=**, and <.10=*.		
R-squared	0.2600	

Notes: Model 2 above can be compared with Model 1 (found in both Table 2.4 and Appendix 3).

Source: British Household Panel Survey, 2001/2.

Table A5.3 Fixed-effects model, decomposing the casewise residual U_i

	Coefficient	Standard error	T-Statistic	Significance
female	-0.094	0.007	-13.9	0
edscale	0.039	0.001	38.58	0
fullyear	-0.013	0.001	-17.96	0
fullyrsq	0.000004	0.000002	2.95	0.003
monthpart	-0.001	0.000	-9.02	0
monthpart2	0.000002	0.000000	4.08	0
monthunem	-0.001	0.000	-6.03	0
monthfam	0.000	0.000	3.84	0
monthmat	-0.001	0.000	-5.62	0
segpoint	0.010	0.001	9.52	0
firm500	0.085	0.007	11.52	0
firm50	0.056	0.006	9.59	0
firm2549	0.025	0.007	3.37	0.001
public	0.055	0.008	7.03	0
inunion	0.067	0.006	11.42	0
inside	-0.025	0.006	-4.27	0
outside	-0.026	0.006	-4.24	0
workeduc	0.006	0.007	0.83	0.406
educnonw	-0.032	0.008	-4.08	0
_Iregion_1	0.095	0.017	5.69	0
_Iregion_2	0.062	0.014	4.35	0
_Iregion_3	0.020	0.012	1.72	0.086
_Iregion_4	0.017	0.013	1.23	0.217
_Iregion_5	-0.001	0.016	-0.07	0.947
_Iregion_6	-0.076	0.013	-5.86	0
_Iregion_7	0.088	0.017	5.09	0
_Iregion_9	-0.006	0.016	-0.36	0.719
_Iregion_10	0.014	0.019	0.7	0.484
_Iregion_11	0.069	0.015	4.62	0
_Iregion_12	-0.091	0.016	-5.59	0
_Iregion_13	-0.016	0.017	-0.96	0.339
_Iregion_14	-0.064	0.017	-3.85	0
_Iregion_15	-0.025	0.018	-1.35	0.178
_Iregion_16	0.003	0.014	0.25	0.805
_Iregion_17	0.078	0.013	5.81	0
_Iregion_18	0.115	0.012	9.4	0
_ISIC_0	-0.103	0.024	-4.32	0
_ISIC_1	0.097	0.021	4.68	0
_ISIC_2	0.077	0.016	4.96	0
_ISIC_3	0.050	0.012	4.09	0
_ISIC_4	-0.009	0.013	-0.75	0.456
_ISIC_5	-0.015	0.015	-1	0.315
_ISIC_6	-0.001	0.012	-0.12	0.902
_ISIC_8	0.159	0.013	12.61	0
_ISIC_9	0.055	0.012	4.75	0
Constant	-0.491	0.022	-22.82	0

Notes: R squared = 26.40%; N = 33,688; F-statistic = 230 ****.

Source: British Household Panel Survey, 2001/2.

Table A5.4 Fixed-effects model with additional interaction effects

Fixed Effects Kilbourne-England et al. Model (Model 3)				
	Main effects	**Significance**	**Gender interaction terms**	**Significance**
Female	-0.3167301	*******		
Education (years)	0.0202914	***	0.0110279	**
Years of full-time work	0.0443312	***	0.0010713	
Years of full-time work squared	-0.0000514	***	-3.46E-06	
Years of part-time work	-0.0133187		0.0260846	**
Years of part-time work squared	0.000281		-0.0004411	
Months of unemployment	-0.0010802		0.0000215	
Months of family care	0.0021283		-0.0030813	
Months on maternity	(dropped)		0.0016437	
Segregation (male % x 10)	0.0024176		0.0053142	**
Firm size 500+ workers	0.0671209	***	0.0010	
Firm size 50+ workers	0.0343359	***	0.0235	*
Firm size 25-49 (<25 is base case)	0.002569		0.0097	
In public sector	0.0050679		0.0269	
In union or staff association	-0.0016079		-0.0001	
insider, >4 years tenure in job	0.0355163	***	-0.0211	******
outsider, <1 year tenure in job	-0.0266254	***	0.0115	
recent education employer funded	-0.0020388		-0.002	
recent education not employer funded	-0.0231299	***	-0.02313	***
IMR	-0.2674042	***	0.0706	***
Controls for region and industry are also in the model				
Significance levels are <.01 = ***; <.05=**, and <.10=*.				
R-squared	0.1900			

Source: British Household Panel Survey, 2001/2.