ESSAYS ON INSTITUTIONS AND EARNINGS INEQUALITY

by

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ABSTRACT

This thesis describes and analyzes the earnings inequality in the United Kingdom and related countries in particular Italy and Germany, incorporating institutional measures and changes. There are three main tasks: firstly, Chapter 2 shows that earnings inequality as well as skill premiums have increased substantially over the last thirty years. A simple supply-demand analysis can only broadly fit with the wage structure changes, but leave much space for institutional explanation (Chapter 3).

Secondly, after controlling for the workers' main characteristics, changes of technology, industrial structure and labor market conditions, our estimates imply that institutional changes (mainly trade union decline) can account for a substantial part of the rise of skill premiums since the 1970s (Chapter 4).

Finally, Chapter 5 and Chapter 6 compare the real wage flexibility in the UK with Italy and Germany, which have centralized collective agreements. We find flexible wages in the private sector in the UK and only in the prosperous regions in Italy (the north) and Germany (the west). When regions within a country are prosperous, the different types of wage-setting institution give similar results. However, when a region is lagging, collective bargaining delays recovery.

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TABLE OF CONTENTS

CHAPTER ONE: INTRODUCTION

CHAPTER TWO: CHANGES IN THE WAGE STRUCTURE OF THE UNITED KINGDOM 1972-2002

CHAPTER THREE: THE MARKET MECHANISM AND WAGE INEQUALITY IN THE UK

CHAPTER FOUR: INSTITUTIONAL EFFECTS ON SKILL PREMIUM

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

BHPS	British Household Panel Survey
CNEF	Cross National Equivalent Files
CPI	Consumer Price Index
DWP	Department for Work and Pension (UK)
EALE	European Association of Labour Economists
ECHP	European Community Household Panel
EF	European Foundation of the Improvement of Living and Working Condition
EFS	Expenditure and Food Survey
EIRO	European Industrial Relations Observatory
ESRI	Economic and Social Research Institute (Dublin)
ESRC	Economic and Social Research Council (UK)
FES	Family Expenditure Survey
FHEA	Further and Higher Education Act
FSO	Federal Statistics Office
FWLS	Family and Working Lives Survey
GHS	General Household Survey
GSOEP	German Socio-Economic Panel Data
HBAI	Households Below Average Income data-set
ISER	Institute for Social and Economic Research (Essex)
ISTAT	Italian National Statistics Institute
ULSC	United Kingdom Longitudinal Studies Centre (ESRC)
NES	New Earnings Survey
OECD	Organization for Economic Co-operation and Development
ONS	Office for National Statistics
RPI	Retail Price Index
REPI	Relative Explanatory Power Index
SBTC	Skill-biased Technology Change
SPI	Survey of Personal Incomes
TDA	Transition Data Analysis
WIRS	Workplace Industrial Relations Survey
WPEG	Work, Pensions and Labour Economics Group

CHAPTER ONE: INTRODUCTION

> "The history of Europe demonstrates that inequality is necessary to reveal progress by different people…… If equality is enforced by socialist law, or encouraged by conservative custom, it slows down or suppresses progress. The peoples of Europe would have remained poorer longer…… Inequality in actions is the way to equality in result." (Arthur Seldon, 1990, "The Virtues of Capitalism." The Collected Works of Arthur Seldon, Volume 1, p213)

Arthur Seldon's "capitalism", as he described it, is only a convenient simplification for "the price system," or "the market economy". Labour economists believing in the market agree with him that the flexible price system in labour markets (i.e. wages) can adjust market forces back to equilibrium. This strand of ideas is obviously following the tradition of "the invisible hand" advocated by Adam Smith (The Wealth of Nations, 1776, vol. IV, ch 2.9). In other words, flexible wages help people to be employed in the face of adverse economic shocks. Consequently, less unemployment brings more happiness for the whole society, not only for those unemployed but also for those employed, since "almost any job is better than no job" (Layard 2003, p5).

However, for the whole society, inequality is perhaps just as unhappy a thing as unemployment is. Relative income position can play a very important role in happiness (Layard 2003, Table 1, p3). If more and more people are located below the average line of the earnings distribution, the welfare of the whole society declines.

Hence, even with a much higher unemployment rate than that in the UK, different institutional "rigidities" are regarded as useful tools for social equality and stability in many continental European countries, and are politically difficult to remove (Boeri 2005). Arthur Seldon argued that inequality in actions is the way to equality in result. The problem is what action can lead to the right way. This dilemma calls for a balance between the government's aims of employment and equality, and can only be resolved by the interaction of institutions and market forces.

1.1 Identifying the problem

This thesis is not going to set another fire to the hot debate on labour market flexibility and rigidity in European countries. Even though the series of essays in this thesis aim to contribute to this debate, they only provide clearer empirical facts which may be used by both sides. The focus of interest here is to describe and analyze earnings inequality in the United Kingdom and related countries in particular Italy and Germany, incorporating institutional measures and changes.

Earnings inequality in the United Kingdom has increased substantially since the 1970s. In 1972, the top ten percent of males, between the ages of 16 and 66 earned double the hourly wages of the bottom ten percent of males. The wage gap had soared by about 40 percent in the mid of 1990s. Even in 2002, the 90th-10th percentile differential of male was still about 20 percent higher than thirty years ago.[1] Among industrialized countries, only the United States has had an increase of similar magnitude during the same period.

[1] The figures in this paragraph are all derived from the General Household Surveys, and are based on the definition and conventions outlined later in this thesis. See Figure 2.4 in Chapter 2.

This thesis tracks the growth of earnings inequality in the United Kingdom over the three decades from 1972 to 2002. Since the unemployment rate in the UK has been controlled below 5% in recent years (Berthoud 2007, Figure A, p2), containing earnings inequality and reducing the number of poor families are aimed to be right at the top of the government's social policy agenda (DWP 2006, p1). This thesis achieves some answers to questions such as "what has happened regarding wage inequality in the British labour market over the last three decades? In addition, if possible, what will happen in the next stage?" An understanding of how the British earnings distribution reached its current position could provide valuable clues on directions for future policy.

Moreover, this thesis sheds light on more difficult questions as "Which factor or factors, among market forces (labour supply and demand), neutral/non-neutral technical shifts, international trade and institutional changes, play the most important role in these changes?" In the broader literature on earnings inequality, much disagreement remains concerning the fundamental causes of the rising earnings inequality in the UK and US. One class of explanations postulates that changes in the British wage structure are driven by skill-biased technological change (Machin and Van Reenen 1998 Table 1, p1220, Katz and Autor 2000 section 5.5, Machin 2001, p774 and O'Mahony et al 2008). They argue that skill-biased technological change (SBTC) – the quick diffusion of computers or other Information and Communication Technology (ICT) facilities at work – raised the relative demand for more skilled workers and reduced the demand for less skilled workers. Krugman (1994, p70) and Nickell and Bell (1996, p302) also agree that the technology impact in the 1980s would be more adverse to unskilled workers who cannot adapt to SBTC, maybe due

to poor quality primary education. There is strong evidence of the empirical association between proxies for SBTC and the widened wage gap of the UK and US in the 1980s. Thus, SBTC is an important factor in the earnings inequality through inducing skill-biased labour demand.

Although the SBTC explanation is successful in explaining the rising earnings inequality in the UK and US in the 1980s, it is also widely realised that the diffusion of computers at work has become so widespread in the 1990s that a simple headcount no longer measures SBTC-induced demand shifts (Machin 2001, p772). Card and DiNardo (2002) review the evidence in favour of the SBTC hypothesis and focus on the implications of SBTC for economy-wide trends in wage inequality, and for the evolution of wage differentials between various groups. They argue that a fundamental problem for the SBTC hypothesis is that wage inequality in the US stabilized in the 1990s, despite continuing advances in computer technology. SBTC also fails to explain the closing of the gender gap, the stability of the racial wage gap, and the dramatic rise in education-related wage gaps for younger versus older workers in the US. Thus, they conclude that the SBTC hypothesis is not very helpful in understanding the myriad shifts in the structure of wages that have occurred over the past three decades. This thesis will push this argument further in late chapters using British data.

An alternative explanation focuses on changes in product demand largely associated with large trade deficits from the 1970s.[2] Wood (1995, p64-67, see also 1994 and 1998) tries to prove that the growth of manufacturing imports from newly

[2] Nickell (2006, Table C) shows trade deficits of the UK since 1955.

industrializing economies has led to a sharp decline in manufacturing employment and a shift in employment towards those skill-intensive sectors. He argues that international trade lowers the economy-wide relative demand for unskilled labour by about 20%. Thus, international trade can explain not only the rise in earnings inequality throughout the industrialized countries, but also the trend towards higher joblessness.

However, the trade explanation does not convince many labour economists (see Machin and Van Reenen 1998, p1239) and even many trade economists (see Sachs and Shatz 1994). Schmitt (1995) uses the General Household Survey (GHS) from 1974-1988 to perform an industry-based shift-share decomposition on the changes of education differentials in the UK. He does not find that employment shifts from manufacturing to service sector have made a significant contribution towards the rise in education differentials during the 1980s, hence suggesting that trade effects on earnings inequality may not be as important as Wood describes.[3]

On the other hand, the rising wage inequality in the UK has been accompanied by institutional reforms in the labour market since the Thatcher-era (Blanchflower and Freeman 1993). A labour policy directed by US-style flexibility may be part of the causation of rising wage inequality. Evidence includes the fact that those continental European countries, such as Italy, Germany and Sweden, with little or no increase in earnings inequality since the 1970s, all continue to have some form of centralized wage setting (see Erickson and Ichino 1995 for Italy, Abraham and Houseman 1995 for Germany and Edin and Holmlund 1995 for Sweden). This difference in wage

[3] However, Acemoglu (2003b, p200) thinks that increased international trade may be more important than generally believed because it induces skill-biased technical change. He thus argues that the two competing explanations, international trade and SBTC, for the increasing skill demand may be related.

inequality across countries has led to a view which is sometimes called the "Krugman hypothesis". It states that the rise in wage inequality in the Anglo-Saxon countries and the rise in unemployment in continental Europe are "two sides of the same coin", namely a fall in the relative demand for unskilled workers under different wage setting institutions (see Krugman 1994, p28-39, Nickell and Bell 1996, p302 and Puhani 2003, p1).

Figure 1.1 describes the supply-demand changes behind the "Krugman hypothesis". The horizontal axis represents the relative employment of skilled workers to unskilled workers (L_S/L_U), and the vertical axis represents the relative wages of skilled workers to unskilled workers (W_S/W_U). As the relative demand (D_1) and relative supply (S) cross, the original equilibrium is at the point A where skilled workers have relative wage w_1 and relative employment l_1. In the face of SBTC, the relative demand curve for skilled workers will increase from D_1 to D_2.

In Anglo-Saxon countries, flexible labour market institutions allow relative demand D_2 and supply S to achieve the new equilibrium B. We find that skilled workers at the new equilibrium have a higher relative wage w_2, that is, higher wage inequality. Flexible wages of unskilled workers can be adjusted low enough for them to keep their jobs or find new jobs. In addition, some unskilled workers may quit voluntarily and make the relative employment of skilled workers rise to l_2. Thus, in the face of SBTC, overall unemployment rates in Anglo-Saxon countries are still kept at a natural level, but wage inequality is higher than before.

In continental European countries, however, centralized wage setting institutions may prevent the wage of unskilled workers from falling to an extent that employers are still willing to employ them. Hence, the relative wage of skilled workers may stay around w_1, and wage inequality does not change much. In the face of SBTC, a rigid wage leads to a relative employment gap (l_3-l_1) between relative supply and demand of skilled workers. The relative supply of skilled workers is still at point A, while the relative demand rises to point C. The rigidity of labour market pushes the wage of unskilled workers above equilibrium. There is an excess-demand for skilled workers as well as a higher unemployment rate for unskilled workers. Thus, it is not surprising to see the evidence of a negative association between wage inequality and the rigidity of labour market institutions in cross-country analysis (e.g. Koeniger et al 2004, Table3, p27, see also the survey in Siebert 2006, Figure 1, p14).

Institutions in this thesis include trade unions, the combined system of taxes and welfare benefits, and minimum wages (similar to DiNardo, Fortin and Lemieux 1996). These institutions have been regarded as the primary factors in different patterns of earnings inequality across countries by many authors, for example Katz et al (1995), Blau and Kahn (1996), Machin (1996), Gottschalk and Joyce (1998), Card et al (2003) and Koeniger et al (2004, 2007). These cross-country analyses tend to treat the UK as an intermediate case between the rigid labour market in continental European countries and the "epitome" of labour market flexibility, the United States. Therefore, examination of the evolution of wage structure in the UK and exploring the possible causation behind the movement have been an important part of the international argument about issues of earnings inequality, unemployment and labour market flexibility.

1.2 Objectives

There are three main tasks for this thesis: the first aim is to describe and analyze the changes in the wage structure of the United Kingdom over the period 1972-2002 (Chapter 2 and 3). Chapter 2 is a further development of Schmitt (1995) and Katz et al (1995), aiming to describe the changes in the wage structure. We find that wage inequality fell slightly in the 1970s and rose rapidly in the 1980s and the early 1990s. In last years of my sample period, wage inequality has been contained to some extent. The cyclical pattern of skill premium, with an increasing trend after the 1970s is analyzed using a repeated cross-section regression in this chapter.

Chapter 3 continues the first aim and analyzes how supply and demand interactions result in the changes of wage inequality in the UK. We test the Katz and Murphy (1992) hypothesis (that fluctuations of labour supply combined with stable or steadily growing labour demand decided wage movements, hence a negative association between employment and wage changes), and the Machin (2001) hypothesis (that fluctuations of labour demand combined with steady changes of labour supply decided wage changes, hence a positive association between employment and wage changes), using a simple supply and demand framework. Empirical results in Chapter 3 show that this supply and demand framework, following either Katz and Murphy's hypothesis or Machin's hypothesis, can only broadly fit with the employment/wage changes in the last thirty years and leave much space for institutional explanations.

Secondly, the above two chapters regard institutions as the underpinning factors of wage changes, however, a formal analysis of institutional effects on skill

premiums is made in Chapter 4. A fairly consensual position is that the wage distribution reflects both market factors and the institutional environment. Institutions presumably work through supply and demand to affect the wage distribution. It is empirically demanding to quantitatively identify and assess the effect of institutions. Chapter 4 aims to disentangle the labour market institutions from the above simple supply and demand framework. A union bargaining model, involving institutional factors such as trade unions, earnings tax, unemployment benefit and minimum wages, is applied to explain the changes of skill premiums. After controlling for the workers' main characteristics, changes of technology, industrial structure and labour market conditions, our estimates suggest that labour market institutions can account for a substantial part of the dramatic increase in skill premium and earnings inequality after the 1970s.

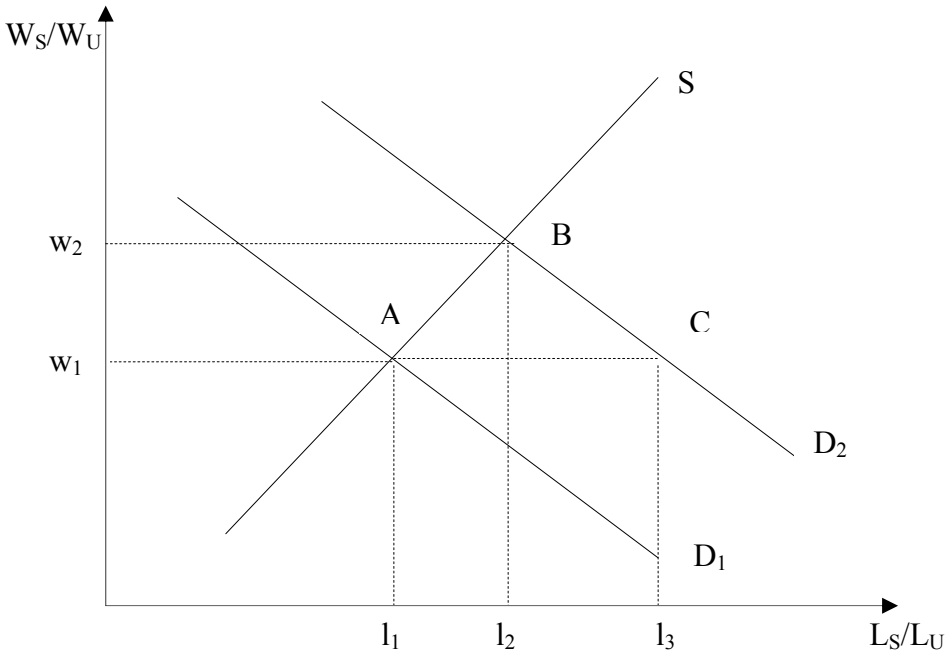
The third task is to analyze the effect of different wage-setting institutions on wage flexibility. With worse economic performance than the US and the UK, policy-makers of many continental European countries particularly emphasized labour market flexibility in recent years. Devereux and Hart (2006) point out that the extent to which wages respond to market conditions determines the extent to which adverse shocks from business cycles result in wage adjustments rather than unemployment. Thus, attainment of overall wage cyclicality has become the central goal of labour market flexibility.

Chapter 5 and Chapter 6 compare real wage cyclicality in the UK with two continental European countries: Italy and Germany. The wage in the UK is set at the company or individual level, compared with the centralised collective agreements in

Italy and Germany. These two chapters find an overall procyclical wage in the UK, in contrast to procyclical wages only in prosperous regions of Italy (the north) and Germany (the west). The rigid wage in the poor regions of Italy (the centre-south) and Germany (the east) is apparently associated with the centralised and coordinated wage setting institutions in both countries. With the same access to technology and international competition, the big difference in the real wage cyclicality of these three countries implies that wage setting institutions play important roles in earnings inequality. The difference can support the "Krugman hypothesis" that flexible wage-setting institutions allow increasing wage inequality and keep unemployment lower, just as rigid institutions contain wage inequality but bring a higher unemployment rate.

In the concluding chapter, I summarise my findings and attempt to shed light on these various issues. On the one hand, it may be argued that the coordinated wage-setting institutions as in Italy and Germany (OECD 2004, Table 3.5, p151) are necessary for labour market flexibility. The collective bargaining in Germany and Italy possibly achieve flexible wages in prosperous regions, but it obviously delays recovery of lagging ones. The advantage of wage bargaining at individual or company level in the UK is that the freedom of bargaining can provide employment opportunities to all participants in labour market. On the other hand, the US-style labour market institutions (such as the decline of the National Minimum Wages, see DiNardo et al 1996) seem not the only way to improve labour market performance, especially considering the cost of higher earnings inequality. The efficiency of such institutional reforms is further questioned in Chapter 7.

Figure 1.1: Institutional effects on wage inequality



CHAPTER TWO:
CHANGES IN THE WAGE STRUCTURE OF THE UNITED KINGDOM 1972-2002

2.1 Introduction

This chapter aims to describe the changes in the wage structure of the United Kingdom over the period 1972-2002. Wage inequality in the United Kingdom has increased substantially since the 1970s and arrived at a high level in terms of either the UK's own historical experience or by comparison with other European countries. Since the patterns and determination of inequality always draw the attention of economists and common public, the evolution of the wage structure over the 1980s and the early 1990s has been well documented by a number of papers.

Schmitt (1995) uses the General Household Survey (GHS) from 1974-1988 to describe how earnings inequality among males fell slightly during the 1970s, only to rise rapidly in the 1980s in the UK. Gosling et al (2000) report that the gap between the 90th and 10th percentile of the wage distribution changed little during the 1960s and early 1970s and has widened rapidly throughout the 1980s and early 1990s using the GHS 1978-1991 and the Family Expenditure Survey (FES) 1978-1995. Dickens (2000) reports a doubling of the variance of the logarithm of hourly wages during the same period using the New Earnings Survey (NES) 1975-1995.

Current literature continues the story. Gosling and Lemieux (2001) report that wage inequality in the UK remained more stable in the second half of the 1990's mainly using the FES 1978-1996, supplemented with the Labour Force Survey (LFS) 1997-1999. Prasad (2002) studies the NES and discusses wage inequality from 1975

to 1999. He argues that there has been virtually no change in wage inequality of the UK in the latter half of the 1990s. Kalwij and Alessie (2003) confirm the above observation by examining the variance-covariance structure of log-wages of British men in the NES 1975-2001. They also find that wage inequality has risen sharply during the 1980s and early 1990s and remained fairly constant in the second half of the 1990s. A strong increase in transitory wage inequality and a lesser increase in permanent wage inequality are the main causes of the worsening wage inequality during the 1980s and early 1990s. They attribute the stable wage inequality in the second half of the 1990s to the stabilization of permanent and transitory wages inequality, especially the strong decrease in the transitory wage inequality for the new entrants. Thus, current research is in sharp contrast to earlier literature and illuminates the "mild miracle" of the British economy in the last 10 years which is enjoying low unemployment, strong money, faster growth of GDP and improved earnings inequality.

However, the main data sources in above pioneering research are the NES and the FES, which cannot provide accurate information about the education level of workers over time. This research cannot analyze issues such as the education and experience premium, permitting a further analysis on the recent improvement in earnings inequality. Schmitt (1995) and Gosling et al (2000) use the rich information of workers in the GHS, but their data only cover the 1980s. Examining the skill (education) premium over the last three decades in the UK by using the GHS 1972-2002 is the main contribution of this chapter.

Many researchers compare changes of the wage structure in the UK with other OECD countries, especially the United States and continental European countries. In these respects, wage inequality in the British labour market shows similar trends to that in the US. Although other industrialised countries have experienced the same changes in global economy over the last decades, the increase of wage inequality is much less pronounced than in the UK and the US. Many continental European countries such as Italy, (West) Germany, France and Scandinavia are even absent from the worsening process of wage inequality during the 1980s (see details in Katz et al 1995, Blau and Kahn 1996, and Gosling and Lemieux 2001). This cross-national research attributes the similarity in the US and UK to the convergence of "US-style" reform in British labour market institutions, in contrast to the rigid labour market in continental Europe. Therefore, understanding the evolution of wage structure is the first step to consider those important issues such as earnings inequality, unemployment and labour market flexibility in the UK.

The aim of this chapter is to analyze a long time series of the wage structure of the UK. It can be treated as an updating of Schmitt (1995) and Katz et al (1995). Our research indicates that the British wage structure has changed a lot since the 1970s. This chapter supports previous findings that wage inequality in the UK fell slightly in the 1970s, and then rose rapidly in the 1980s and early 1990s. This increasing trend has been effectively contained in the late 1990s and 2000s. The evolution of skill premiums, by education and experience is described and analyzed in this chapter using the GHS 1972-2002. Results in this chapter show that the movement of the degree premium fits the change of wage inequality well.

Another contribution of this paper is that the same analysis is applied not only to males but also females, as a reflection of the increasing role of women in terms of workforce participation. The remainder of the paper is organised as follows. Section 2 describes the main data sources. Section 3 describes the changes in the wage structure and earnings inequality in the UK over the period 1972-2002. In section 4, we apply a standard earnings equation to check the changes of skill premium. The last section concludes.

2.2 Data description

2.2.1 Demographic trends in the GHS

The principle data in this thesis come from the series of the annual General Household Survey (GHS) from 1972 to 2002. The GHS is a continuous multipurpose survey of large random samples of households across Great Britain, conducted on an annual basis by the Office for National Statistics (ONS 2004). The survey has been carried out continuously except for two breaks in 1997 when the survey was reviewed and 1999 when the survey was redeveloped. Hence, there are 29 years of data over the total 31 years of 1972-2002. Since 2000, the annual sample has been based on financial years. That is, the GHS has been conducted continuously from April of one year to March of the next year, but they are labelled according to the first-named year for convenience. Hence, the phrase "the year of 2000" in this paper actually indicates a time period from April of 2000 to March of 2001.[4]

[4]The General Household Survey 1972-2002 is distributed by the Economic and Social Data Service, Office of National Statistics (ONS). Crown Copyright material is reproduced with the permission of the Controller of HMSO and the Queen's Printer for Scotland. For a detailed description of the GHS, visit the website of ONS: http://www.statistics.gov.uk/StatBase or the GHS home of Economic and Social Data Service (ESDS government) http://www.esds.ac.uk/government/ghs/.

The GHS include about 13,000 households in each year, that is, about 16,000 adults aged 16 and over in England, Scotland and Wales. Data are collected on five core topics including education, employment, health, housing, and population and family information. These surveys provide individual information on wages and employment for 337,836 workers during the period 1972-2002. Hence, each of the 29 annual GHS included in the analysis covers about 12,000 males and females with wage and employment information. Other variables such as education and working hours are also covered in a continuous way. The GHS datasets are reasonably consistent over time for wage variables of workers with age, gender, education and other demographic characteristics and thus provides consistent and nationally representative information on individuals.

We use three demographic characteristics: gender, education and potential labour market experience (simplified as experience for further analysis) to categorize our sample. The education variables used in this thesis are based on the highest educational qualification earned by the respondent, which is either vocational or academic. Schmitt (1995) argues that the use of qualification-based variables in the GHS offers two advantages over education measures based on years of schooling. First, the qualification variables outperform years variables in standard human capital equations (see Schmitt 1991). Second, the value of different types of qualifications, particularly vocational as opposed to academic qualifications, may shed more light on the workings of the supply and demand for skills than an undifferentiated years variable. In order to simplify the complicated structure of British qualifications, all highest qualifications earned by the respondent are categorized into six groups:

NOQUAL, BOLEV, OLEV, ALEV, HIGHER and DEGREE. The complete list and brief description of education variables are in the Table 2.1.

Since 1973, all British children have had to attend full-time education until the age of sixteen. Those who have never gone to school and who have never earned a qualification consist of the group of workers without qualifications (NOQUAL). According to the GHS, NOQUAL was the largest group in the total employment before 1994 (for example, about 61.5 percent in 1972). This group has decreased rapidly over the last thirty years so that only about 15 percent of workers had no qualifications in 2002, as shown in Panel A of Figure 2.1.

Those who earn qualifications follow either a vocational or an academic track. Following Schmitt (1995), the vocational qualifications increase in skill from miscellaneous, relatively low-skilled apprenticeships (VOC-OTHER) through incremented, nationally recognized apprenticeships (VOC-LOW, VOC-MIDDLE, and VOC-HIGH). The highest level vocational qualifications can involve some instruction at college level.[5] School children following the academic track prepare for and sit a series of national tests by academic subject. Those who finally earn the lowest academic (below O-LEVEL) or vocational qualifications (VOC-OTHER) are categorized into the BOLEV group. The BOLEV group also decreased from about 14 percent in 1972 to 11 percent in 2002 in Panel A of Figure 2.1.

[5] Works generally earn vocational qualifications while they work, through apprenticeship schemes, part-time study, or relatively short periods of full-time study "sandwiched" between spells of employment, often with the same employer. Thus, we involve company training (if with qualifications) in this education variable.

Students passing grades on a series of national tests by academic subject, generally taken around age 16, may earn qualifications that would place individuals in the OLEVEL 1-4, O-LEV&CLER, and O-LEVEL 5+ categories. The "Ordinary Level" examination categories distinguish between students who pass between one and four examinations, and those who attempt and pass five or more. The distinction is important for some employers and for further study. Workers with these O-LEVEL equivalent or VOC-LOW qualifications are categorized into the OLEV group, which increased from about 10 percent in 1972 to about 20 percent in 2002 in Panel A of Figure 2.1.

After O-LEVEL, some students (usually around age 18) take further national examinations at "Advanced level". For some students, A-LEVEL is a terminal qualification; for others they are only a prerequisite for university admission. Workers with these A-LEVEL equivalent or VOC-MIDDLE qualifications are categorized into the ALEV group. The ALEV group has increased five-fold from about 4 percent to 19 percent over the entire period.

The remaining two education groups have also increased over the last thirty years. The HIGHER group includes college equivalent qualifications, which consist of all educational or professional qualifications below degree level but above GCE A-level (For example, Teaching, Nursing and VOC-HIGH etc). The employment share of the higher education group (HIGHER, about 10 percent in 2002) has doubled in the last thirty years. The DEGREE group here includes all respondents who successfully finished the standard three-year university course as well as those who study further. In particular, the employment share of the DEGREE group has increased about nine-

fold from 2.7 percent to 22 percent over the period 1972-2002. Thus, the employment composition has shifted to a more educated (skilled) structure, revealing big changes of relative supply in the British labour market.

The experience variable is defined in the standard way as the minimum of (age-years of education-5, age-16).[6] This assumes that all workers should enter education at the age of five and cannot leave school before they are sixteen years old. Observations are categorized into eight groups, each covering five years of experience. Card and Lemieux (2001) argue that the United Kingdom experienced baby boom in the 1950s and the falling supply of college graduate in this cohort may raise the return of college for young in the 1980s. Daveri and Maliranta (2007) also reveal the impact of age and seniority on wages and productivity in Finland. More British people are staying longer in the workforce so common practice of excluding experience over 40s may be introducing biases. Thus, workers with more than 40-year experience are also put into the last experience group.

In Panel B of Figure 2.1, the employment share of new entrants (with 0-10 years experience) was quite stable in the 1970s and decreased from about 25 percent to about 19 percent during the 1980s and early years of the 1990s. At the same time, the employment share of prime experienced workers (with 21-30 years experience) had continuously increased from about 20 percent to about 27 percent. Just as in other developed countries such as the US and Canada, the evolution of experience structure in Britain reflects baby boom in the 1950s (also see Card and Lemieux 2001) and the long term aging process of the workforce. Thus, higher employment shares of prime

[6] See Katz and Murphy (1992, p37).

experienced workers reflect a slight shift to the more experienced structure in the British labour market.

2.2.2 Wage variables in the GHS

The wage variable used in this chapter is the real gross hourly earnings, deflated by the annual Retail Price Index (RPI) with 1995 as 100. This deflating factor is calculated from the prices of all items excluding mortgage interest payments provided by the Office for National Statistics (ONS 2008). The wage variable is from a wage sample including all full-time employees aged sixteen to sixty-six. "Full time employee" here is defined as workers (excluding employer and self-employed) with weekly working hours exceeding 35 hours. Self-employed workers, part time workers and those working without pay are excluded from the sample. Our variables for earnings are all calculated from the wage sample which provides accurate wage information by excluding noise from extreme cases.

The complete list and a description of the earnings variables appear in Table 2.2. This hourly wage variable is derived as follows. Firstly, gross earnings before any deduction are divided by the corresponding payment period (weeks). This process is applied for every year of the entire period except 1979-88, during which the GHS provides hourly earnings directly. Although the definitions of hourly earnings in GHS change a little from period to period, which may affect comparability between periods, the consistency of the hourly earnings variable can be taken as satisfactory. Schmitt (1995, p179) also thinks the real gross weekly wage is the most continuous measure of the unit price of labour input in the GHS.

Secondly, real weekly earnings are divided by weekly working hours (*workhrs*) to calculate real hourly earnings. According to the ONS (2006, p3), before 1996 *workhrs* gives the "Usual number of hours worked per week excluding mealtime and overtime". But, after 1996, this variable includes mealtime and overtime. Figure 2.2 describes changes of the weekly working hours by gender. The left vertical axis represents the mean working hours for all full time workers, males and females. The right vertical axis represents the working hours gap between males and females. We can find weekly working hours of all three groups are quite stable over the entire period. Full time males work longer time, about 42 hours per week than females (about 39 hours per week). Moreover, the working hours gender gap has been slowly increasing after the 1970s, from about 2 hours in 1980 to about 4 hours in 2002. Since the working hour variable before 1996 does not include over time, our hourly earnings variable may be affected by the different coverage of the weekly earnings variable and working hour variables in the GHS.

The main concern about our wage variable is likely to be the measurement of overtime hours. Overtime working is commonly regarded as short-term employment adjustment mechanism that enables firms to meet unexpected variations in demand without incurring the fixed costs of hiring or firing workers (e.g. Bils, 1987). Hart et al (2000) find that significant numbers of employees work more hours in the workplace than their contract stipulates. Hence, overtime working is an important part of working hours in the British labour market and the quantitative significance of both paid and unpaid overtime is even greater in the UK (than in Germany).[7] Thus, the

[7] Bell and Hart (2003a, p471) find that about 35% of total male workers and 18% of women in the 1998 NES sample worked overtime. Of the non-managerial men they studied, 49% worked overtime.

missing overtime problem in working hours (ONS 2006, p3) may bring upwards biases in wage rate.

Bell and Hart (2003a, p475-6) show that without national laws regulating overtime assignment or compensation, British overtime premium is independent of overtime hours and the proportions of overtime workers working at given average rates are very similar across the hours groups. Moreover, Bell and Hart (2003b) show that overtime hours and pay are not wholly geared to meeting short-term shifts in production requirements even in labour markets like Britain where statutory overtime rules do not apply. The maximum lengths of standard weekly hours set by many firms follow wider industrial or regional or national collective bargaining norms. These observations are consistent with the view that the conditions for overtime working follow "custom and practice" and a long-term contractual role for overtime, suggesting that the effect of overtime working in our hourly earnings may be stable (Bell and Hart 2003a, p478). Thus, the missing overtime problem in our working hours variable may be not very serious.[8]

Therefore, hourly wage can exclude the effect of working hours from our earnings variable hence be a more accurate measurement. Even though this hourly earnings variable may be affected by the different coverage of the weekly earnings variable and working hour variables in the GHS, hourly earnings is still a better measure of the unit price of labour input than the weekly earnings.[9]

[8] We will discuss more on the working hour problem in different data sources in Chapter 5 and 6.
[9] In fact, the missing overtime problem in the working hours variable does not appear to be serious, because the main conclusions remain. In particular, I still find cyclical patterns for labour demand in Chapter 3. Moreover, Chapter 4's results about increased unskilled trade union power reducing earnings inequality also remain. (The interested reader can find results for weekly earnings in Appendixes to Chapter2 and 3, and in sensitivity tables for Chapter 4).

2.3 Changes in Wage Structure

2.3.1 Mean wage changes by gender

This section provides a broad empirical characterization of the evolution of the wage structure in the UK during the period 1972-2002. Figure 2.3 describes changes of the real hourly wages by gender. The left vertical axis represents the log form mean wage for all full time workers, and for males and females. The right vertical axis represents the wage gap between males and females. We can see that over the entire period, the real hourly wage of all full time workers increases by about 60 percent (from 1.46 in 1972 to 2.06 in 2002).[10] Since about two thirds of the full time workers are males, the mean wage of males has increased by a similar magnitude as the full work force, that is, 50 percent over the entire period (from 1.61 in 1972 to 2.11 in 2002).

At the same time, Figure 2.2 indicates that the mean wage of females has increased by about 90 percent over the last thirty years (from 1.06 in 1972 to 1.96 in 2002). This result implies that the gender gap between males and females has decreased by about 40 percent (=90-50). In 1972, full time males earned about 55 percent (=1.65-1.10) more than females, while wage gap decreased to less than 40 percent in 1980, and then to only 16 percent (=2.10-1.94) in 2002.[11] Since the wage gap between males and females has been decreasing over the last three decades, the narrowing gender gap should decrease overall earnings inequality. Thus, the well

[10] We refer to 100 times log changes as percentage changes.

[11] GHS oversampled married women in the early years so reduction in the wage gap might also reflect this sampling bias. The GHS Summary Quality Report from ONS (2007a) also admits: "one of the limitations of the GHS is that the nature of the sample design means that the precision of survey estimates is reduced ……Although this effect is reduced by the use of stratification it is nevertheless a limitation of the survey." However, we find that the ratio of married women is quite stable in our sample during the period 1972-1995. Thus, the oversample problem on married women may be not very serious in our research.

documented rising earnings inequality in the UK must be from the worsening inequality within rather than between gender groups.

2.3.2 Wage inequality within gender group

In order to illustrate the rising inequality within each gender group, Panel A of Figure 2.4 summarizes movements of wage inequality by gender. It plots the times series of wage inequality for males and females as measured by the log wage differentials between the ninetieth and the tenth percentiles of the wage distribution. Overall hourly wage inequality (90th-10th percentile differentials) increased about 25 percent (from about 1.0 in 1972 to about 1.25 in 2002) for males as well as about 13 percent (from about 1.0 in 1972 to about 1.13 in 2002) for females over the entire period. Moreover, with this long term increasing trend, wage inequality in the UK follows a cyclical pattern over the entire period. The figure shows earnings inequality narrowed in the 1970s, especially for females, and moved up until the early years of the 1990s. After 1995, the rising trend of earnings inequality was definitely reduced for females and kept quite stable for males. This graph is consistent with results of Prasad (2002).

We use the national unemployment rate of males as an indicator of business cycle, which is derived from the Labour Force Survey (LFS, ONS 2007b). Panel A of Figure 2.4 shows that the earnings inequality increases as the labour market becomes loose, *vice versa*. This phenomenon is even more prominent for females. Barlevy and Tsiddon (2006) also find the cyclical pattern of earnings inequality using data that during the first half of the 20th century. They argue that recessions should contribute more to raising inequality when inequality is rising over the long run than when it is falling. Our findings in Panel A are consistent with their model.

Barlevy and Tsiddon (2006) also point that cyclical fluctuations as well as other factors, such as changes in the incidence of unemployment, search and matching, dynamic contracting and so on all affect earnings over the business cycle, and are all important in ultimately shaping the distribution of earnings. Panel B of Figure 2.4 illustrates this image by plotting the cumulative log real wage growth of three groups - the tenth, fiftieth, and ninetieth percentiles of the wage distribution - for males. More precisely, the figure displays the log ratio of each group's real hourly earnings in each year relative to that group's level of real earnings in 1972 (the base year), and gives us a snapshot of the movement in earnings of the three groups.

In Panel B of Figure 2.4, recessions in business cycle correspond to periods of low productivity, so all three groups show procyclical wages, in line with micro evidence from the past thirty years of the UK (Devereux and Hart 2006) and the US (Solon et al 1994). However, wages of the top percentile group are more sensitive to the recovery of business cycle and increase much faster than the middle and bottom percentile group during the 1980s and 1990s. Consequently, wages of the poor group have achieved the least growth (only about 42 percent) among the three groups over the entire period, and then the middle group (about 48 percent), while the wages of the rich group have grown fastest (about 62 percent). Hence, the rich have grown richer at faster pace than the poor in the last thirty years and ultimately reshape the earnings distribution.

For example, responding to the two big unemployment shock around the mid-1980s and the mid-1990s (see also Berthoud 2007, Figure A, p2), wages of the rich group showed very high procyclicality and recovered from the shock very quickly.

Brewer et al (2008) investigate two different sources of data – the Households Below Average Income data-set (HBAI) and the Survey of Personal Incomes (SPI), and also find that the rich have grown richer at faster pace than most workers and their incomes may have accelerated even further in recent years on the back of a rising stock market. They argue that with so many working in finance, there is a strong link between fortunes of the rich group and those of the stock market. Similarly, the graph of the 90th percentile in Panel B maintained high speed over the entire period, maybe due to the ICT booming in production (see O'Mahony et al 2008) and the "dot-com bubble" in financial market covering roughly 1995–2001 (Goldfarb et al 2008, Figure 5-8, p55-58). Hence, wage of the rich group is not only following a long term increasing trend but also highly procyclical to business fluctuation.

Wages of the middle and poor groups also show overall procyclical pattern over time. However, wages of the poor group are not as sensitive as the middle and rich groups to the business recovery around the mid-1980s. Hence, wages of the poor group had been left behind further by the other two groups during the big unemployment shock around the mid-1980s. With the decline of trade union's collective bargaining (see Blanchflower and Bryson 2007), wages of the poor group become more sensitive to business cycle during the 1990s and the 2000s and increase very fast after the unemployment shock of the mid-1990s. This time, it is wages of the middle group that are sticky and insensitive to the business recovery. This result is consistent with the findings of O'Mahony et al (2008, p16) that the intermediate skill groups became more disadvantageous in the 1990s than in the 1980s. O'Mahony et al (2008) also find an increasing complementarity between capital and unskilled labour in the 1990s. Thus, with help of better adaptation for technology in the 1990s, the

earnings of the poor group converged to the middle group quickly over the last years in our sample.[12]

2.4 A standard earnings equation

2.4.1 Evolution of the skill premium

In this section, we apply a standard earnings equation to do repeated cross-section regressions. Workers' educational qualifications and experience are used as skill proxies to analyze the evolution of skill premiums over time. Moreover, we also estimate residual wages after these repeated cross-section regressions. Residual wage inequality is the dispersion of wages after controlling for the measured supply-demand changes of skill groups. Thus, residual inequality is the part of overall inequality unexplained by measurable skill variables such as education and experience.

Hourly earnings are estimated for males and females in a repeated cross-section regression as in Katz et al (1995, p 39, Table 1.2):

$$\ln w_i = a + b_1 Q_i + b_2 Exp_i + b_3 Exp_i^2 + b_4 R_i + b_5 W_i + b_6 M_i + b_7 T_t + e_i \qquad (2.1)$$

The dependent variable $\ln w_i$ is log form real gross hourly pay. Explanatory variables include a vector of five education dummies Q_i: BOLEV, OLEV, ALEV, HIGHER and DEGREE (NOQUAL as the base group); the quadratic experience terms (Exp and Exp^2) to capture the concavity of the experience earnings profile, a vector of four region dummies R_i: MIDLAND, SOUTH, WALES and SCOTLAND (Northern

[12] We discuss the effect of wage setting institutions on wage cyclicality (and earnings inequality) in Chapter 5 and 6 using panel data of three European countries: Italy, Germany and the UK.

England as the base group), an ethnicity dummy set as 1 for white people (W_i), a marital status dummy set as 1 married people (M_i) and a vector of year dummies T_t only for pooled datasets; e_i is an error term. We use Stata's OLS regression programme (*reg,* see Stata 2003a) to estimate equation (2.1).

Table 2.3 presents estimated coefficients for males and females using the pooled datasets of six periods: 1972-76, 1977-81, 1982-86, 1987-91, 1992-96 and 1998-2002. As can be seen, education premiums are represented as the estimated coefficients of the education dummies in equation (2.1). Higher educated workers have a higher level of education premiums for both males and females in each period. For instance, during the period 1998-2002, males in the DEGREE group earn about 68.1 percent more than males in the NOQUAL group, while males in the BOLEV group only earn about 8.7 percent more than the NOQUAL group. The highest return from education is for the DEGREE group, which is about 30 percent higher than the second highest educated group (HIGHER) for both males and females. Hence, more education brings higher earnings. And, degrees from university are the most important education qualification for earnings. This result is consistent with the considerable existing literature on education return e.g. Harmon, Hogan and Walker (2003), Harmon, Oosterbeek and Walker (2003) and Walker and Zhu (2003, 2005).[13]

Education premiums in Table 2.3 have shown a cyclical pattern with an increasing trend over the entire period for males, but this increasing trend is more

[13] For example, Walker and Zhu (2003) demonstrate, mainly using the Labour Force Survey (LFS), that there is a large earnings premium associated with more education – perhaps as much as 10 per cent per additional year of education.

evident after the 1970s.[14] Moreover, the more educated are male workers, the faster do their education premiums grow after the 1970s. This clear ranking in education premium growth after the 1970s is as follows: 12.1 percent for DEGREE (=0.681-0.560), 4.1 percent for HIGHER (=0.4-0.359), about 2 percent for ALEV and OLEV, and no much change for BOLEV. Those males who are more educated seem to have faster wage growth. Consequently, the more dispersed education premiums have pushed up male wage inequality since the 1970s.

Females in Table 2.3 also show that the large earnings premium is associated with more education. And, education premiums of females are higher than those of males (also see Walker and Zhu 2003, Figure 1, p147). However, females' education premiums are more stable and cyclical than males. And, primary education (BOLEV and OLEV) are much more important for females' earnings than for males'. For example, wages of females in the BOLEV group have increased by about 3.08 percent (=0.1517-0.1208) as well as about 5 percent (=0.228-0.1822) in the OLEV group since the 1970s. Earnings premiums of higher educated groups (ALEV, HIGHER and DEGREE) have not changed much over the entire period.

Therefore, we find the earnings premiums of all education groups have been increasing, at least stable after the 1970s for both males and females. With recent rapid expansion of high education (see Figure 2.1), our results suggest that the increased supply of graduates has been absorbed by the labour market, implying that the demand for skills has overwhelmed the supply of skills, at least increased roughly

[14] Repeated cross section regressions do not account for influence of overall pattern of the business cycle on wage earnings, which might cause misspecification problem in our regression. We will follow the standard two step method in Solon et al (1994) and Devereux and Hart (2006) to capture the effect of business cycle in the Chapter 4-6.

in tandem in recent two decades. Our findings are consistent with Harmon, Hogan and Walker (2003) and Walker and Zhu (2005) using different data sources.

The coefficients of quadratic experience are reported in the next four rows in Table 2.4. Similar to education premiums, there is also an increasing trend of the experience premiums for both males and females over the entire period (especially after the 1970s). Moreover, the females' experience premiums increase much faster than males'. As can be seen, the experience premiums of females increase from 3.56 percent in the period 1972-1976 to 4.59 percent in the period 1998-2002, while the experience premiums of males only increase from 4.32 to 4.58 percent.

Considering the quadratic effect of experience, and controlling for other variables, a female worker with 10 years experience would earn about 28.6 percent (=3.56×10-0.07×100) more than a new entrant in the period 1972-1976, while she would earn about 36.9 percent (=4.59×10-0.09×100) more in the period 1998-2002. However, there is no such dramatic increase in the experience premiums of males. Thus, the experience premiums of females have grown faster than males and become similar to males in recent years.

Our regressions also show some other points worthy of mention. Firstly, regional premium is only prominent for the south of England (including the Great London area), which increases from 6.77 percent to 16.01 percent for males, and from 11.56 percent to 16.43 percent for females over the last thirty years. For other regions, there is no continuous significant regional premium compared with the north of England. Hence, only the south of England (including the Great London area) is

different from other regions and the wage gap between the south of England and others is becoming wider, showing it is becoming the most prosperous area in the UK.

Secondly, ethnicity is important for males but not for females (especially in the 1970s and 1980s). Married males earn more than unmarried, while married females may earn a little less, but not significant. Obviously, these control variables contribute little to changes of wage structure (and the increasing earnings inequality). The main measurable variables to explain the higher earnings inequality are skills, i.e. education attainment and its earnings premium (see Gosling, Machin and Meghir 2000, and Harmon, Oosterbeek and Walker 2003).

Finally, R-squared values in Table 2.4 decrease from 36.95 percent in 1972-76 to 19.26 percent in 1998-2002 for males. Much literature also shows that measured characteristics (gender, education and experience) of workers can only explain about thirty percent of wage variations (see Katz et al 1995, p39, Table 1.2). The declining explanatory power of measured characteristics may reflect the inaccuracy of educational qualifications as an approximation of human capital. For instance, Nickell and Bell (1996) argue that primary education quality in the UK has declined, which may decrease the explanatory power of primary education. Since educational qualifications are imperfect proxies of human capital, wage variations from policy changes or other unmeasured characteristics such as ability or education quality are reflected in the residuals of equation (2.1).

2.4.2 Residual wage inequality

We now do the repeated cross-section regressions for each year. After controlling for the characteristics of workers, the distribution of residuals from these regressions may be thought of as capturing the dispersion of wage unexplained by the supply and demand framework. The Panel A of Figure 2.5 plots the 90th-10th percentile differentials of residual earnings for males and females and shows a very similar cyclical pattern to the overall inequality in Figure 2.4. The recessions around the mid-1980s and mid-1990s would contribute to raising residual inequality, while the recovery around the year of 1990 and the 2000s dramatically decrease residual inequality. Our results show that, after controlling for skills (and their cyclicality), residual inequality is still affected by business cycle.

Moreover, if the increase in overall inequality were due solely to rising inequality between education-experience groups, we would expect the residual distribution to show no tendency toward greater inequality. The overall inequality would only stem from changing skill endowments or market valuations of human capital that the earnings regressions would remove from the data (Schmitt 1995, p187). The Panel A of Figure 2.5 seems supportive to Schmitt (1995)'s argument. For example, the residual inequality of females only shows a cyclical movement without tendency toward greater inequality over the entire period (around 0.9 in 1972 and 2002). During which the overall inequality has increased by 13 percent over the same period (see Panel A of Figure 2.4). Hence, changes in the skill endowments and market valuation can fully account for the changes in female earnings inequality over the entire period.

For males, the residual inequality has increased by only 14 percent from 1972 (0.83) to 2002 (0.97), compared with 25 percent in the overall inequality (from about 1.0 in 1972 to about 1.25 in 2002, see Panel A of Figure 2.4). By this crude measure, changes in the skill endowments and market valuation can account for about 44 percent i.e. (25-14)/25 of the changes in male earnings inequality over the entire period. Hence, for males, approximately 56 percent (=14/25) of the increase of overall earnings inequality has occurred within education and experience groups. This result is very similar to Schmitt (1995, p187) who claims that about 60 percent of the increase of earnings inequality occurred within education and experience groups in the period 1978-1988. Therefore, the residual inequality of males shows a cyclical movement with a much less increasing tendency toward greater inequality over the entire period.[15]

Panel B of Figure 2.5 plots the cumulative growth of the tenth, fiftieth, and ninetieth percentiles of males' residual wage. The residual wages of three groups show different sensitiveness to shocks from business cycle, which decides the evolution of residual wage inequality. Firstly, the residual wages of the middle group (or semi-skilled workers) are quite stable around zero and insensitive to shocks from business cycle before 1990. Furthermore, the jump of residual wages around the mid-1990s even shows a counter-cyclical pattern, which may be associated with

[15] The increasing residual or within earnings inequality is a widely observed phenomenon in the USA and UK (see Figures 1.3D, 1.4D in Katz et al 1995, p34, 37). Rosen (1981) pioneers the economics of superstars and argues that the standard competitive model is virtually silent about any special role played by either the size of the total market or the amount of it controlled by few people. MacDonald (1988) emphasises that the young in occupations such as acting and finance earn well below what their current alternative offers, and success is rare and rewarded highly in these occupations (also see Brewer et al 2008). Even with the same skill qualifications, most young participants will not become superstars in these occupations and are paid less than their peers in other occupations at least, which presumably increases the within earnings inequality.

disadvantage of semi-skilled workers in capital complementarity in the 1990s (see O'Mahony et al 2008). Hence, compared with the middle group in Figure 2.4, wage procyclicality with the increasing trend of the middle group has been represented by changes in skill endowments and market valuation.

Secondly, the residual wages of the poor group are also quite stable around zero and insensitive to business cycle during the 1970s and the 1980s. However, after 1990, their residual wages show high procyclicality and become very sensitive to the recovery of business cycle. Hence, the tenth percentile of residual wages increases very fast and quickly converges to the middle group in the last ten years of our sample. This result is consistent with O'Mahony et al (2008) which find an increasing complementarity between capital and unskilled labour in the 1990s.

Finally, the residual wages of the rich group only show an increasing trend without clear cyclicality. Hence, the 90th-50th percentile differentials of residual wages have been increasing after the 1970s. Compared with the rich group in Figure 2.4, wage procyclicality and its partial increasing trend of the rich group have been represented by changes in skill endowments and market valuation. Thus, the increasing residual wage inequality of males is mainly from the increasing trend of the rich group, which cannot be explained by changes in skill endowments and premiums.

2.5 Conclusions

Through a standard earnings equation, we do repeated cross-section regressions for real wages of males and females. The basic changes in the British wage structure can be summarized as follows:

1. The overall real hourly wage has increased about 60 percent in the UK from 1972 to 2002. Gender premiums have been decreasing over the last thirty years. Wages of females increase by 40 percent relative to the wages of males.

2. Overall hourly wage inequality (90th-10th percentile differentials) increased about 25 percent for males as well as about 13 percent for females over the entire period. Wage inequality shows a cyclical pattern, which may be from the different wage cyclicality of the top, middle and bottom percentile groups.

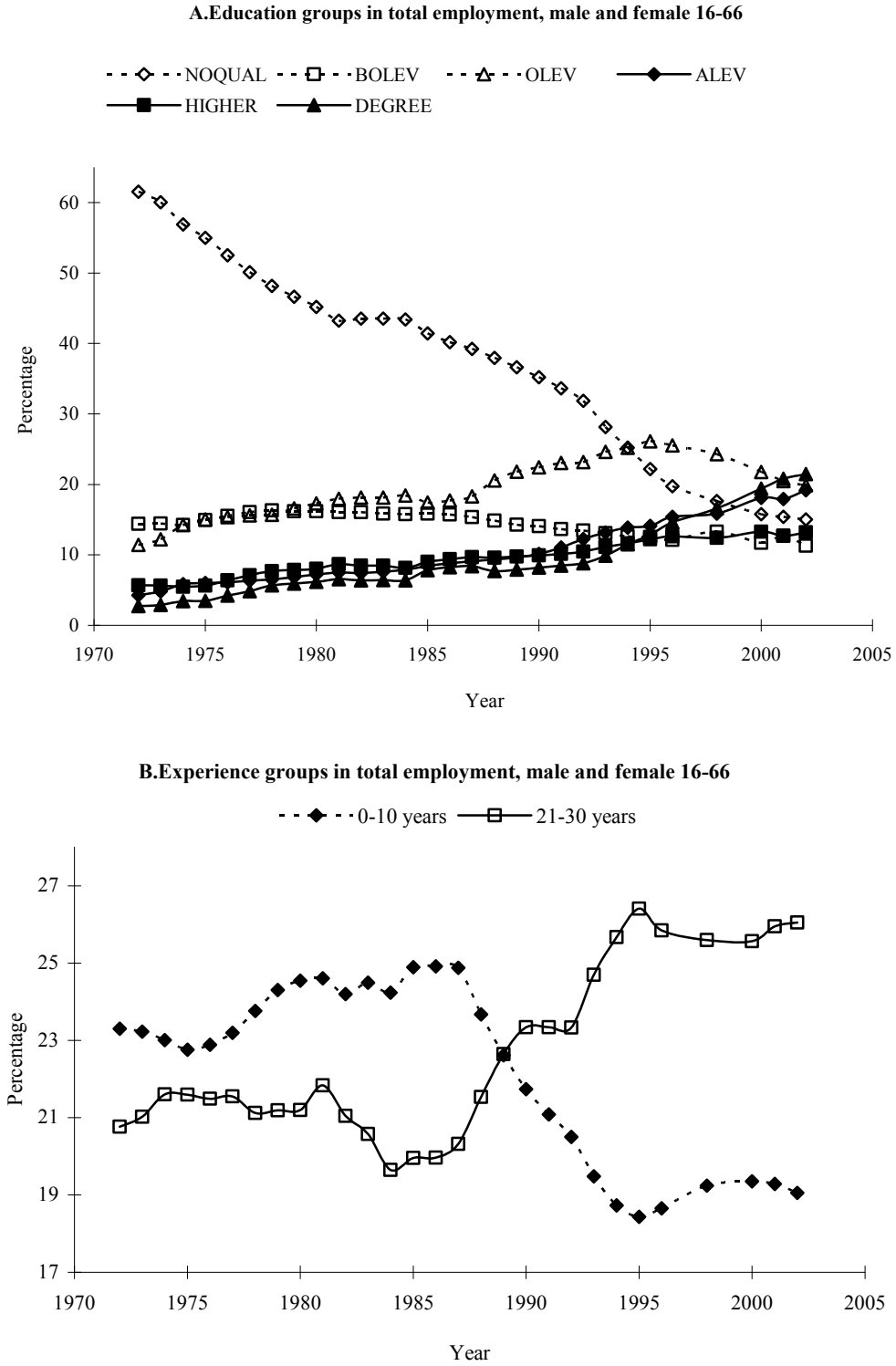
3. The education premiums of males also show a cyclical pattern with somewhat increasing trend, especially after the 1970s. Higher educated male workers have experienced a faster growth of the education premiums so that the wages of males have become more dispersed after the 1970s. However, female workers with only primary education have faster wage growth than higher educated ones. Moreover, the experience premiums of females have grown faster than males and become similar to males in recent years.

5. Changes in the skill endowments and market valuation can fully account for the changes in female earnings inequality over the entire period. However, the residual earnings inequality accounts for about 56 percent of changes in overall earnings inequality of males, which cannot be explained by changes in skill endowments and market returns.

6. The evolution of the wage structure, including changes in gender gap, overall wage inequality, skill premiums as well as residual wage inequality are

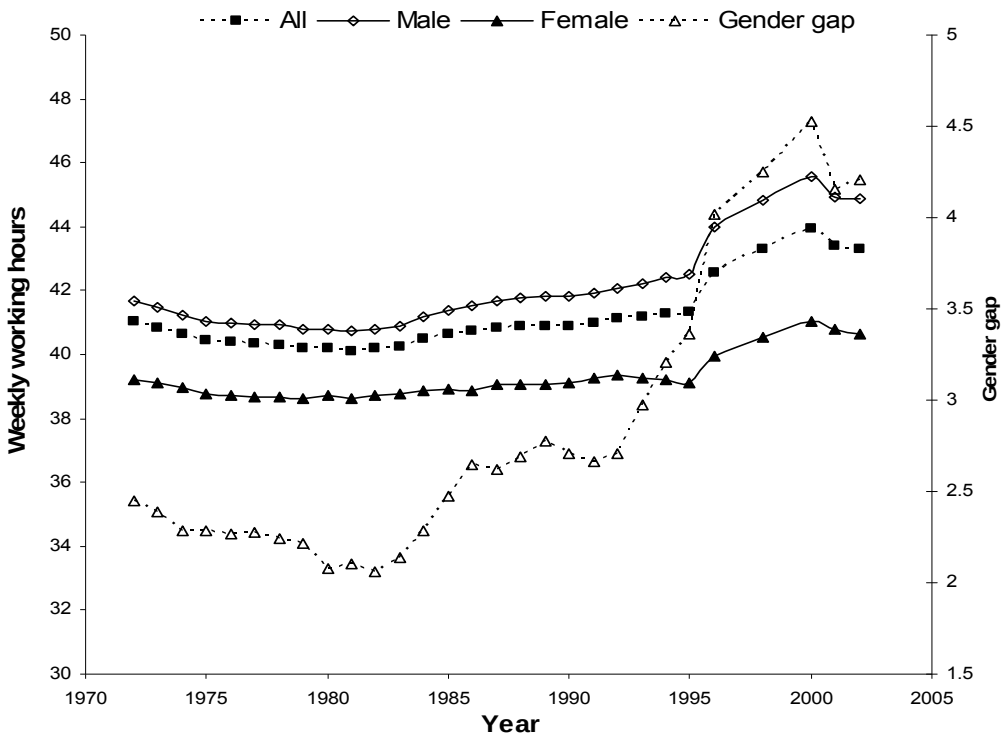
induced not only by business cycle, but also by different type of technological changes and institution evolution. Our results demand further analysis on labour market performance with those underpinning forces.

Figure 2.1: Relative skill shares in total employment



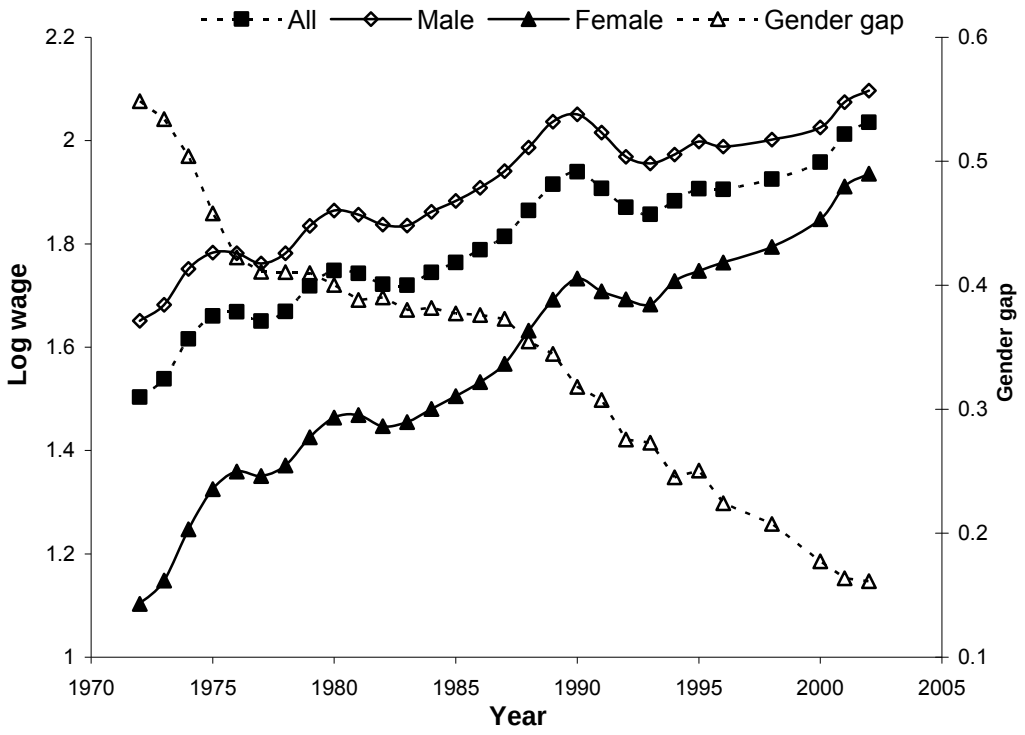
Sources: General Household Surveys 1972-2002. All numbers are from the males and females aged 16-66. Except the first and last years (1972 and 2002), all points are three-year averages.

Figure 2.2: Mean working hours changes by gender, the GHS 1972-2002



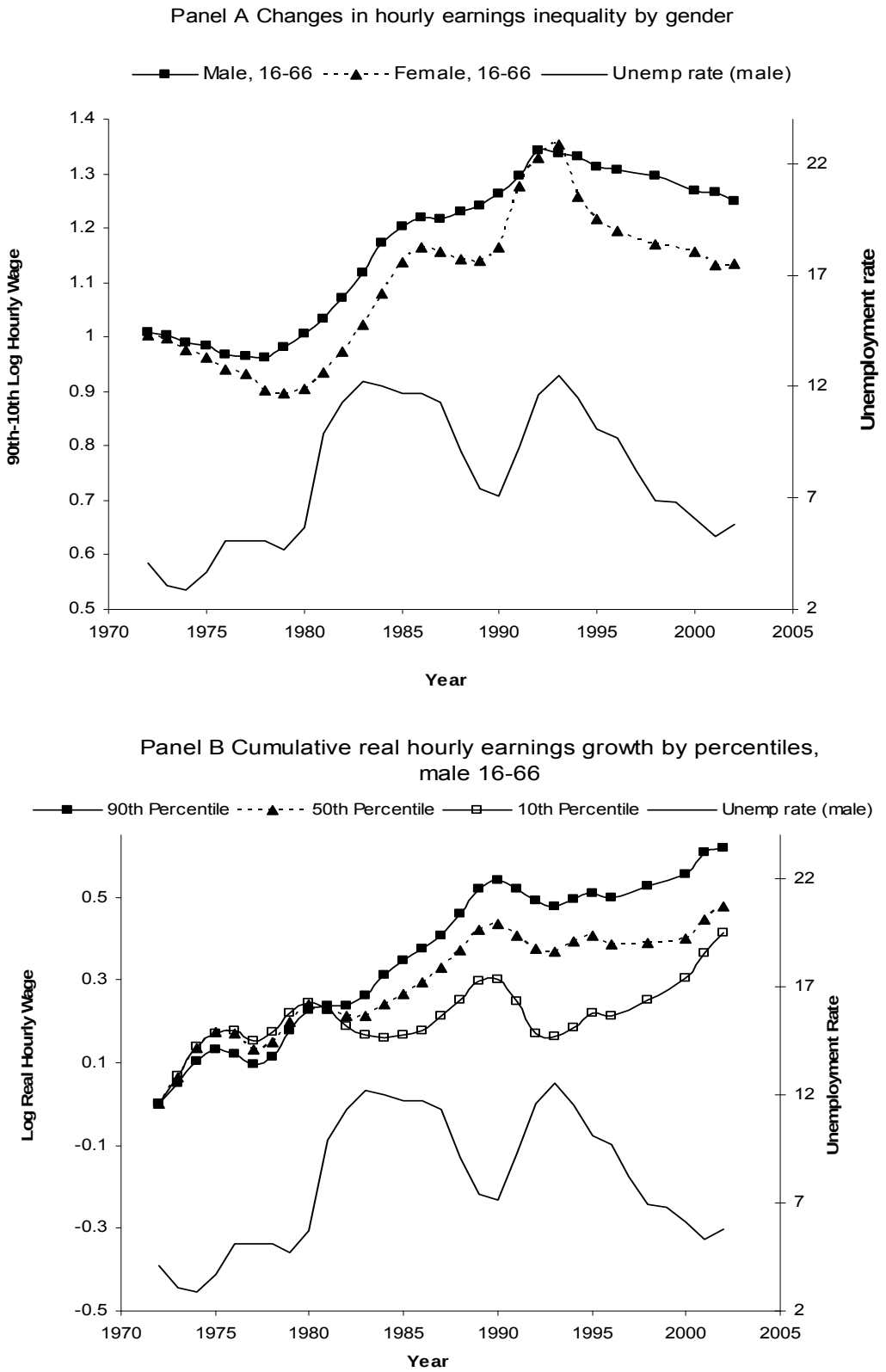
Sources: General Household Surveys 1972-2002. All numbers are from the full-time workers aged 16-66 (*workhrs*>35). Except the first and last years (1972 and 2002), all points are three-year averages.

Figure 2.3: Mean wage changes by gender, the GHS 1972-2002



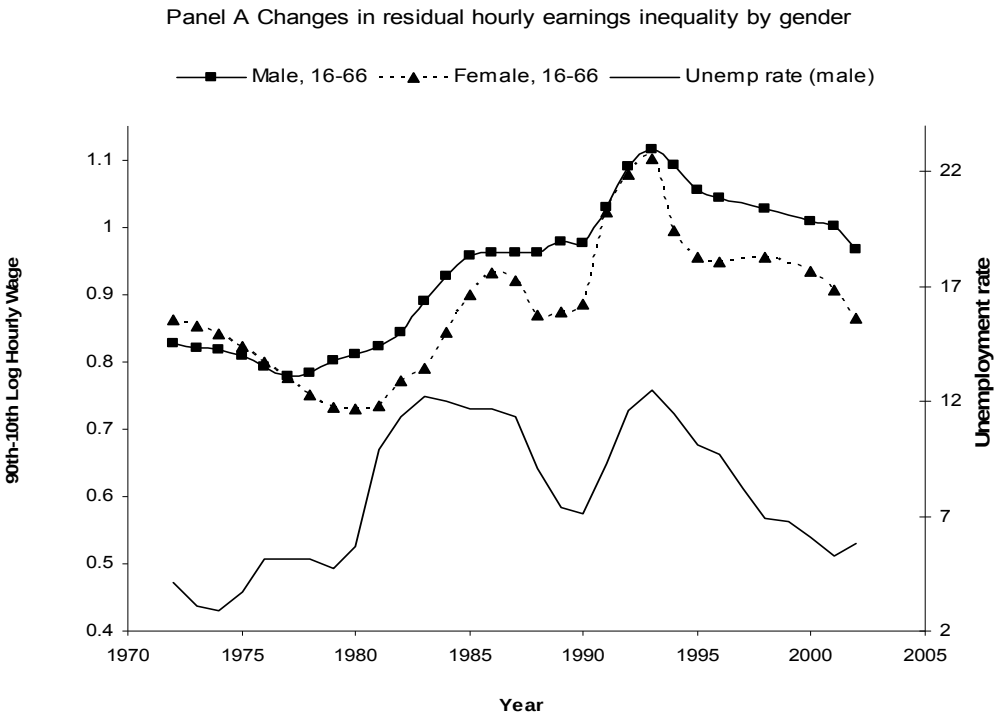
Note: The numbers in the figure represent log hourly wages using data from the General Household Surveys, 1972-2002. Wage samples include full-time workers aged 16-66 years who were not self-employed and all earnings numbers are deflated based on 1995 pounds. Except the first and last years (1972 and 2002), all points are three-year averages.

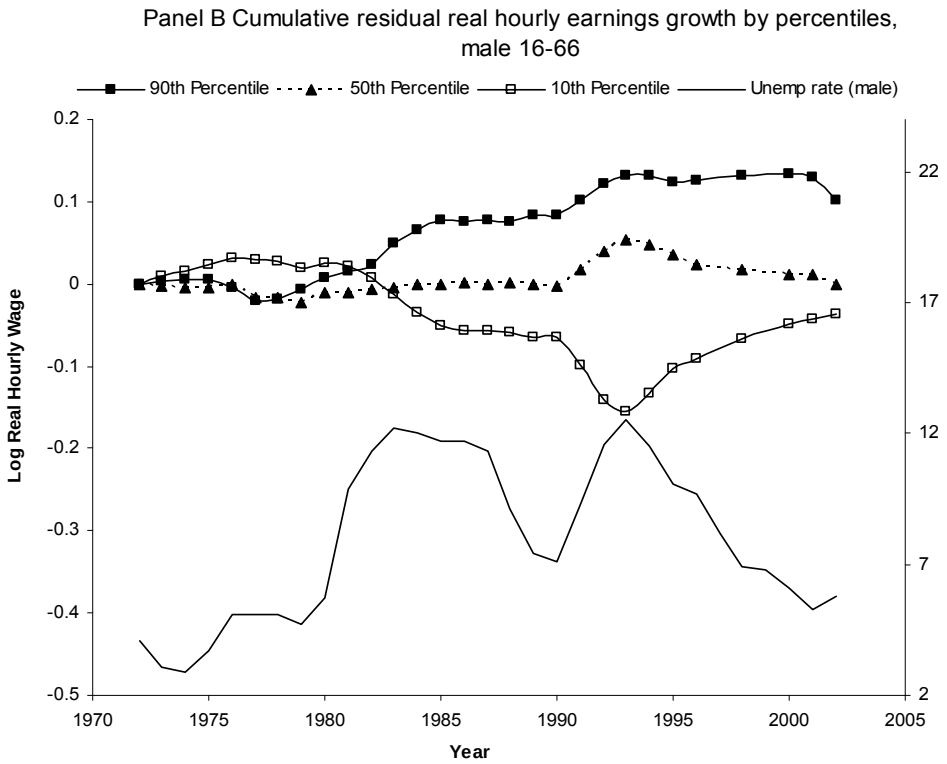
Figure 2.4: Wage inequalities in the UK



Note: The numbers in the figure represent log changes in hourly wages using data from the General Household Surveys, 1972-2002. Wage samples include full-time workers aged 16-66 years who were not self-employed and all earnings numbers are deflated based on 1995 pounds. Except the first and last years (1972 and 2002), all points are three-year averages.

Figure 2.5: Residual wage inequalities in the UK





Note: The numbers in the figure represent log changes in hourly wages using data from the General Household Surveys, 1972-2002. Wage samples include full-time workers aged 16-66 years who were not self-employed and all earnings numbers are deflated based on 1995 pounds. Except the first and last years (1972 and 2002), all points are three-year averages.

Table 2.1a: Education qualification variables in the GHS 1972-2002

Variable	Description
NOQUAL	*NOQUAL* includes: Without any qualification or never attended school.
Below O-LEVEL	*Below O-LEVEL* includes: *CLERICAL*: Commerce and clerical qualification without O-levels; *OTHER* : CSE grade 2-5 and CSE below grade 1, GCSE below grade c, O-level degraded, SCE degraded, plus all remaining qualifications, which consist mainly of local or regional school-leaving certificates and college or professional awards no regarded as " higher educational", i.e. not above GCE A-level or O-level standard; *FOREIGN*: foreign qualification; etc. *VOC-OTHER*: Miscellaneous apprenticeships;
O-LEVEL	*O-LEVEL* includes: *O-LEVEL 5+* and equivalent: Five or more subjects at GCE O-level obtained before 1975 or in grades A-C if obtained later, five or more subjects at SCE Ordinary obtained before 1973 or in bands A-C if obtained later, five or more subjects at CSE grade 1 or at School Certificate, SLC Lower, or SUPE Lower; *O-LEVEL 1-4* and equivalent: Less than five O-LEVELS with or without clerical or commercial qualification such as typing, shorthand, bookkeeping, commerce etc; *VOC-LOW:* City and Guilds Craft or Ordinary etc;
A-LEVEL	*A-LEVEL* and equivalent includes: *GCE A-level* in one, two or more subjects, Scottish Leaving Certificate (*SLC*), Scottish Certificate of Education (*SCE*), Scottish University Preliminary Examination (*SUPE*) at Higher Grade, Certificate of Sixth Year Studies; *VOC-MIDDLE:* City and Guilds Advanced or Final, Ordinary National Certificate (*ONC*) or Diploma (*OND*), BEC/TEC National, General, or Ordinary etc.
HIGHER EDUCATION	*HIGHER EDUCATION* includes: *TEACHING*: Non-graduate teaching qualifications (Census Level C); *NURSING*: Nursing qualifications (e.g. SEN,SRN,SCM); *VOC-HIGH:* *HND* and equivalent: Higher National Diploma [HND]/Higher National Certificate [HNC], BEC/TEC Higher Certificate or Higher Diploma; City and Guilds Full Technological Certificate, qualifications obtained from colleges of further education or from professional institutions below degree level but above GCE *A-level* standard
DEGREE	*DEGREE* includes: Higher degrees (Census Level A), first degree, university diploma or certificate, qualifications obtains from colleges of further education or from professional institutions of degree standard (Census Level B)

Table 2.1b: Recoding process of six education groups in the GHS 1972-2002

Years	Variable	NOQUAL	Below O-LEVEL	O-LEVEL	A-LEVEL	Higher Education	Degree
1972-1982	**hedqual**	(0=0) no qual	(10/14=8) clerical & comm qual; cse other; apprenticeship; any foreign qual; other qual.	(7/9=11) gce'o'level-5 or more; gce'o'1-4,with c&c; gce'o' 1-4,no c&c	(6=12) gce'a'level, onc, ond	(3/5=14) teaching qual-non gr; hnc, hnd, tech cert; nursing qual.	(1 2=15) higher degrees 1st ; degree, univ. dip
1983-1988	**edlev**	(16/20=0) no quals; never went to school	(11/15=8) com qual no o levels; cse grades 2-5; apprenticeship; foreign quals; other qual.	(8/10=11) gce o level 5+; gce o lev1-4 & cq; gce o lev1-4 no cq	(6 7=12) gce a level 2+; gce a level 1	(3/5=14) teaching qual; other higher qual; nursing qual	(1 2=15) higher degree ; first degree
1989-1998	**edlev2**	(8=0) none	(5/7=8) cse gra2-5 equiv; sg 6-7 no award; foreign, other	(4=11) gcse olev equiv	(3=12) gce alevel equiv	(2=14) <degree higher q	(1=15) degree or equiv
2000-2002	**edlev00**	(-9 13=0) no qual	(10/12=8) cse below grade 1; gcse below grade c; apprenticeship; other qualification	(8/9=11) gcse/olevel, standard grades, 5+; gcse/olevel 1-4	(6 7=12) gce a level in two or more subjects; gce a level in one subject	(3/5=14) teaching qual; other higher qual; nursing qual	(1 2=15) higher degree; first degree

Sources: The General Household Survey 1972-2002.

Notes: Adapted from Table 5.1 in Schmitt (1995, p181) and Code manuals of the General Household Survey 1972-2002 (ONS, 2004). Even with the same name, variables may change in definition and label value. For example, "edlev" in 1986 and 1987 is different since the latter year includes one more qualifications and changes the label values. Another example is that the "other qualification" in "edlev00" is not directly comparable with "other qualification" in previous GHS "edlev" output categories. It was not possible to separate foreign qualifications and other qualifications given the current set of questions. The foreign qualifications do not exist in the period 2000-2002. Even though these changes may affect the comparability between different time periods (jumps are found in the aggregate the NOQUAL group in 1983 and the OLEV group in 1986), the consistency of this broad education categorization is satisfactory over the entire period.

Table 2.2: Calculation of weekly/hourly earnings variable

Years	Variable of Earnings	Corresponding Working Weeks	Weekly Earnings	Weekly Working Hours	Hourly Earnings
1972-1978	incempx	incempw	incempx /incempw	workhrs	incempx /incempw /workhrs
1979-1982	-	-	payweek	workhrs	payweek/ workhrs
1983-1986	paygross	payperd (perd)	paygross /perd	workhrs	paygross /perd /workhrs
1987-1991	-	-	uge	workhrs	uge /workhrs
1992-1996	-	-	geind	workhrs	geind /workhrs
1998-2002	-	-	grearn	workhrs	grearn /workhrs

Sources: Code manuals of the General Household Surveys 1972-2002 (ONS, 2004).
Note: Definition of earnings variables in the GHS:
Incempx: Gross income from employment in last year.
Incempw: No. weeks income from employment in last year.
Workhrs: No. hours worked per week in main job -excluding meals and overtime.
Payweek: Gross weekly earnings from main job.
Paygross: Gross pay of last time from main job before any deduction.
Payperd (perd): Period covered by last wage or salaries, which is corresponding working weeks of *paygross*[16].
Uge: Usual gross weekly earnings from main job and other jobs.
Geind: Usual gross weekly earnings from main job and second job.
Grearn: Gross weekly earned income from main job and second job.

For years 1972-1978, weekly earnings were derived from all earnings including wages, salaries, tips, bonus and commissions in all jobs held in the previous twelve months. For years 1979-1986, weekly earnings were estimated as the usual gross earnings including tips and bonuses per pay period from the worker's main job, divided by the usual number of weeks covered in each pay period. In the 1987-2002 surveys, weekly earnings include all income earned from the main job and other (or second) jobs. These changes may affect comparisons of earnings between different two periods, but no evident discontinuity is found. On the other hand, weekly earnings include payments for bonuses and overtime but the measurement of working hours per week excludes overtime which varies across individuals and over the business cycle. That implied that hourly earnings in this paper may suffer upwards bias, though the GHS is still consistent and comparable with the hourly earnings from other datasets.

[16] *Perd* is a variable derived by author from *payperd,* according to rules: one calendar month = 4.3 weeks, one quarter =13 weeks.

Table 2.3: Log Hourly Earnings Equations, the GHS 1972-2002. Estimation from equation (2.1)

A. Males (full time workers)						
	1972-1976	**1977-1981**	**1982-1986**	**1987-1991**	**1992-1996**	**1998-2002**
BOLEV	0.1030***	0.0851***	0.0935***	0.1152***	0.1097***	0.0870***
	(0.0053)	***(0.0062)***	***(0.0084)***	***(0.0099)***	***(0.0147)***	***(0.0229)***
OLEV	0.2123***	0.1656***	0.1863***	0.2066***	0.1664***	0.1826***
	(0.0060)	***(0.0066)***	***(0.0084)***	***(0.0090)***	***(0.0124)***	***(0.0203)***
ALEV	0.2986***	0.2558***	0.2927***	0.3344***	0.2922***	0.2720***
	(0.0079)	***(0.0081)***	***(0.0098)***	***(0.0101)***	***(0.0135)***	***(0.0210)***
HIGHER	0.4434***	0.3589***	0.4216***	0.4478***	0.3894***	0.3999***
	(0.0087)	***(0.0086)***	***(0.0099)***	***(0.0102)***	***(0.0140)***	***(0.0227)***
DEGREE	0.6593***	0.5602***	0.5917***	0.6683***	0.6145***	0.6810***
	(0.0104)	***(0.0091)***	***(0.0102)***	***(0.0105)***	***(0.0138)***	***(0.0206)***
EXP	0.0432***	0.0407***	0.0481***	0.0516***	0.0481***	0.0458***
	(0.0006)	***(0.0008)***	***(0.0010)***	***(0.0011)***	***(0.0015)***	***(0.0021)***
EXP2	-0.0008***	-0.0007***	-0.0009***	-0.0009***	-0.0009***	-0.0008***
	(0.0000)	***(0.0000)***	***(0.0000)***	***(0.0000)***	***(0.0000)***	***(0.0000)***
MIDLAND	0.0169***	0.0054	-0.0058	0.0238***	0.0598***	0.0158
	(0.0059)	***(0.0066)***	***(0.0086)***	***(0.0090)***	***(0.0122)***	***(0.0181)***
SOUTH	0.0677***	0.0658***	0.0953***	0.1513***	0.1696***	0.1601***
	(0.0048)	***(0.0054)***	***(0.0069)***	***(0.0073)***	***(0.0097)***	***(0.0144)***
WALES	-0.0059	-0.0265***	-0.0135	-0.0601***	-0.0488***	0.0011
	(0.0094)	***(0.0110)***	***(0.0138)***	***(0.0150)***	***(0.0208)***	***(0.0290)***
SCOTLAND	0.0062	-0.0005	0.0133	-0.0052	0.0014	0.0187
	(0.0062)	***(0.0081)***	***(0.0105)***	***(0.0118)***	***(0.0153)***	***(0.0228)***
WHITE	0.0506***	0.0455***	0.0648***	0.1190***	0.1218***	0.0408*
	(0.0095)	***(0.0097)***	***(0.0135)***	***(0.0149)***	***(0.0199)***	***(0.0261)***
MARRIED	0.2124***	0.1830***	0.1658***	0.1671***	0.1818***	0.1063***
	(0.0059)	***(0.0066)***	***(0.0085)***	***(0.0089)***	***(0.0121)***	***(0.0158)***
y1	0.0662***	-0.0985***	-0.0501***	-0.0724***	-0.0289***	0.0599***
	(0.0059)	***(0.0068)***	***(0.0086)***	***(0.0093)***	***(0.0123)***	***(0.0164)***
y2	0.1209***	-0.0810***	-0.0449***	0.0005	-0.0480***	0.0799***
	(0.0061)	***(0.0068)***	***(0.0088)***	***(0.0094)***	***(0.0125)***	***(0.0161)***
y3	0.1848***	0.0026	-0.0450***	0.0245***	0.0053	0.1340***
	(0.0059)	***(0.0069)***	***(0.0089)***	***(0.0092)***	***(0.0127)***	***(0.0163)***
y4	0.1409***	0.0541***	-0.0067	0.0382***	-0.0122	-
	(0.0060)	***(0.0069)***	***(0.0088)***	***(0.0094)***	***(0.0127)***	-
R^2	0.3695	0.3160	0.3424	0.3707	0.2352	0.1926
N	34,086	30,300	21,329	21,635	18,543	12,239

Continued

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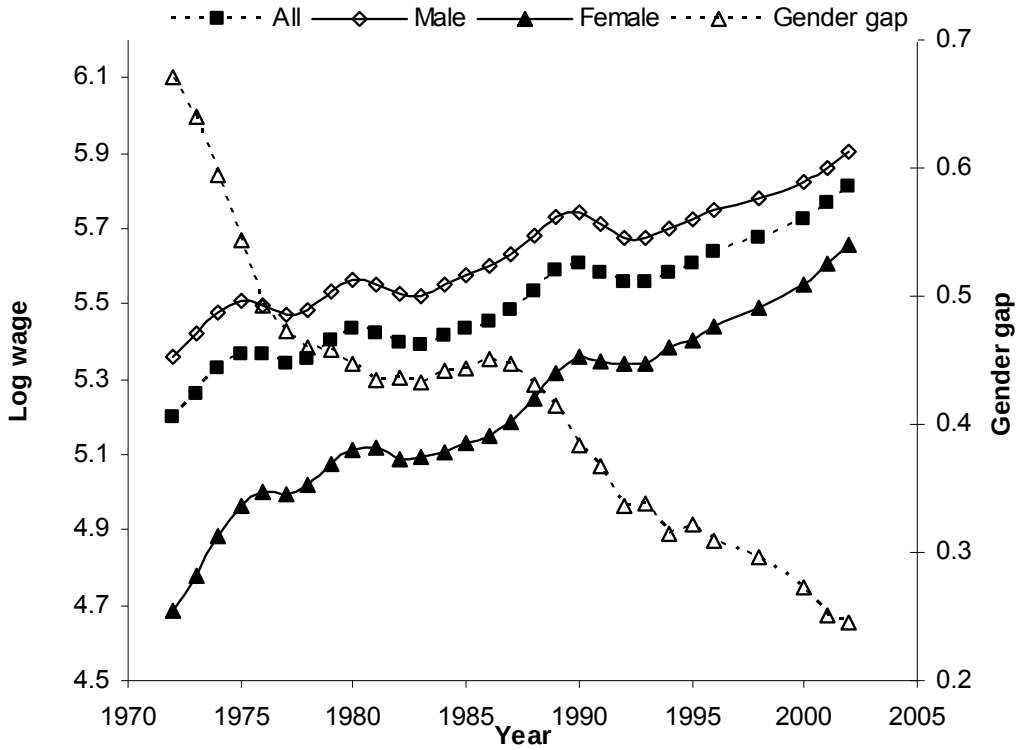
B. Females (full time workers)						
	1972-1976	**1977-1981**	**1982-1986**	**1987-1991**	**1992-1996**	**1998-2002**
BOLEV	0.1525***	0.1208***	0.1183***	0.1460***	0.1750***	0.1517***
	(0.0098)	***(0.0105)***	***(0.0135)***	***(0.0134)***	***(0.0193)***	***(0.0299)***
OLEV	0.2293***	0.1822***	0.2259***	0.2804***	0.2392***	0.2280***
	(0.0097)	***(0.0101)***	***(0.0123)***	***(0.0119)***	***(0.0165)***	***(0.0271)***
ALEV	0.3787***	0.3345***	0.3551***	0.4331***	0.3524***	0.3326***
	(0.0180)	***(0.0169)***	***(0.0172)***	***(0.0156)***	***(0.0199)***	***(0.0278)***
HIGHER	0.4663***	0.4490***	0.4834***	0.5864***	0.5473***	0.4588***
	(0.0162)	***(0.0143)***	***(0.0159)***	***(0.0148)***	***(0.0195)***	***(0.0291)***
DEGREE	0.7357***	0.6720***	0.6690***	0.7679***	0.7223***	0.6799***
	(0.0270)	***(0.0208)***	***(0.0185)***	***(0.0165)***	***(0.0202)***	***(0.0270)***
EXP	0.0356***	0.0341***	0.0424***	0.0460***	0.0447***	0.0459***
	(0.0011)	***(0.0012)***	***(0.0015)***	***(0.0014)***	***(0.0019)***	***(0.0025)***
EXP2	-0.0007***	-0.0006***	-0.0008***	-0.0009***	-0.0009***	-0.0009***
	(0.0000)	***(0.0000)***	***(0.0000)***	***(0.0000)***	***(0.0000)***	***(0.0001)***
MIDLAND	-0.0156	0.0129	-0.0239*	-0.0036	0.0304**	0.0144
	(0.0110)	***(0.0114)***	***(0.0136)***	***(0.0125)***	***(0.0164)***	***(0.0224)***
SOUTH	0.1156***	0.1014***	0.1247***	0.1746***	0.1753***	0.1643***
	(0.0087)	***(0.0090)***	***(0.0108)***	***(0.0100)***	***(0.0129)***	***(0.0176)***
WALES	-0.0244	-0.0311*	0.0019	-0.0661***	-0.0467*	0.0180
	(0.0173)	***(0.0181)***	***(0.0226)***	***(0.0206)***	***(0.0268)***	***(0.0349)***
SCOTLAND	-0.0051	0.0069	0.0075	0.0122	0.0198	0.0524**
	(0.0103)	***(0.0131)***	***(0.0159)***	***(0.0155)***	***(0.0199)***	***(0.0266)***
WHITE	0.0218	0.0085	0.0299	0.0194	0.0321	0.0726***
	(0.0165)	***(0.0156)***	***(0.0204)***	***(0.0176)***	***(0.0228)***	***(0.0280)***
MARRIED	-0.0127	-0.0016	-0.0148	-0.0033	0.0266**	-0.0243
	(0.0084)	***(0.0092)***	***(0.0111)***	***(0.0106)***	***(0.0138)***	***(0.0183)***
y1	0.0593***	-0.0116	0.0131	0.0679***	-0.0806***	0.0695***
	(0.0105)	***(0.0114)***	***(0.0135)***	***(0.0127)***	***(0.0163)***	***(0.0200)***
y2	0.1569***	0.0855***	0.0094	0.1282***	-0.0406***	0.0949***
	(0.0107)	***(0.0114)***	***(0.0138)***	***(0.0127)***	***(0.0166)***	***(0.0195)***
y3	0.2727***	0.1396***	0.0310**	0.1394***	-0.0096	0.1534***
	(0.0105)	***(0.0113)***	***(0.0136)***	***(0.0129)***	***(0.0165)***	***(0.0197)***
y4	0.2782***	0.0905***	0.0312**	0.1286***	0.0065	-
	(0.0106)	***(0.0114)***	***(0.0137)***	***(0.0128)***	***(0.0165)***	-
R^2	0.2786	0.2360	0.2660	0.3280	0.2136	0.1771
N	12,833	11,891	9,440	11,501	10,496	7,459

Note: The numbers in the table represent the estimated coefficients and standard errors using the pooled GHS datasets of six periods: 1972-76, 1977-81, 1982-86, 1987-91, 1992-96 and 1998-2002. Samples include full-time workers aged 16-66 years who were not self-employed and all hourly earnings numbers are deflated based on 1995 pounds. The dependent variable is log gross hourly pay. Explanatory variables include a vector of five education dummies (BOLEV, OLEV, ALEV, HIGHER and DEGREE, NOQUAL as the base group), the quadratic in experience (Exp and Exp^2), four region dummies (MIDLAND, SOUTH, WALES and SCOTLAND, the North of England as the base group), an ethnicity dummy (WHITE), a marital status dummy (MARRIED) and a vector of year dummies. ***, ** and * denote significance at 1%, 5% and 10% levels for two-tail tests. We use Stata's OLS regression programme (*reg,* see Stata 2003a) to estimate equation (2.1).

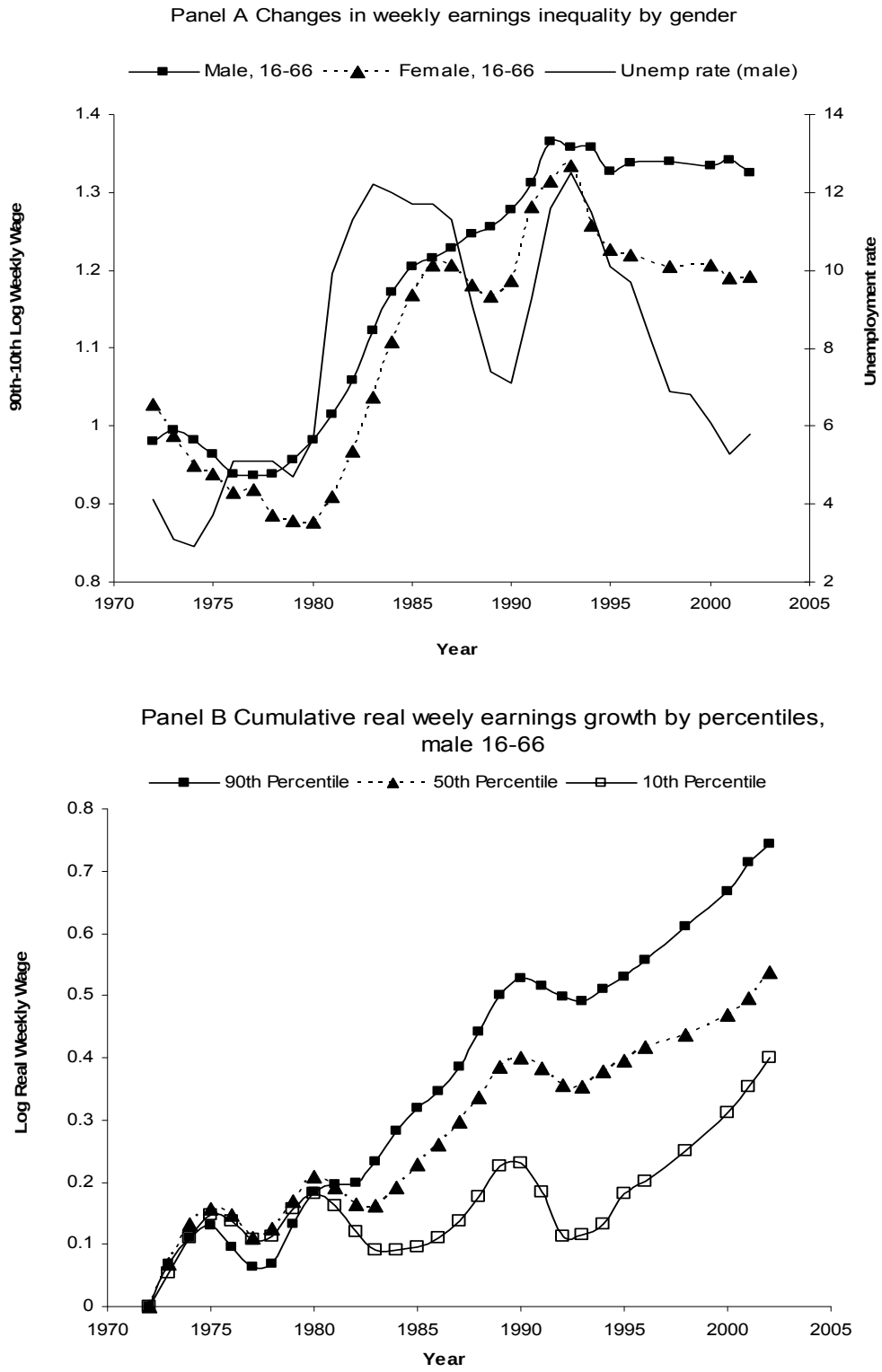
Appendix 2.1 Results using weekly earnings

Figure A2.1: Weekly wage changes by gender, the GHS 1972-2002



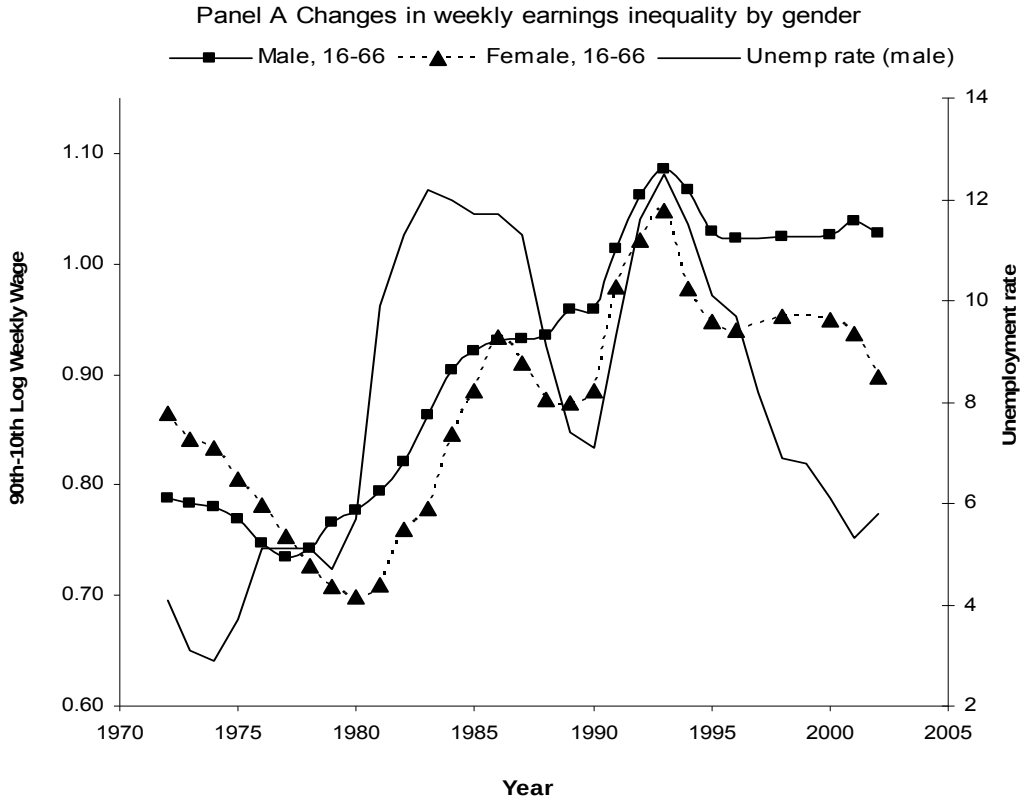
Note: The numbers in the figure represent log weekly wages using data from the General Household Surveys, 1972-2002. Wage samples include full-time workers aged 16-66 years who were not self-employed and all earnings numbers are deflated based on 1995 pounds. Except the first and last years (1972 and 2002), all points are three-year averages.

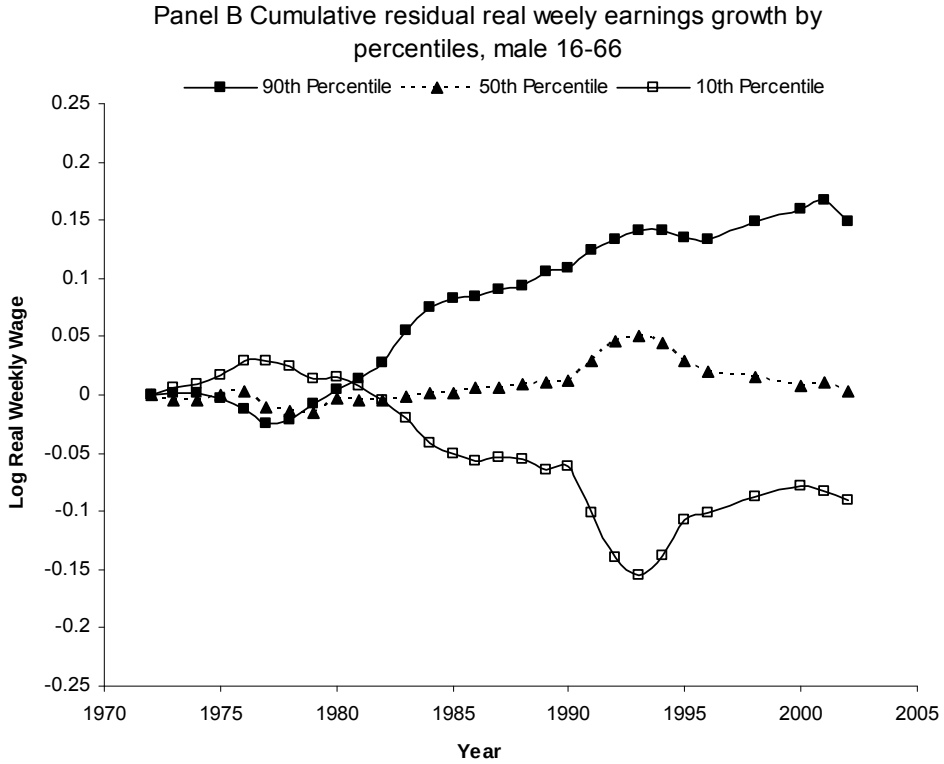
Figure A2.2: Weekly wage inequalities in the UK



Note: The numbers in the figure represent log changes in weekly wages using data from the General Household Surveys, 1972-2002. Wage samples include full-time workers aged 16-66 years who were not self-employed and all earnings numbers are deflated based on 1995 pounds. Except the first and last years (1972 and 2002), all points are three-year averages.

Figure A2.3: Residual weekly wage inequalities in the UK





Note: The numbers in the figure represent log changes in weekly wages using data from the General Household Surveys, 1972-2002. Wage samples include full-time workers aged 16-66 years who were not self-employed and all earnings numbers are deflated based on 1995 pounds. Except the first and last years (1972 and 2002), all points are three-year averages.

Table A2.1: Log Weekly Earnings Equations, GHS 1972-2002. Estimation from equation (2.1).

A. Males (full time workers)						
	1972-1976	**1977-1981**	**1982-1986**	**1987-1991**	**1992-1996**	**1998-2002**
BOLEV	0.0891***	0.0768***	0.0887***	0.1234***	0.1206***	0.0972***
	(0.0043)	***(0.0064)***	***(0.0088)***	***(0.0118)***	***(0.0154)***	***(0.0253)***
OLEV	0.2030***	0.1417***	0.1747***	0.2137***	0.1601***	0.1902***
	(0.0046)	***(0.0065)***	***(0.0084)***	***(0.0104)***	***(0.0128)***	***(0.0221)***
ALEV	0.2775***	0.2265***	0.2800***	0.3409***	0.2914***	0.2812***
	(0.0061)	***(0.0078)***	***(0.0096)***	***(0.0115)***	***(0.0137)***	***(0.0226)***
HIGHER	0.4052***	0.3261***	0.4114***	0.4595***	0.3744***	0.4173***
	(0.0066)	***(0.0083)***	***(0.0098)***	***(0.0116)***	***(0.0142)***	***(0.0241)***
DEGREE	0.6459***	0.5241***	0.5957***	0.6906***	0.6378***	0.7109***
	(0.0080)	***(0.0087)***	***(0.0101)***	***(0.0119)***	***(0.0139)***	***(0.0220)***
EXP	0.0515***	0.0487***	0.0623***	0.0608***	0.0567***	0.0554***
	(0.0007)	***(0.0009)***	***(0.0011)***	***(0.0014)***	***(0.0018)***	***(0.0026)***
EXP2	-0.0010***	-0.0010***	-0.0012***	-0.0011***	-0.0011***	-0.0010***
	(0.0000)	***(0.0000)***	***(0.0000)***	***(0.0000)***	***(0.0000)***	***(0.0001)***
MIDLAND	0.0167***	0.0086	-0.0057	0.0491***	0.0694***	0.0276
	(0.0047)	***(0.0066)***	***(0.0087)***	***(0.0104)***	***(0.0124)***	***(0.0191)***
SOUTH	0.0688***	0.0748***	0.1011***	0.1833***	0.1944***	0.1805***
	(0.0039)	***(0.0054)***	***(0.0070)***	***(0.0085)***	***(0.0098)***	***(0.0151)***
WALES	-0.0156**	-0.0007	-0.0232	-0.0534***	-0.0406**	0.0130
	(0.0076)	***(0.0110)***	***(0.0155)***	***(0.0174)***	***(0.0210)***	***(0.0304)***
SCOTLAND	0.0042	0.0107	0.0242***	0.0013	0.0058	0.0159
	(0.0048)	***(0.0081)***	***(0.0102)***	***(0.0135)***	***(0.0156)***	***(0.0238)***
WHITE	0.0645***	0.0507***	0.0808***	0.1262***	0.1506***	0.0560**
	(0.0069)	***(0.0095)***	***(0.0133)***	***(0.0168)***	***(0.0201)***	***(0.0270)***
MARRIED	0.2338***	0.1787***	0.1433***	0.1929***	0.1945***	0.1292***
	(0.0050)	***(0.0066)***	***(0.0089)***	***(0.0102)***	***(0.0122)***	***(0.0163)***
y1	0.0569***	-0.1455***	0.0047	-0.1112***	-0.0428***	-0.0183
	(0.0047)	***(0.0068)***	***(0.0087)***	***(0.0107)***	***(0.0125)***	***(0.0172)***
y2	0.1059***	-0.1346***	0.0111	-0.0353***	-0.0615***	0.0167
	(0.0048)	***(0.0068)***	***(0.0090)***	***(0.0109)***	***(0.0127)***	***(0.0168)***
y3	0.1565***	-0.0470***	0.0157*	-0.0049	0.0021	0.0665***
	(0.0047)	***(0.0069)***	***(0.0091)***	***(0.0106)***	***(0.0128)***	***(0.0170)***
y4	0.1196***	-0.0587***	0.0490***	-0.0356***	-0.0137	-
	(0.0047)	***(0.0070)***	***(0.0088)***	***(0.0108)***	***(0.0129)***	-
R^2	0.4182	0.3593	0.3865	0.3631	0.2706	0.2129
N	47582	26812	19655	20349	17381	11388

Continued

Continued

B. Females (full time workers)	1972-1976	1977-1981	1982-1986	1987-1991	1992-1996	1998-2002
BOLEV	0.1062***	0.0925***	0.0993***	0.1602***	0.1655***	0.1568***
	(0.0083)	***(0.0100)***	***(0.0135)***	***(0.0162)***	***(0.0195)***	***(0.0313)***
OLEV	0.1943***	0.1470***	0.2114***	0.2647***	0.2178***	0.2182***
	(0.0082)	***(0.0096)***	***(0.0123)***	***(0.0143)***	***(0.0166)***	***(0.0283)***
ALEV	0.3665***	0.2928***	0.3612***	0.4293***	0.3430***	0.3416***
	(0.0158)	***(0.0158)***	***(0.0170)***	***(0.0185)***	***(0.0199)***	***(0.0287)***
HIGHER	0.4645***	0.4468***	0.5386***	0.6196***	0.5542***	0.4873***
	(0.0135)	***(0.0134)***	***(0.0158)***	***(0.0176)***	***(0.0193)***	***(0.0300)***
DEGREE	0.7583***	0.6680***	0.7001***	0.8159***	0.7600***	0.7544***
	(0.0242)	***(0.0194)***	***(0.0189)***	***(0.0195)***	***(0.0200)***	***(0.0279)***
EXP	0.0377***	0.0367***	0.0489***	0.0527***	0.0557***	0.0546***
	(0.0011)	***(0.0013)***	***(0.0016)***	***(0.0019)***	***(0.0021)***	***(0.0028)***
EXP2	-0.0007***	-0.0007***	-0.0010***	-0.0010***	-0.0011***	-0.0011***
	(0.0000)	***(0.0000)***	***(0.0000)***	***(0.0000)***	***(0.0001)***	***(0.0001)***
MIDLAND	-0.0261***	0.0188*	-0.0059	-0.0143	0.0451***	0.0163
	(0.0094)	***(0.0109)***	***(0.0133)***	***(0.0149)***	***(0.0162)***	***(0.0227)***
SOUTH	0.0926***	0.0960***	0.1241***	0.1675***	0.1841***	0.1713***
	(0.0075)	***(0.0086)***	***(0.0105)***	***(0.0119)***	***(0.0128)***	***(0.0178)***
WALES	-0.0239*	-0.0232	-0.0086	-0.0652***	-0.0451*	0.0196
	(0.0151)	***(0.0173)***	***(0.0249)***	***(0.0244)***	***(0.0266)***	***(0.0353)***
SCOTLAND	-0.0048	0.0160	0.0082	-0.0024	0.0095	0.0352
	(0.0085)	***(0.0125)***	***(0.0152)***	***(0.0186)***	***(0.0198)***	***(0.0268)***
WHITE	-0.0051	0.0083	0.0291	0.0396*	0.0442**	0.0800***
	(0.0126)	***(0.0146)***	***(0.0197)***	***(0.0209)***	***(0.0224)***	***(0.0282)***
MARRIED	-0.0370***	-0.0069	-0.0212**	-0.0083	0.0089	-0.0372**
	(0.0075)	***(0.0088)***	***(0.0114)***	***(0.0126)***	***(0.0136)***	***(0.0183)***
y1	0.0760***	-0.0103	-0.0085	0.0929***	-0.0722***	0.0451**
	(0.0089)	***(0.0109)***	***(0.0141)***	***(0.0152)***	***(0.0161)***	***(0.0202)***
y2	0.1772***	0.0829***	-0.0330***	0.1420***	-0.0427***	0.0505***
	(0.0092)	***(0.0109)***	***(0.0141)***	***(0.0149)***	***(0.0165)***	***(0.0197)***
y3	0.2937***	0.1356***	-0.0224*	0.1668***	-0.0092	0.1101***
	(0.0090)	***(0.0108)***	***(0.0140)***	***(0.0152)***	***(0.0164)***	***(0.0200)***
y4	0.2962***	0.0932***	-0.0120	0.1516***	0.0087	-
	(0.0090)	***(0.0109)***	***(0.0136)***	***(0.0152)***	***(0.0163)***	-
R^2	0.2942	0.2693	0.2975	0.2864	0.2477	0.2073
N	16631	11164	9340	11227	10134	7187

Note: The numbers in the table represent the estimated coefficients and standard errors using the pooled GHS datasets of six periods: 1972-76, 1977-81, 1982-86, 1987-91, 1992-96 and 1998-2002. Samples include full-time workers aged 16-66 years who were not self-employed and all earnings numbers are deflated based on 1995 pounds. The dependent variable is log gross weekly pay. Explanatory variables include a vector of five education dummies (BOLEV, OLEV, ALEV, HIGHER and DEGREE, NOQUAL as the base group), the quadratic in experience (Exp and Exp^2), four region dummies (MIDLAND, SOUTH, WALES and SCOTLAND, the North of England as the base group), an ethnicity dummy (WHITE), a marital status dummy (MARRIED) and a vector of year dummies. ***, ** and * denote significance at 1%, 5% and 10% levels for two-tail tests. We use Stata's OLS regression programme (*reg,* see Stata 2003a) to estimate equation (2.1).

CHAPTER THREE:
THE MARKET MECHANISM AND WAGE INEQUALITY IN THE UK

3.1 Introduction

In the previous chapter, we described the changes of the wage structure in the British labour market. Wage inequality has increased substantially in the United Kingdom over the last thirty years. However, not all changes in wage structure cause increases in wage inequality. For instance, the narrowing gender gap (see Figure 2.3) has tended to decrease overall wage inequality.

We find that three prominent changes in the British labour market contribute to rising wage inequality. Firstly, the increase in education/experience inequality has made total employment more heterogeneous (see Figure 2.1). Secondly, skill premiums (mainly education and experience premiums) have been increasing over the entire period, especially after the 1970s (see Table 2.3). Finally, even after we control for the changes of skill endowment and returns, the residual wage inequality of males still increases after the 1970s (see Figure 2.5). This implies that the composition shifts and skill premium changes cannot capture all wage changes in the British labour market. A significant residual space is left for technological, institutional and other explanations (Garicano and Hansberg 2006), which definitely need further analysis. Thus, in this chapter, we apply a further supply and demand framework to analyze the rising wage inequality.

The usual approach to analyze earnings inequality begins by considering a standard supply and demand framework, and then generalizes further by considering labour-market institutions and the role of unemployment (Machin 1996, p57). This

chapter aims to check whether a simple supply and demand framework can fit with wage structure changes in the British labour market over the last thirty years. The basic idea here is that one has a supply and demand for workers of different skill attributes and that one can trace out a relative supply and demand model. We use two strands of research to explain relative wage changes. The first one is from the work of Katz and Murphy (1992). They argue that fluctuations in the growth rate of relative supply for skill, combined with steadily growing relative demand can explain changes of the skill premium.

Katz and Murphy's hypothesis is plotted in Figure 3.1. As in previous chapters, the horizontal axis represents the relative employment of skilled workers to unskilled workers (L_S/L_U), and the vertical axis represents the relative wage of skilled workers to unskilled workers (W_S/W_U). The relative demand (D_1) intersecting relative supply (S) give the original equilibrium point A, in which skilled workers have relative wage w_1 and relative employment l_1. Since the relative demand is constant or steadily growing, the relative demand curve for skilled workers would stay at D_1 or increase from D_1 to D_2. At the same time, relative supply S_1 increases to S_2. Hence, the new equilibrium B or C shows that changes of relative wages are negatively associated with the relative supplies. Katz and Murphy (1992, p51, Table III) examine this negative association using the Current Population Surveys (CPS) 1964-1988.

On the other hand, many economists find that the changes in the British wage structure are driven primarily by shifts in the relative labour demand favouring more skilled workers over less skilled workers (see Nickell and Bell 1995, 1996, Katz and Autor 2000, Machin 2001 and references therein). In a relative supply and demand

framework, a simultaneously rising skill premium and employment share of skilled workers can only suggest that relative demand must have risen at a faster rate than supply. Figure 3.2 describes the supply-demand changes behind this argument. Machin (2001, p755) argues that skill-biased technology changes (SBTC) increase the relative demand for skilled workers, hence the relative demand curve for skilled workers would increase from D_1 to D_2. At the same time, the relative supply of skilled workers stays at S_1 or steadily increases from S_1 to S_2. Hence, the new equilibrium has a higher relative wage w_2 or w_3 (that is, higher inequality) and higher relative employment l_2 or l_3 for skilled workers. Over the period of rising wage inequality, relative demand for skill has won the race against the increasing relative supply of skill. There is a positive association between relative skill wage and relative supply of skill.

Therefore, Katz and Murphy (1992) argue that supply fluctuations dominate the relative wage changes in the USA during 1964-1988 by proving the negative association between relative wage and supply. Machin (2001, p 756, Table 1) tests the positive associations and concludes that relative demand has surpassed relative supply in both the UK and the US during 1980-2000. The positive or negative associations between relative supply and relative wage are outcomes of a horse-race between relative supply and demand for skill.

This chapter tests whether this supply-demand framework can fit the wage structure changes in the British labour market over the last thirty years. In the same vein as Katz and Murphy (1992), we treat the different demographic (gender-education-experience) groups as distinct labour inputs, and hence imperfect

substitutes for each other in the production process. The interaction between relative supply and demand decides relative wages. We concentrate on the Katz and Murphy (1992) hypothesis (negative associations between relative supply and wage) and Machin (2001) hypothesis (positive associations between relative supply and wage) using a simple supply-demand framework.

Even though the changes of skill supply can be due to exogenous institutions such as education policy, we do not know why the relative demand should change in the same way as described in Katz and Murphy hypothesis or Machin hypothesis. It is true that many economists have analyzed the causal factors underpinning the relative demand shifts based on concepts of skill-biased technical changes (see Machin and Van Reenen 1998 for seven OECD countries and O'Mahony et al 2008 for four countries), international trade (Wood 1994, 1995 and 1998) and labour market institutions (Addison et al 2003 and Card et al 2004 for trade union, Gosling and Lemieux 2001 for trade union and minimum wage, and Daniel and Siebert 2005 for EPL). In this chapter, we are not going to tackle these deeper forces behind the changes of relative demand, which will be analyzed in the next chapter in details as we introduce the institutional explanations. Thus, the supply-demand framework applied here cannot isolate the above causal factors, but it is still a useful way to see how the market mechanism works in the British labour market.

We here assume that the shocks from trade patterns, technology and institutions have been completely absorbed by the relative demand changes. Hence, there is no unemployment above the natural level in this framework as described in Figure 3.1 and 3.2. Holding the full employment assumption, the observed relative

wage and employment must be "at the equilibrium" and the changes of relative wages can be explained by the interaction between the relative supply and demand. We will loosen these assumptions in the next chapters. The remainder of this chapter is organised as follows. Section 2 reviews the simple model of supply and demand in Katz and Murphy (1992). Section 3 describes the main data sources and measurement of relative wage and relative labour supply. In Section 4, we provide the basic empirical results. The last section concludes.

3.2 A model of supply and demand

In this section, we simply review the basic model of supply-demand derived by Katz and Murphy (1992) and discuss the possibility of Machin (2001) hypothesis in this theoretical model. This model involves an aggregate production function, which provides *K* types of outputs and requires *J* types of labour inputs (*J*=96 here, that is, 2×6×8 by two gender, six education and eight experience groups). It is assumed that there are *K* sectors in the aggregate production function and each sector can only provide one kind of output *k* but may employ all *J* types of labour. Each sector applies a different technology to combine labour inputs. Thus, the production function of sector *k* can be written as:

$$Y_{kt} = A_t \; F_{kt}(X_{kt}) \tag{3.1}$$

where Y_{kt} is the output of sector k in year t; A_t is the total factor productivity (TFP) decided by the neutral technology, that is, an index of the productivity level of the whole economy in year t; X_{kt} is a J × 1 vector of labour inputs employed in the sector k in year t; $F_{kt}(X_{kt})$ is the contribution from the labour inputs, which is concave for each input and decided by non-neutral technology. Hence, the aggregate production

function is: $Y_t = A_t\ F(X_t)$, where Y_t is a K×1 vector of all kinds of outputs in year t; X_t is a J×1 vector of total labour inputs employed and $F(X_t)$ is also concave for each aggregate labour input.

Under the free entry assumption, wages are set equal to the marginal products of labour inputs: $W_t = A_t\ F_X(X_t)$. Then, the labour demand for one kind of labour input is the sum of labour demand for this labour input in all sectors, that is, $X_t = \sum_{k=1}^{K} F_{kt}^{X\ -1}(\frac{W_t}{A_t})$. Thus, the aggregate labour demand is simplified as

$$X_t \equiv D(\frac{W_t}{A_t}, Z_t) \tag{3.2}$$

X_t is the labour demand associated with the aggregate production function. In this demand function, W_t/A_t is a J×1 vector of relative wage to the total productivity in year t. In addition, Z_t is Z×1 vector of labour demand shifts induced by changes of technology, international competition and institutions. Under the assumption of a concave production function $F_{kt}(X_{kt})$, the relationship between the wage changes and labour supply is negative in each sector, given constant labour demand (Z_t-Z_{t-1}=0). According to Walras' Law of markets, if all output markets are in equilibrium, the market for labor will also be in equilibrium. Hence, there is a negative relationship between relative wage (to the contemporary TFP) and labour supply.[17]

[17] That is, $(\frac{W_t}{A_t} - \frac{W_{t-1}}{A_{t-1}})'\{X_t - X_{t-1}\} \leq 0$. If there is not much change in the TFP, i.e. A_t=A_{t-1}, this inequality can be simplified as $(W_t$-$W_{t-1})'$ $(X_t$-$X_{t-1}) \leq 0$. This is the common sense of the supply-demand theory: as the labour supplies increase, the prices of labour inputs decrease, *ceteris paribus*.

Moreover, even if the demand in equation (3.2) shifts over the time (Z_t-$Z_{t-1}\neq 0$), the (J×J) matrix of cross relative wage effects on labour demands (i.e. $D_{\frac{W}{A}}$), is still negative semi-definite from the concave aggregate production function. Thus, the change of labour demand can be written in terms of differentials as:

$$dX_t = D_{\frac{W}{A}} d(\frac{W_t}{A_t}) + D_Z dZ_t \tag{3.3}$$

Katz and Murphy (1992) rearrange equation (3.3) and multiply the two sides by the (1×J) vector of relative wage changes, i.e. $d(\frac{W_t}{A_t})'$. The negative semi-definiteness of $D_{\frac{W}{A}}$ implies that

$$d(\frac{W_t}{A_t})'(dX_t - D_Z dZ_t) = d(\frac{W_t}{A_t})' D_{\frac{W}{A}} d(\frac{W_t}{A_t}) \leq 0 \tag{3.4}$$

Thus, changes in labour supplies (dX_t) net of demand shifts ($D_Z dZ_t$) are negatively associated with changes in relative wage. It shows the negative relationship between changes of net labour supply and relative wages. The discrete version of equation (3.4) is in the form of:

$$(\frac{W_t}{A_t} - \frac{W_{t-1}}{A_{t-1}})' \left\{ (X_t - X_{t-1}) - [D(\frac{W_{t-1}}{A_{t-1}}, Z_t) - D(\frac{W_{t-1}}{A_{t-1}}, Z_{t-1})] \right\} \leq 0 \tag{3.5}$$

The changes of net supplies are the actual changes of labour supply less the demand changes that would have happened at fixed wage (W_{t-1}/A_{t-1}). Thus, there is a negative association between relative wage changes and net labour supply changes, as described in Figure 3.1.

Katz and Murphy (1992) firstly assume the relative demand is stable, and then there is no change in relative demand over time. Hence, their hypothesis is simplified as $(\frac{W_t}{A_t} - \frac{W_{t-1}}{A_{t-1}})'\{X_t - X_{t-1}\} \leq 0$. Secondly, technological and institutional changes may be reflected at last as a steadily growing relative demand for skill. The steady growth of relative demand affects equation (3.5) in two ways: a growth in relative wage and a decrease in net labour supply. Hence, equation (3.5) can be simplified as: $(\frac{W_t}{A_t} - \frac{W_{t-1}}{A_{t-1}} - b_1)'\{X_t - X_{t-1} - b_2\} \leq 0$, in which b_1 and b_2 are the time trends of relative wage and relative demand: $W_t/A_t=a_0+b_1t$; $D_t=a_1+b_2t$. If the inner products of the detrended relative wage changes with the detrended net supplies changes were negative, the steadily growing demand hypothesis described in Figure 3.1 would be proved.

Moreover, Acemoglu (2003b, p207) proves that even if the returns to scale are constant at the firm level, the aggregate production possibilities set of the economy may exhibit increasing returns to scale because technologies are also determined endogenously. Hence, the production $F_{kt}(X_{kt})$ in equation (3.1) could be convex for skilled labour inputs because of skill-biased technical changes. It suggests that as more skilled workers join one sector, the marginal productivity of skilled workers may be even higher. The (J×J) matrix of cross relative wage effects on labour demands in equation (3.4) may be positive semi-definite from the convex aggregation production.

Machin (2001) suggests that SBTC and institutional changes (such as trade union decline) were reflected in an accelerating relative demand for skill in the 1980s, so that the relative skill supply and skill premium increased together. The wage setting institutions should be flexible enough to allow relative wage changes. If wages

in a rigid labour market cannot respond to shocks from business cycle, equation (3.5) could be a positive inequality. Thus, in the face of SBTC, Machin (2001) hypothesis i.e. $(\frac{W_t}{A_t} - \frac{W_{t-1}}{A_{t-1}})'\{X_t - X_{t-1}\} \geq 0$ or $(\frac{W_t}{A_t} - \frac{W_{t-1}}{A_{t-1}} - b_1)'\{X_t - X_{t-1} - b_2\} \geq 0$ is also possible in Katz and Murphy's (1992) model.

3.3 Data description and measurement

3.3.1 Measurement of relative wage and relative supply

The data used in this chapter is the series of the GHS 1972 to 2002 as in Chapter 2. We categorize the data of each year into 96 (2×6×8) distinct labour cells, distinguished by two gender, six education (NOQUAL, BOLEV, OLEV, ALEV, HIGHER and DEGREE) and eight experience groups (from one to forty by five years). The 96 labour cells are regarded as distinct labour supplies in the above supply-demand model.

Following the same line of Katz and Murphy (1992), two samples are created from the GHS data: (1) the count sample: this is a sample taken from the original GHS dataset so that we can measure the amount of labour supplied within each demographic cell. The count sample is a very close concept to total work force, including all individuals who work at least one week in the sample year with clear information of weekly working hours (*workhrs*), regardless of whether they were part- or full-time, self employed, or otherwise. We use annual working hours (weekly working hours times week number) as measure of labour supply. According to the ONS (2006, p3), this variable is the most continuous hours variable in the GHS (see Figure 2.2), which reflects "Usual number of hours worked per week excluding mealtime and overtime". Since the working hour variable does not include over time

hours before 1996 (see the previous chapter), the main concern about our labour supply variable is overtime hours which is an important part of working hours in the British labor market (Hart et al 2000). Hence, the missing overtime problem in annual working hours may bring biases in our labour supply variable.

Bell and Hart (2003a, b) show that overtime hours and pay are not wholly geared to meeting short-term shifts in production requirements even in labour markets like Britain where statutory overtime rules do not apply. The maximum lengths of standard weekly hours set by many firms follow wider industrial or regional or national collective bargaining norms. Their observations are consistent with the view that the conditions for overtime working follow "custom and practice" and a long-term contractual role for overtime, suggesting that the proportion of overtime in our labour input measure of annual working hours may be stable. Hence, the missing overtime problem in our working hours variable may be not very serious.

Furthermore, the total working hours within each demographic cell are calculated for each sample year. Then, the total working hours of each cell is divided by the sum of all cells in that year so that they are expressed as proportions. Thus, the labour supply concept used in this chapter is actually a proportion to the total working hours, hence actually a relative labour supply.[18]

(2)The wage sample: as in Chapter 2, the wage sample only includes all full-time employees aged sixteen to sixty-six. "Full time employee" here is defined as

[18] See more discussion on the working hours variable (*workhrs*) in Chapter 2. I have also tested the headcount employment measure and found there is not much difference from our basic conclusions. The headcount employment is an inferior measure of labour input to working hours. Hence, we only present results using working hours in this chapter. The interested reader can find results for headcount employment in Appendix 3.2.

workers with weekly working hours exceeding 35 hours (excluding employer and self-employed). Self-employed workers, part time workers and those working without pay are excluded from the sample. The wage variable used in this chapter is the real gross hourly earnings deflated by the annual Retail Price Index (RPI) based on the year of 1995, which is derived from the wage sample using the same calculation process as in Chapter 2 (see Table 2.2).[19] Wage variable is calculated only from the wage sample since it can provide accurate wage information by excluding noise from extreme cases. In GHS 1972, the count sample is broader than the wage sample by 33 percent. The coverage difference between the two samples increases to 61 percent in the GHS 1995, which is consistent with the widely agreed fact of more labour participation of women as part-time workers after the 1970s. Even though the wage sample is much narrower than count sample, we still have enough observations in each cell.

Empirically, we measure variables in equation (3.5) using the above two samples. First of all, we calculate the working hours shares of 96 demographic cells for each sample year from the count sample. The average working hours share of each cell over the entire period 1972-2002 is the fixed weight for that cell, i.e. $\overline{E}$ (see Table A3.1 in Appendix 3.1). For example, male workers without any education qualification, but with experience less than 5 years provided about 3.19 percent of the total labour input in 1972. The proportion declined to only about 0.23 percent in 2002. Hence, the fixed weight of this cell (male-NOQUAL-5) is the average working hours share over the entire period: about 1.27 percent. On the other hand, male workers with more than 35 years experience in the DEGREE group provided about 0.15 percent of

[19] The interested reader can find results for weekly earnings in Appendix 3.2.

the total labour input in 1972. The proportion increased to about 0.64 percent in 2002. Hence, the fixed weight of this cell (male-DEGREE-40) is the average working hours share over the entire period: about 0.44 percent.

Secondly, we calculate the mean hourly wage of each cell for each sample year. Hence, W_t in equation (3.5) is a 96 ×1 vector, which denotes the mean wages for our 96 demographic (gender-education-experience) cells in year t (t=1972…2002). Using the average working hours shares ($\overline{E}$), the fixed weighted mean wage of that year is calculated, that is the wage index of that year (A_t, see the upper part of Table A3.2 in Appendix 3.1). The fixed weighted mean wage was about 5.22 pounds (based on 1995 pounds) per hour in 1972, and then increased to about 7.07 pounds per hour in 2002. Thus, after controlling for the labour input composition shifts, the productivity level in the UK has increased about 35.4 percent, i.e. (7.07-5.22)/5.22.

Consequently, the mean wage of each cell is divided by the wage index of that year to get the relative wage of the cell (W_{jt}/A_t, see the lower part of Table A3.2 in Appendix A3.1). The average relative wage of each cell over the entire period 1972-2002 is the *efficiency units* of this worker group. For example, the mean wage of the male-NOQUAL-5 group was about 55 percent of the wage index in 1972. In 2002, the relative wage of this group was about 58 percent. The average relative wage over the last thirty years is about 0.55. On the other hand, the mean wage of the male-DEGREE-40 group was about 2.54 times of the wage index in 1972 and 1.77 times in 2002. Hence, the efficiency units of this group are about 1.91.

Finally, the relative labour supply used in this chapter is the working hours share of each cell measured in *efficiency units*. The working hours share of each cell multiplies its efficiency units, and divided by the sum of all cells (see Table A3.3 in Appendix 3.1). Hence, the relative supply is quite different from the simple working hours share, especially for low skilled and high skilled workers. For example, the working hours share of the male-NOQUAL-5 group was about 3.19 percent in 1972 (see the first row of Table A3.1). However, as labour input is measured in efficiency units, this group only provided about 1.97 percent of total efficiency input in 1972. That is because the productivity of this group is only about 55 percent of the average level (see the first row of Table A3.2).

Nevertheless, the working hours share of the male-DEGREE-40 group was only 0.15 percent in 1972 (see the middle row of Table A3.1), while the efficiency contribution of this group was about 0.32 percent. That is because the productivity of this group is 1.91 times of the average level (see the middle row of Table A3.2). Moreover, the efficiency share of this group increased from 0.32 percent in 1972 to 1.07 percent in 2002. This result shows the dramatic increase in working hours share of those educated senior males (from 0.15 percent in 1972 to 0.64 percent in 2002, see Table A3.1) on the one hand, and the decline of their relative earnings over the last thirty years (2.54 in 1972 to 1.77 in 2002, see Table A3.2) on the other hand. We will push this argument further in the next section for more aggregated groups.

3.3.2 Changes in relative supply

We compare relative labour supply with the working hours shares and summarize changes of relative supply in Table 3.1. The top panel is the working hours shares for

different groups in seven years: 1972, 1977, 1982, 1987, 1991, 1998 and 2002. The middle panel is relative labour supply measured in efficient unit at the same seven years. The bottom panel of Table 3.1 summarizes the corresponding changes in relative labour supplies over the 1972-2002 and six sub-periods: 1972-1977, 1977-1982, 1982-1987, 1987-1992, 1992-1998 and 1998-2002.

In the first two rows of each panel, the overall change in relative supply, i.e. X_t-X_{t-1} in equation (3.5) is presented by gender. The top panel shows that labour input of females has been increasing from about 32 percent to about 43 percent of total working hours over the entire period. However, the middle panel shows that the relative supply measured in efficiency units of females is much lower than their working hours shares, only from about 25 percent to about 36 percent. The difference between the two measures is due to the fact that the average productivity of females (as measured by their efficiency units) is lower than males. Hence, their relative labour supply in efficiency units is lower than simple working hours proportions. The bottom panel shows the relative supply of females has increased by about 37.6 percent over the entire period, corresponding to a continuous drop of males (-16.2 percent). This result reflects not only the increasing role of women in terms of workforce participation but also their increasing productivity level.

The similar analysis can be applied for other groups in Table 3.1. The top panel shows that working-hours proportions of college graduate (from about 2.3 percent to about 23 percent) and O-level holders (from about 9.7 percent to about 19.8 percent) has been increasing over the entire period. Meanwhile, the working-hours proportions of the NOQUAL group fell from 59.6 percent to 13.7 percent over the

same period. This result is consistent with what we find in headcount employment share of education groups over time (see Figure 2.1a).

The middle panel also illustrates that there has been substantial long-run growth in the relative supply of college graduates (from 4.1 percent in 1972 to 32.1 percent in 2002) and O-level holders (from 9.5 percent in 1972 to 17.1 percent in 2002), while the relative labour supply of the NOQUAL group fell from 54.1 percent to 9.8 percent over the same period. Thus, relative labour measured in efficiency units is higher than the simple working-hours proportions for high skilled workers, but lower for unskilled workers. Relative supply of high skilled workers (28 percent for college graduate) is also growing faster than low skilled workers (7.6 percent for O-level).

As regards the experience groups, the relative supply of male new entrants fell almost half from 5.1 percent to 3 percent, while the relative supply of the senior males (with 26-30 years experience) is quite stable over the entire period. Therefore, the relative labour supply in the UK has shifts more educated and experienced (hence more skilled). As we find in Chapter 2, skill premiums have been increasing after the 1970s (see Table 2.3). Hence, for some specific groups such as females, or high educated or prime experienced workers, their relative wages and labour supplies are increasing together after the 1970s. After controlling for gender, it seems as though that the relative demand for skill accelerated and surpassed the increasing relative supply. Evidence to support Machin (2001) hypothesis may be found in years after the 1970s. We next test Katz and Murphy's (1992) and Machin's (2001) hypotheses using the inner products of all 96 cells.

3.4 Empirical results

To examine how relative supply changes line up with the relative wage changes, we implement the framework outlined above. We firstly test the changes of wage structure in the UK are from the interaction between relative labour supply and a constant demand. For this test, we compute the inner products of changes of relative wages with changes of relative labour supplies between time periods. In order to reduce the numbers of computations and minimize the impact of measurement error, we aggregate our 29 years into six five-year intervals centred in 1974, 1979, 1984, 1989, 1994 and 2000. Then, the average relative wages and average relative supplies of our 96 demographic cells are computed for these sub-periods. The inner products of the changes in these measures of wages and supplies are calculated for each pair of these six intervals.

The results of these calculations are given in the top part of Table 3.2. For the period taken as a whole, results in the top part appear to be inconsistent with the stable demand hypothesis in Katz and Murphy (1992). For males, only eight of all fifteen comparisons over the period are negative, as well as three for females. Thus, it seems that the stable labour demand hypothesis is only partially proved for the entire period.

Moreover, inner products of wage and supply changes show a cyclical pattern for males, but an increasing trend for females over the entire period. As we expect, the positive associations between relative wages and labour supply are especially evident for males in the 1980s. For example, all comparisons between the interval centred in 1974 and intervals after 1974 (that is, 1979, 1984, 1989, 1994 and 2000) for males are negative, while all comparisons between the interval centred in 1979 and intervals

after 1979 (that is, 1984, 1989, 1994 and 2000) are positive. Then, all comparisons between the interval centred in 1989 and intervals after 1989 (that is, 1994 and 2000) are again negative. However, we cannot find negative inner products for females except a few comparisons associated with two early intervals centred in 1974 and 1979, which suggests a continuous acceleration in relative demand for female skilled workers after the 1970s.

As the relative supply of skilled workers has been increasing continuously over the entire period (see Figure 2.1), the changes of relative supply of skilled workers are always positive. Hence, the cyclical pattern of males must be from the changes of skill premium. Panel A of Figure 3.3 illustrates possible supply-demand movement behind the above comparison for males. The horizontal axis represents the relative labour supply of skilled workers to unskilled workers (L_S/L_U), and the vertical axis represents the relative wages of skilled workers to unskilled workers (W_S/W_U). The relative demand (D_1) and relative supply (S_1) cross in the 1974 interval to achieve the original equilibrium. Since the relative supply of skilled workers has continuously increased from S_1 to S_6 over the entire period, the changes of relative wages decide the signs of inner products. New equilibriums in later intervals have to follow the trace of the dashed curve to keep consistent with Table 3.2. Hence, skilled workers have lower relative wages in the intervals centred in 1979 and 1994, but higher relative wages in the intervals centred in 1974 and 1989.

The only possible explanation is that the increase of relative supply of skills has surpassed relative demand during the 1970s (from D_1 to D_2) and early years of the 1990s (from D_4 to D_5), between which the increase of relative supply of skills has

been surpassed by the increase of relative demand. Hence, changes of relative wages of skills as well as inner products are negative in the 1970s and early years of the 1990s. Thus, Katz and Murphy (1992) hypothesis is proved for males during the 1970s and early years of the 1990s, while the 1980s and the 2000s seems more compatible to Machin (2001) hypothesis.

Similarly, Panel B of Figure 3.3 illustrates supply-demand movement for females. Equilibrium points also follow the trace of the dashed curve to keep consistent with Table 3.2. Hence, skilled female workers have lower relative wages in the interval centred in 1984 and higher relative wages in the interval centred in 1974 and 2000. After the interval centred in 1984, the relative demand of skills has surpassed the relative supply and pushed the relative wages to a historical height in the 2000s. Thus, Machin (1992) hypothesis is proved for females after the 1970s.

The top part of Table 3.2 rejects the stable demand hypothesis for the period taken as a whole. Consequently, the alternative steadily growing demand hypothesis is tested in the bottom part. We examine whether the observed relative wage changes can be made consistent with the observed pattern of relative labour supply changes, simply by allowing for stable increasing relative demand. Thus, we include a time trend for relative wages and net labour supply in equation (3.5) to allow a steady relative demand growth. And then we take the average residuals over five-year intervals for each cell, and compute the inner products of detrended relative wages changes and net labour supply changes.

The results of this procedure are shown in the bottom part of Table 3.2. If the inner products were negative, results would support the steadily growing demand hypothesis in Katz and Murphy (1992). Otherwise, the acceleration of relative demand hypothesis in Machin (2001) is proved. From the bottom part of Table 3.2, we find some evidences to support the steadily growing relative demand hypothesis. For males, eight of all fifteen comparisons still show negative associations over the period, as well as only three for females. Those positive inner products in the 1980s and the 2000s (for example, 0.0017, between 1994 and 2000 for males, and 0.0023, between 1974 and 1984 for females) are too big to be regarded as measurement errors. This result suggests an acceleration of relative demand for skilled workers in the 1980s and the 2000s.

In order to test the robustness of our conclusion, Table 3.3 uses the same procedure for different time intervals (3-year centred interval) and different years: 1973, 1978, 1983, 1988, 1993 and 2001. We find a similar cyclical pattern of co-variation between the relative wages and relative supplies as already shown in Table 3.2, which rejects the stable relative demand as well. In the bottom part of Table 3.3, more detrended results (eleven of all fifteen comparisons) are negative for males. Nevertheless, those positive co-variations between relative wages and relative supplies such as 1978-1993 (0.0023) for males and 1973-1988 (0.0052) for females, again confirm the acceleration of relative demand in the 1980s and the 2000s.[20]

Figure 3.4 plots (log form) relative supplies' changes against relative wages' changes of the 96 labour cells between 5 year interval centred in 1974 and 2000 and

[20] More sensitiveness tests can be found in Appendix 3.2. Our basic conclusions still remain using weekly wages as earnings variable and headcount employment as labour input.

five sub-periods: 1974-1979, 1979-1984, 1984-1989, 1989-1994 and 1994-2000. In order to find the associations between relative wage and labour supply on these periods, we predict wage changes from a weighted least squares regression for each period.[21] These predicted values are represented as the lines drawn in the Figure 3.4. Since males are majority of labour input (see Table 3.1), the overall picture of all 96 labour cells would follow the cyclical pattern of males. We can find the associations between relative wage and labour supply are negative for the entire period 1974-2000, also for 1974-1979 and 1989-1994, but positive for the periods of 1979-1984, 1984-1989 and 1994-2000. Thus, the six graphs shown in the figure reinforce the cyclical pattern that we find in the inner products of males.

3.5 Conclusions

This chapter tests a basic hypothesis about relative supply and demand shifts in the British labour market. A supply and demand framework as in Katz and Murphy (1992) is built to test the hypothesis that given stable or steadily growing relative demand, relative supply shifts can explain the changes of relative wage (that is, Katz and Murphy hypothesis, alternatively, Machin hypothesis).

From co-variation of relative wages and relative labour supplies, we reject the hypothesis that the relative labour demand is stable over time for both males and females. By using detrended relative wages and supplies, we infer that an acceleration of relative demand for skills, that is, a positive association between relative wages and labour supplies (males in the 1980s and the 2000s, females after the 1970s). Hence, the steadily growing relative demand in Katz and Murphy (1992) can only broadly fit

21 Weights used here are the average working hours proportion over the entire period, i.e. $\overline{E}$.

with the cyclical co-variation of wage and labour supply of males, but not for the long term growing trend of females.

The acceleration of relative demand for skilled workers moves beyond the steadily growing relative demand model. Moreover, these results cannot tell us why there is a steadily growing relative demand and what factors are accelerating relative demand for skill. Along with the technological changes, institutional factors such as trade unions, tax and unemployment benefits should be important forces behind this model. Thus, the next chapter puts this supply and demand argument into a more realistic institutional environment.

Figure 3.1: Relative supply and demand for skills, Katz and Murphy (1992) hypothesis

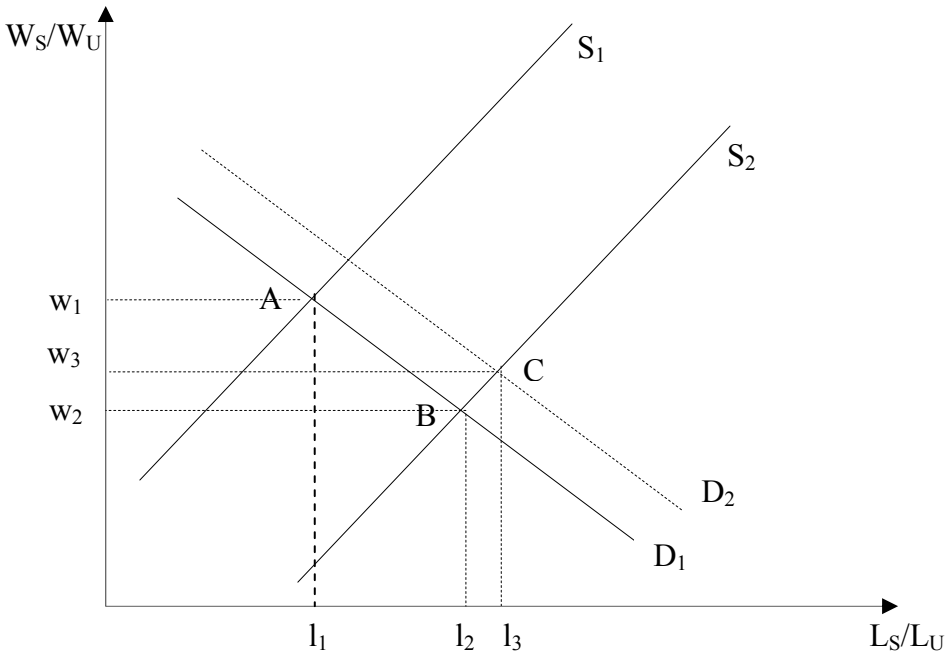


Figure 3.2: Relative supply and demand for skills, Machin (2001) hypothesis

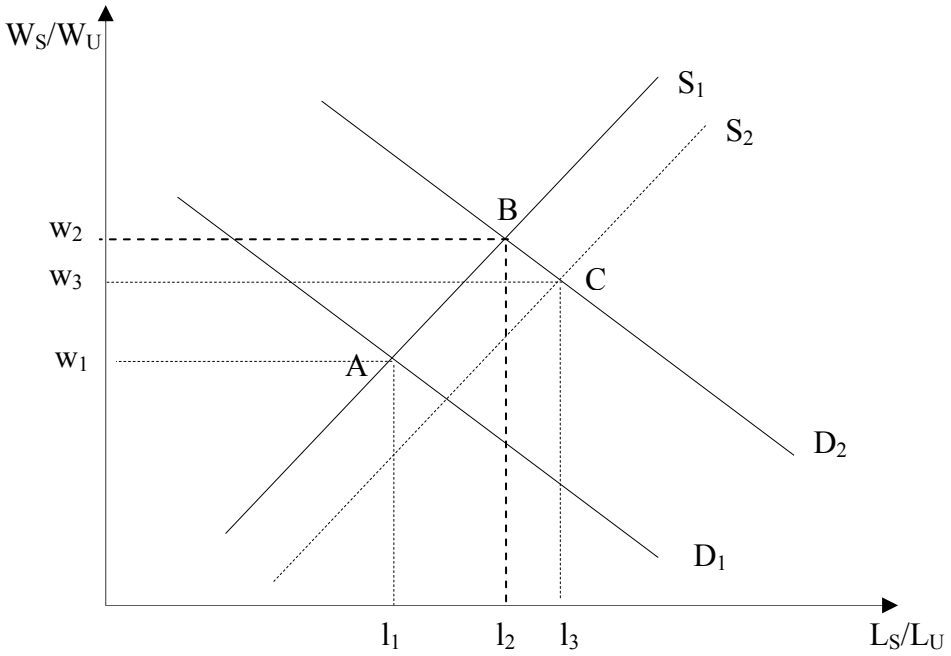


Figure 3.3: Relative wages and relative supply in the UK, 1972-2002

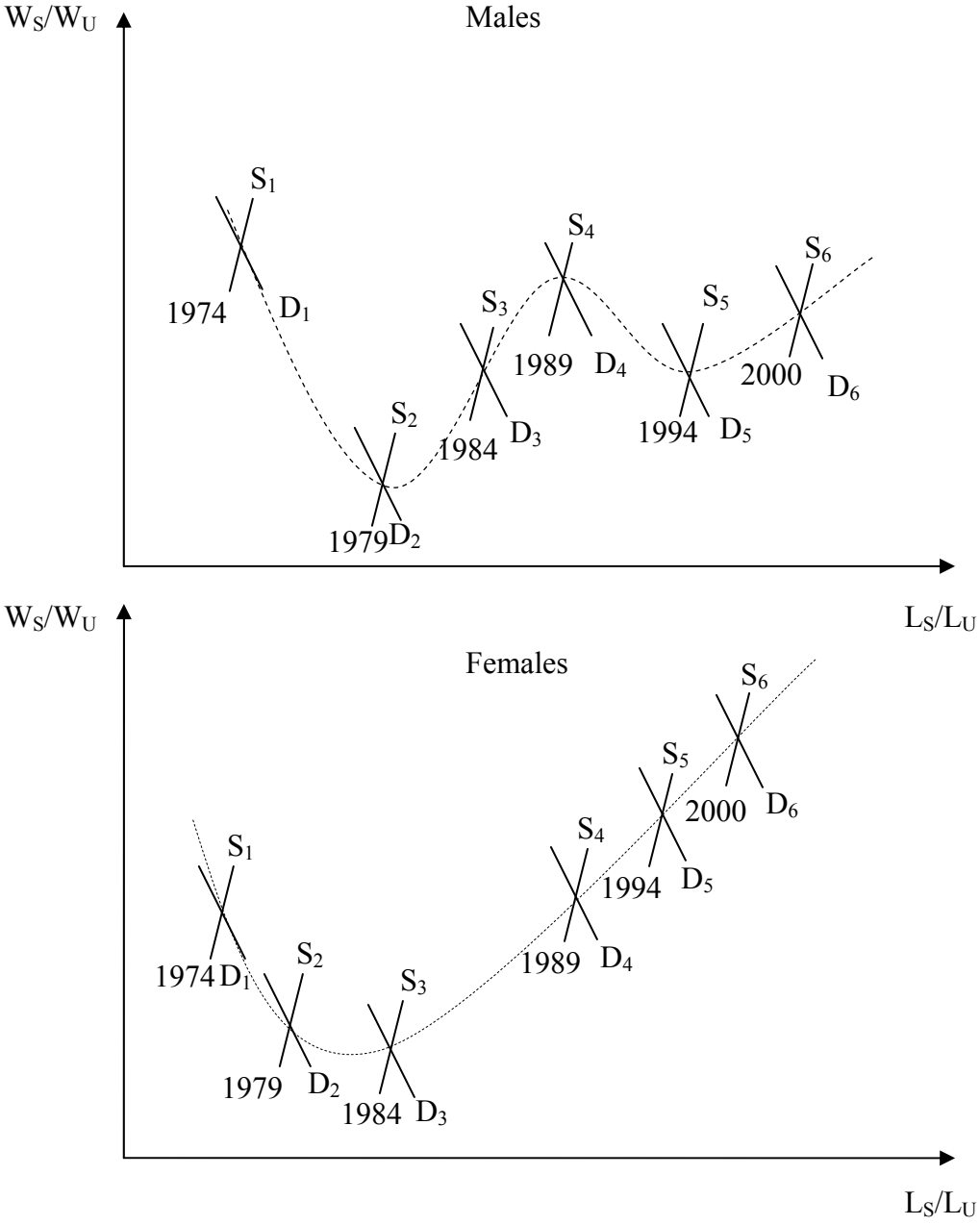


Figure 3.4: Price and quantity changes for 96 demographic cells

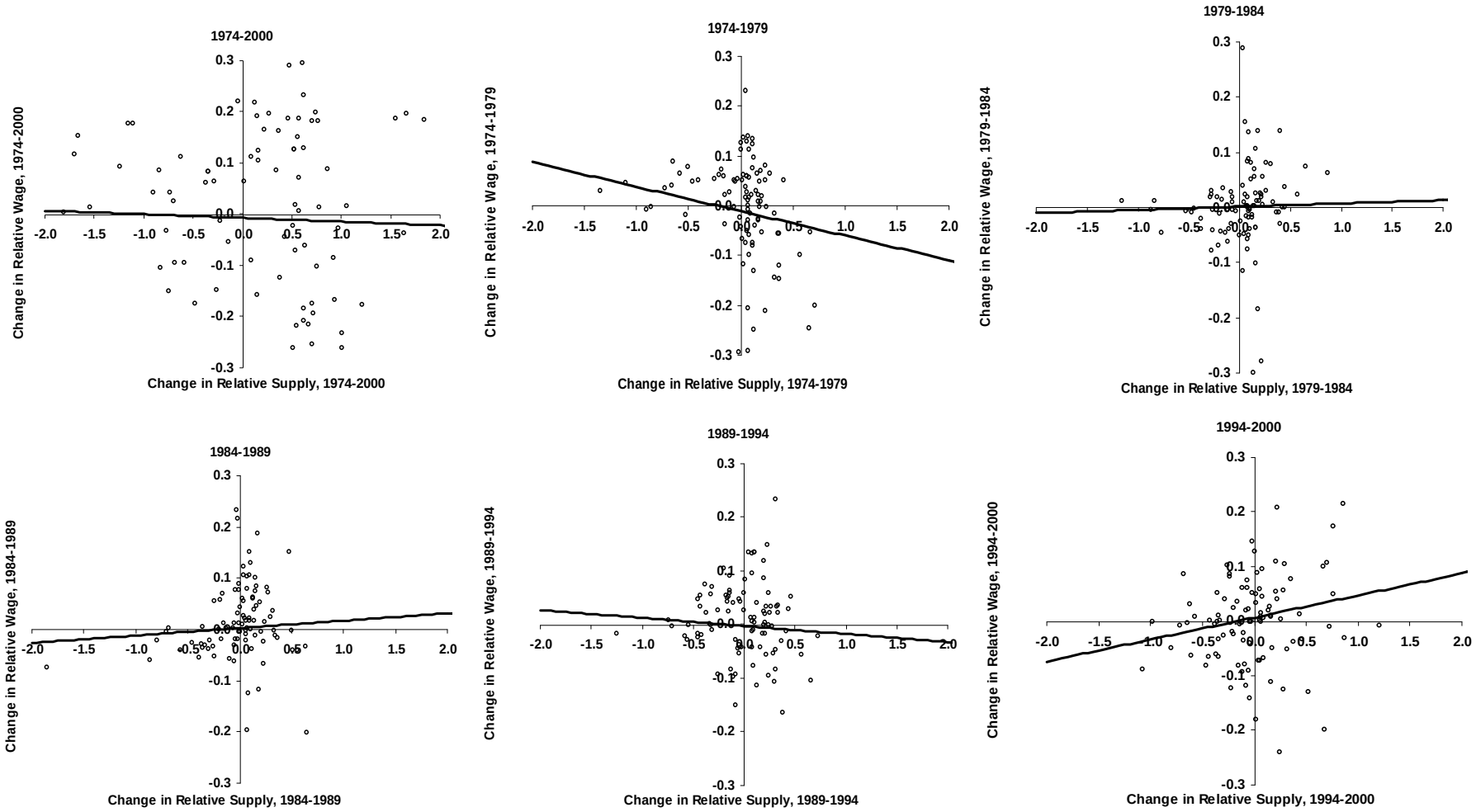


Table 3.1: Relative supply changes in the UK, 1972-2002

Group	Share of annual working hours (%) 1972	1977	1982	1987	1992	1998	2002
Gender:							
Men	68.0	65.6	63.3	61.4	58.2	58.0	57.2
Women	32.0	34.4	36.7	38.6	41.8	42.0	42.8
Education:							
No qualification	59.6	48.5	40.2	30.6	23.8	14.6	13.7
O-level	9.7	14.9	18.2	20.6	24.7	23.5	19.8
Degree	2.3	5.2	7.1	10.3	11.6	18.4	23.4
Experience (men):							
1-5 years	7.5	8.0	7.6	8.0	4.9	4.4	4.6
26-30 years	7.4	6.3	6.2	6.1	7.9	6.6	6.6
Group	**Relative labour supply (annual working hours measured in *efficiency units*, %) 1972**	**1977**	**1982**	**1987**	**1992**	**1998**	**2002**
Gender:							
Men	75.4	73.4	71.3	69.4	66.3	65.3	64.1
Women	24.6	26.6	28.7	30.6	33.7	34.7	35.9
Education:							
No qualification	54.1	42.3	34.4	24.7	18.5	10.5	9.8
O-level	9.5	14.2	16.4	18.4	22.1	20.8	17.1
Degree	4.1	8.9	11.9	16.4	17.9	25.6	32.1
Experience (men):							
1-5 years	5.1	5.5	5.1	5.3	3.2	2.8	3.0
26-30 years	9.2	8.0	7.8	8.1	10.2	8.6	8.5
Group	**Change in log form relative labour supply (annual working hours measured in *efficiency units*, multiplied by 100) 1972 -1977**	**1977 -1982**	**1982 -1987**	**1987 -1992**	**1992 -1998**	**1998 -2002**	**1972 -2002**
Gender:							
Men	-2.7	-2.9	-2.7	-4.5	-1.5	-1.8	-16.2
Women	7.7	7.6	6.5	9.6	2.9	3.3	37.6
Education:							
No qualification	-24.7	-20.6	-33.0	-28.8	-56.5	-7.0	-170.6
O-level	39.6	14.8	11.4	17.9	-5.9	-19.5	58.4
Degree	76.4	28.7	32.5	8.6	35.8	22.8	204.8
Experience (men):							
1-5 years	7.6	-6.5	3.6	-51.6	-12.8	5.6	-54.1
26-30 years	-13.6	-3.2	3.8	23.3	-16.9	-0.8	-7.5

Note: Figures in this table represent the shares of annual working hours and relative labour supply measured in *efficiency units* (average relative wage of each demographic cell over the last thirty years) using the GHS 1972-2002. Samples include all workers in the count sample.

Table 3.2: Inner products of changes in relative wages and changes in relative supply (annual working hours measured in *efficiency units*)

A. Actual changes					
	5-year centred interval				
5-year centred interval	**1974**	**1979**	**1984**	**1989**	**1994**
Inner Products of actually changes:			**Male**		
1979	-0.0120				
1984	-0.0192	0.0029			
1989	-0.0176	0.0101	0.0016		
1994	-0.0384	0.0057	-0.0022	-0.0031	
2000	-0.0270	0.0198	0.0083	-0.0007	0.0068
Inner Products of actually changes:			**Female**		
1979	-0.0006				
1984	-0.0016	-0.0003			
1989	0.0053	0.0051	0.0020		
1994	0.0079	0.0098	0.0074	0.0008	
2000	0.0070	0.0110	0.0140	0.0039	0.0005
B. Detrended changes					
Inner Products of changes in detrended data::			**Male**		
1979	-0.0016				
1984	-0.0028	0.0007			
1989	-0.0015	0.0001	-0.0012		
1994	-0.0011	0.0025	0.0000	0.0008	
2000	0.0009	-0.0018	-0.0011	-0.0008	0.0017
Inner Products of changes in detrended data:			**Female**		
1979	0.0006				
1984	0.0023	0.0005			
1989	0.0023	0.0008	-0.0010		
1994	0.0003	0.0006	-0.0002	-0.0001	
2000	0.0004	0.0006	0.0036	0.0033	0.0013

Table 3.3: Inner products of changes in relative wages and changes in relative supply (annual working hours measured in *efficiency units*)

A. Actual changes					
	3-year centred interval				
3-year centred interval	**1973**	**1978**	**1983**	**1988**	**1993**
Inner Products of actually changes:			**Male**		
1978	-0.0146				
1983	-0.0207	0.0037			
1988	-0.0299	0.0082	-0.0006		
1993	-0.0520	0.0038	-0.0068	-0.0034	
2001	-0.0470	0.0168	0.0000	-0.0035	0.0065
Inner Products of actually changes:			**Female**		
1978	-0.0010				
1983	0.0011	0.0010			
1988	0.0036	0.0036	0.0001		
1993	0.0103	0.0107	0.0064	0.0026	
2001	0.0009	0.0080	0.0057	0.0072	-0.0029
B. Detrended changes					
Inner Products of changes in detrended data::			**Male**		
1978	-0.0017				
1983	-0.0027	-0.0002			
1988	-0.0042	-0.0004	-0.0010		
1993	-0.0025	0.0023	-0.0001	0.0004	
2001	0.0016	-0.0026	-0.0011	-0.0033	0.0006
Inner Products of changes in detrended data:			**Female**		
1978	0.0005				
1983	0.0025	0.0002			
1988	0.0052	0.0016	-0.0001		
1993	0.0012	-0.0006	0.0004	-0.0002	
2001	0.0000	0.0004	0.0026	0.0054	0.0004

APPENDIX 3.1
Katz and Murphy (1992) supply –demand framework

Table A3.1: Annual working hours shares by gender, education and experience (percentage)

GENDER	EDUCATION	EXP	1972	1977	1982	1987	1992	1998	2002	Fixed Weight $\overline{E}$
Male	NOQUAL	5	3.19	2.10	1.25	1.32	0.50	0.39	0.23	1.27
Male	NOQUAL	10	3.69	2.09	1.72	1.40	0.44	0.30	0.33	1.40
Male	NOQUAL	15	3.95	3.26	1.91	1.72	1.12	0.49	0.47	1.82
Male	NOQUAL	20	3.68	2.98	2.69	1.64	1.27	0.69	0.55	1.97
Male	NOQUAL	25	3.76	3.00	2.73	2.46	1.52	0.98	0.83	2.23
Male	NOQUAL	30	4.75	3.06	2.93	2.03	2.14	0.93	0.77	2.51
Male	NOQUAL	35	5.20	3.70	3.05	2.21	2.43	1.41	1.05	2.86
Male	NOQUAL	40	10.89	9.91	8.50	5.43	4.40	3.13	3.95	6.67
Male	BOLEV	5	1.24	1.07	1.39	1.35	0.44	0.43	0.41	0.90
Male	BOLEV	10	1.89	0.81	0.99	0.97	0.66	0.40	0.43	0.84
Male	BOLEV	15	1.95	1.05	0.72	0.78	0.67	1.00	0.71	0.93
Male	BOLEV	20	1.51	1.07	0.89	0.59	0.79	0.86	1.07	0.92
Male	BOLEV	25	1.19	1.17	1.02	0.91	0.65	0.59	0.89	0.91
Male	BOLEV	30	1.38	1.46	1.25	0.91	0.86	0.59	1.08	0.98
Male	BOLEV	35	1.38	1.25	1.27	1.26	0.78	0.76	0.81	1.05
Male	BOLEV	40	2.83	2.97	2.89	2.27	1.64	1.52	2.12	2.34
Male	OLEV	5	1.56	2.32	2.50	2.38	1.53	1.13	1.35	1.97
Male	OLEV	10	1.18	1.71	1.86	2.24	2.10	1.13	1.32	1.79
Male	OLEV	15	0.81	1.53	1.31	1.51	2.00	1.94	1.33	1.67
Male	OLEV	20	0.51	1.16	1.41	1.10	1.38	2.22	1.65	1.45
Male	OLEV	25	0.47	0.73	0.88	1.16	1.31	1.90	1.74	1.19
Male	OLEV	30	0.38	0.47	0.62	0.92	1.47	1.12	1.21	0.97
Male	OLEV	35	0.46	0.50	0.48	0.69	1.09	1.36	1.07	0.81
Male	OLEV	40	0.62	0.89	0.66	1.04	1.43	1.93	1.64	1.08
Male	ALEV	5	0.68	1.25	1.19	1.25	1.45	0.98	1.08	1.19
Male	ALEV	10	0.59	1.50	1.47	1.52	1.54	1.61	1.44	1.36
Male	ALEV	15	0.33	1.16	1.24	1.40	1.53	1.57	1.49	1.22
Male	ALEV	20	0.33	0.47	0.82	1.30	1.30	1.89	1.39	1.05
Male	ALEV	25	0.15	0.32	0.58	0.75	1.38	1.46	1.61	0.87
Male	ALEV	30	0.16	0.36	0.41	0.57	1.02	1.23	1.19	0.67
Male	ALEV	35	0.13	0.23	0.27	0.39	0.59	0.98	1.33	0.53
Male	ALEV	40	0.08	0.28	0.48	0.50	0.67	0.99	1.39	0.54
Male	HIGHER	5	0.51	0.73	0.79	1.08	0.62	0.70	0.42	0.66
Male	HIGHER	10	1.04	1.01	1.03	1.25	1.03	0.89	0.37	0.98
Male	HIGHER	15	0.74	1.03	1.37	1.08	1.62	1.56	1.01	1.10
Male	HIGHER	20	0.62	0.67	0.93	1.33	1.30	1.58	1.16	1.08
Male	HIGHER	25	0.62	0.59	0.87	1.13	1.36	1.34	0.94	0.94
Male	HIGHER	30	0.54	0.60	0.61	0.93	1.29	1.51	0.64	0.82
Male	HIGHER	35	0.50	0.51	0.39	0.64	0.73	1.09	0.79	0.65
Male	HIGHER	40	0.57	0.45	0.62	0.69	0.54	0.87	0.81	0.59
Male	DEGREE	5	0.30	0.51	0.51	0.65	0.41	0.73	1.12	0.59
Male	DEGREE	10	0.36	0.88	0.99	1.39	1.10	2.04	1.90	1.15
Male	DEGREE	15	0.32	0.73	1.07	1.27	0.98	1.75	2.23	1.13
Male	DEGREE	20	0.29	0.57	1.00	1.26	1.15	1.83	1.97	1.10

Male	**DEGREE**	**25**	0.18	0.47	0.74	0.99	1.39	1.64	2.08	1.02
Male	**DEGREE**	**30**	0.17	0.33	0.36	0.74	1.07	1.22	1.69	0.71
Male	**DEGREE**	**35**	0.15	0.39	0.46	0.57	0.81	0.82	1.50	0.59
Male	**DEGREE**	**40**	0.15	0.30	0.23	0.44	0.70	0.51	0.64	0.44
Female	**NOQUAL**	**5**	2.42	1.44	0.82	0.74	0.16	0.23	0.12	0.90
Female	**NOQUAL**	**10**	1.67	1.07	0.79	0.75	0.30	0.06	0.16	0.72
Female	**NOQUAL**	**15**	1.33	1.38	1.05	0.75	0.38	0.27	0.18	0.81
Female	**NOQUAL**	**20**	1.59	1.51	1.42	1.13	0.89	0.36	0.31	1.15
Female	**NOQUAL**	**25**	2.16	2.13	1.91	1.51	1.12	0.86	0.50	1.65
Female	**NOQUAL**	**30**	2.99	2.62	2.50	2.08	2.05	1.02	0.75	2.12
Female	**NOQUAL**	**35**	3.05	2.96	2.38	2.23	2.02	1.36	0.91	2.30
Female	**NOQUAL**	**40**	5.22	5.27	4.59	3.26	3.04	2.13	2.56	3.94
Female	**BOLEV**	**5**	0.87	1.17	1.31	1.16	0.35	0.35	0.32	0.84
Female	**BOLEV**	**10**	0.83	0.65	0.83	0.89	0.58	0.28	0.23	0.64
Female	**BOLEV**	**15**	0.49	0.60	0.40	0.54	0.63	0.52	0.64	0.54
Female	**BOLEV**	**20**	0.34	0.61	0.47	0.56	0.42	0.64	0.88	0.55
Female	**BOLEV**	**25**	0.42	0.51	0.71	0.73	0.74	0.48	0.89	0.65
Female	**BOLEV**	**30**	0.46	0.54	0.58	0.64	0.99	0.70	1.28	0.71
Female	**BOLEV**	**35**	0.45	0.67	0.58	0.69	0.88	0.96	0.90	0.69
Female	**BOLEV**	**40**	0.69	0.76	0.89	0.83	0.96	1.05	1.57	0.91
Female	**OLEV**	**5**	1.58	2.41	2.93	2.74	2.16	1.10	1.06	2.06
Female	**OLEV**	**10**	0.91	1.17	2.08	2.20	2.59	1.14	0.80	1.70
Female	**OLEV**	**15**	0.32	0.50	0.89	1.01	1.84	1.67	0.87	1.08
Female	**OLEV**	**20**	0.18	0.37	0.75	0.86	1.42	1.47	1.36	0.90
Female	**OLEV**	**25**	0.19	0.32	0.53	0.93	1.23	1.47	1.18	0.81
Female	**OLEV**	**30**	0.18	0.38	0.51	0.80	1.35	1.36	1.11	0.76
Female	**OLEV**	**35**	0.20	0.16	0.26	0.54	1.01	1.30	0.89	0.62
Female	**OLEV**	**40**	0.20	0.33	0.51	0.50	0.83	1.29	1.23	0.63
Female	**ALEV**	**5**	0.35	0.31	0.60	1.00	1.00	1.06	1.17	0.80
Female	**ALEV**	**10**	0.21	0.44	0.57	0.72	1.08	1.52	0.82	0.74
Female	**ALEV**	**15**	0.05	0.11	0.26	0.40	0.53	1.18	0.92	0.48
Female	**ALEV**	**20**	0.02	0.04	0.10	0.31	0.50	0.87	0.55	0.34
Female	**ALEV**	**25**	0.01	0.05	0.09	0.17	0.37	0.71	0.72	0.28
Female	**ALEV**	**30**	0.01	0.02	0.13	0.10	0.35	0.66	0.64	0.28
Female	**ALEV**	**35**	0.03	0.06	0.05	0.10	0.29	0.40	0.46	0.18
Female	**ALEV**	**40**	0.01	0.04	0.01	0.07	0.15	0.37	0.68	0.19
Female	**HIGHER**	**5**	0.40	0.39	0.37	0.62	0.45	0.38	0.38	0.44
Female	**HIGHER**	**10**	0.35	0.45	0.65	0.78	0.73	0.62	0.67	0.61
Female	**HIGHER**	**15**	0.22	0.42	0.41	0.60	0.74	0.73	0.75	0.52
Female	**HIGHER**	**20**	0.28	0.30	0.53	0.68	0.79	0.82	0.75	0.60
Female	**HIGHER**	**25**	0.26	0.30	0.45	0.69	0.89	0.56	0.85	0.58
Female	**HIGHER**	**30**	0.21	0.38	0.46	0.50	0.83	0.89	0.96	0.60
Female	**HIGHER**	**35**	0.18	0.32	0.27	0.48	0.62	0.80	0.83	0.46
Female	**HIGHER**	**40**	0.27	0.24	0.28	0.33	0.59	0.49	0.64	0.36
Female	**DEGREE**	**5**	0.10	0.22	0.40	0.52	0.63	0.90	1.38	0.52
Female	**DEGREE**	**10**	0.06	0.24	0.44	0.83	0.78	1.61	1.83	0.74
Female	**DEGREE**	**15**	0.01	0.12	0.29	0.48	0.55	1.27	1.46	0.54
Female	**DEGREE**	**20**	0.04	0.06	0.11	0.36	0.58	1.34	1.43	0.46
Female	**DEGREE**	**25**	0.05	0.09	0.15	0.26	0.64	1.21	1.32	0.45
Female	**DEGREE**	**30**	0.05	0.09	0.12	0.18	0.51	0.71	1.43	0.33
Female	**DEGREE**	**35**	0.02	0.06	0.17	0.19	0.21	0.56	0.90	0.21
Female	**DEGREE**	**40**	0.05	0.12	0.06	0.12	0.05	0.26	0.53	0.13

Notes: All figures in this table are calculated from the GHS 1972-2002.

Table A3.2: Relative wages of gender-education-experience groups to wage index (ratio)

Wage Index (At), in 1995 pounds	1972	1977	1982	1987	1992	1998	2002	average
	5.22	5.64	5.97	6.35	6.11	6.08	7.07	6.24

GENDER	EDUCATION	EXP	1972	1977	1982	1987	1992	1998	2002	Efficiency units
Male	NOQUAL	5	0.55	0.60	0.60	0.50	0.41	0.59	0.58	0.55
Male	NOQUAL	10	0.86	0.88	0.85	0.76	0.89	0.65	0.80	0.81
Male	NOQUAL	15	0.95	0.94	0.97	0.90	0.90	0.85	0.94	0.91
Male	NOQUAL	20	0.97	1.01	0.96	0.94	0.94	0.90	0.87	0.97
Male	NOQUAL	25	0.99	1.01	1.00	1.02	0.94	0.92	0.91	0.99
Male	NOQUAL	30	0.92	0.99	1.00	1.03	1.04	0.98	0.98	1.00
Male	NOQUAL	35	0.95	0.97	1.01	1.00	0.99	0.93	0.97	0.99
Male	NOQUAL	40	0.85	0.91	0.92	0.97	0.95	0.93	0.93	0.92
Male	BOLEV	5	0.53	0.56	0.59	0.50	0.54	0.59	0.58	0.55
Male	BOLEV	10	0.96	0.93	0.86	0.82	0.86	0.82	0.84	0.87
Male	BOLEV	15	1.04	1.03	1.00	1.04	1.06	0.91	0.90	0.99
Male	BOLEV	20	1.12	1.10	1.10	1.17	0.97	0.95	0.90	1.07
Male	BOLEV	25	1.07	1.12	1.13	1.10	1.11	0.99	0.93	1.10
Male	BOLEV	30	1.06	1.06	1.20	1.14	1.21	1.11	1.07	1.14
Male	BOLEV	35	1.09	1.10	1.11	1.16	1.00	1.11	1.10	1.14
Male	BOLEV	40	1.01	1.00	1.08	1.04	1.06	1.05	1.04	1.03
Male	OLEV	5	0.53	0.60	0.59	0.53	0.60	0.52	0.62	0.56
Male	OLEV	10	0.99	0.93	0.91	0.93	0.88	0.80	0.79	0.92
Male	OLEV	15	1.21	1.08	1.16	1.06	1.05	1.03	1.07	1.08
Male	OLEV	20	1.34	1.22	1.21	1.17	1.22	1.16	1.11	1.21
Male	OLEV	25	1.38	1.32	1.22	1.24	1.25	1.12	1.11	1.25
Male	OLEV	30	1.47	1.27	1.28	1.35	1.12	1.18	1.27	1.31
Male	OLEV	35	1.45	1.47	1.37	1.33	1.38	1.23	1.20	1.30
Male	OLEV	40	1.38	1.20	1.21	1.22	1.22	1.11	1.15	1.24
Male	ALEV	5	0.60	0.72	0.68	0.70	0.71	0.61	0.61	0.68
Male	ALEV	10	1.08	1.05	0.98	1.05	1.05	0.92	0.94	1.01
Male	ALEV	15	1.51	1.21	1.18	1.14	1.23	1.24	1.11	1.22
Male	ALEV	20	1.26	1.29	1.30	1.34	1.30	1.22	1.34	1.31
Male	ALEV	25	1.76	1.36	1.29	1.34	1.44	1.38	1.23	1.39
Male	ALEV	30	1.27	1.33	1.53	1.66	1.35	1.46	1.34	1.42
Male	ALEV	35	1.42	1.45	1.64	1.42	1.49	1.18	1.46	1.38
Male	ALEV	40	1.18	1.16	1.20	1.39	1.29	1.17	1.10	1.28
Male	HIGHER	5	0.88	0.93	0.91	0.90	0.88	0.82	0.91	0.90
Male	HIGHER	10	1.21	1.20	1.08	1.17	1.20	1.10	1.33	1.18
Male	HIGHER	15	1.40	1.32	1.30	1.39	1.35	1.28	1.26	1.34
Male	HIGHER	20	1.61	1.46	1.47	1.52	1.27	1.42	1.18	1.44
Male	HIGHER	25	1.85	1.54	1.57	1.49	1.51	1.50	1.50	1.53
Male	HIGHER	30	1.72	1.50	1.54	1.42	1.47	1.39	1.61	1.57
Male	HIGHER	35	1.88	1.54	1.73	1.33	1.24	1.39	1.52	1.56
Male	HIGHER	40	1.66	1.38	1.62	1.33	1.47	1.36	1.65	1.45
Male	DEGREE	5	1.00	0.92	0.87	1.10	0.96	1.04	1.10	1.02
Male	DEGREE	10	1.51	1.36	1.34	1.36	1.48	1.45	1.33	1.40
Male	DEGREE	15	1.85	1.65	1.60	1.62	1.80	1.83	1.61	1.70
Male	DEGREE	20	2.25	1.96	1.89	1.86	1.83	2.18	1.78	1.90
Male	DEGREE	25	2.11	1.95	1.81	2.25	1.81	2.23	1.86	1.94

Male	**DEGREE**	**30**	2.48	2.00	1.95	1.90	1.89	1.94	1.86	2.03
Male	**DEGREE**	**35**	2.59	1.90	1.73	2.05	1.55	2.12	1.98	2.00
Male	**DEGREE**	**40**	2.54	2.21	2.16	1.92	1.65	2.08	1.77	1.91
Female	**NOQUAL**	**5**	0.40	0.51	0.49	0.47	0.47	0.58	0.64	0.50
Female	**NOQUAL**	**10**	0.53	0.65	0.60	0.59	0.62	0.60	0.64	0.61
Female	**NOQUAL**	**15**	0.54	0.64	0.62	0.66	0.83	0.67	0.46	0.64
Female	**NOQUAL**	**20**	0.51	0.64	0.68	0.63	0.62	0.81	0.74	0.65
Female	**NOQUAL**	**25**	0.54	0.65	0.67	0.59	0.62	0.71	0.64	0.63
Female	**NOQUAL**	**30**	0.52	0.65	0.65	0.64	0.76	0.73	0.77	0.67
Female	**NOQUAL**	**35**	0.54	0.66	0.65	0.61	0.68	0.68	0.81	0.67
Female	**NOQUAL**	**40**	0.52	0.63	0.66	0.65	0.72	0.65	0.78	0.65
Female	**BOLEV**	**5**	0.41	0.51	0.47	0.45	0.41	0.47	0.56	0.49
Female	**BOLEV**	**10**	0.65	0.70	0.67	0.62	0.76	0.70	0.78	0.69
Female	**BOLEV**	**15**	0.69	0.77	0.72	0.76	0.76	0.94	0.88	0.79
Female	**BOLEV**	**20**	0.65	0.67	0.80	0.61	1.00	0.79	0.99	0.77
Female	**BOLEV**	**25**	0.67	0.68	0.75	0.72	0.84	0.60	0.94	0.78
Female	**BOLEV**	**30**	0.69	0.78	0.78	0.78	0.82	0.93	0.99	0.79
Female	**BOLEV**	**35**	0.64	0.84	0.75	0.81	0.76	0.88	0.86	0.79
Female	**BOLEV**	**40**	0.68	0.80	0.75	0.74	0.86	0.80	0.81	0.79
Female	**OLEV**	**5**	0.48	0.53	0.56	0.52	0.48	0.55	0.63	0.53
Female	**OLEV**	**10**	0.74	0.75	0.76	0.75	0.79	0.79	0.69	0.76
Female	**OLEV**	**15**	0.68	0.83	0.83	0.93	0.84	1.04	0.98	0.88
Female	**OLEV**	**20**	0.63	0.82	0.82	0.90	0.87	1.05	1.01	0.87
Female	**OLEV**	**25**	0.77	0.78	0.86	0.91	0.88	0.96	0.92	0.86
Female	**OLEV**	**30**	0.83	0.76	0.89	0.88	0.75	0.95	0.83	0.84
Female	**OLEV**	**35**	0.91	0.93	0.83	1.00	0.93	0.95	0.91	0.90
Female	**OLEV**	**40**	0.68	0.98	0.91	0.88	0.66	0.89	0.96	0.86
Female	**ALEV**	**5**	0.56	0.59	0.70	0.65	0.59	0.60	0.73	0.62
Female	**ALEV**	**10**	0.85	0.86	0.85	0.79	0.89	0.86	0.81	0.85
Female	**ALEV**	**15**	0.88	1.23	1.01	0.91	1.18	1.12	1.02	1.02
Female	**ALEV**	**20**	0.71	1.34	0.83	1.02	1.17	1.14	1.08	1.04
Female	**ALEV**	**25**	0.77	0.76	0.87	0.95	0.83	1.12	0.96	0.94
Female	**ALEV**	**30**	0.93	0.97	0.90	0.46	1.05	1.21	1.12	0.97
Female	**ALEV**	**35**	1.26	0.75	0.95	0.93	1.02	1.06	1.02	1.16
Female	**ALEV**	**40**	0.79	1.18	0.97	1.09	1.02	0.93	0.85	0.94
Female	**HIGHER**	**5**	0.68	0.71	0.79	0.78	0.83	0.80	0.72	0.76
Female	**HIGHER**	**10**	0.80	0.97	1.01	0.97	1.21	1.07	0.89	0.99
Female	**HIGHER**	**15**	0.71	1.00	1.13	1.08	1.14	1.13	1.12	1.10
Female	**HIGHER**	**20**	1.17	0.89	1.13	1.12	1.24	1.15	1.23	1.08
Female	**HIGHER**	**25**	0.98	1.24	1.10	1.17	1.33	1.14	1.13	1.12
Female	**HIGHER**	**30**	1.11	1.16	1.25	1.32	1.22	1.32	1.32	1.16
Female	**HIGHER**	**35**	1.15	1.09	1.23	0.95	0.92	1.23	1.14	1.08
Female	**HIGHER**	**40**	1.03	0.94	1.20	1.34	1.00	1.02	1.04	1.10
Female	**DEGREE**	**5**	0.84	0.80	0.88	1.00	0.92	0.68	0.84	0.90
Female	**DEGREE**	**10**	1.24	1.26	1.31	1.17	1.31	1.33	1.37	1.23
Female	**DEGREE**	**15**	1.27	0.97	1.23	1.58	1.17	1.61	1.48	1.37
Female	**DEGREE**	**20**	1.80	1.81	1.19	1.19	1.35	1.76	1.61	1.46
Female	**DEGREE**	**25**	0.85	1.85	1.83	1.53	1.50	1.57	1.54	1.41
Female	**DEGREE**	**30**	1.92	1.41	1.11	1.45	1.59	1.54	1.29	1.48
Female	**DEGREE**	**35**	1.34	1.21	0.85	1.46	1.36	1.39	1.41	1.35
Female	**DEGREE**	**40**	2.02	1.61	1.56	1.29	2.08	1.37	1.73	1.60

Notes: All figures in this table are calculated from the GHS 1972-2002.

Table A3.3: Relative labour supplies of gender-education-experience groups (measured in efficiency units)

GENDER	EDUCATION	EXP	1972	1977	1982	1987	1992	1998	2002	Average
Male	NOQUAL	5	1.97	1.25	0.72	0.73	0.26	0.19	0.11	0.75
Male	NOQUAL	10	3.35	1.83	1.46	1.14	0.34	0.22	0.23	1.22
Male	NOQUAL	15	4.00	3.18	1.81	1.56	0.97	0.39	0.37	1.76
Male	NOQUAL	20	3.98	3.11	2.72	1.59	1.17	0.59	0.47	1.95
Male	NOQUAL	25	4.14	3.18	2.82	2.44	1.43	0.86	0.72	2.23
Male	NOQUAL	30	5.28	3.28	3.05	2.03	2.03	0.83	0.68	2.45
Male	NOQUAL	35	5.74	3.93	3.16	2.19	2.29	1.24	0.91	2.78
Male	NOQUAL	40	11.21	9.84	8.21	5.03	3.87	2.57	3.20	6.27
Male	BOLEV	5	0.75	0.63	0.79	0.74	0.23	0.21	0.19	0.51
Male	BOLEV	10	1.85	0.76	0.90	0.86	0.55	0.31	0.33	0.79
Male	BOLEV	15	2.16	1.12	0.75	0.77	0.63	0.88	0.62	0.99
Male	BOLEV	20	1.80	1.23	1.00	0.64	0.81	0.82	1.00	1.04
Male	BOLEV	25	1.45	1.38	1.17	1.00	0.68	0.57	0.85	1.02
Male	BOLEV	30	1.75	1.79	1.49	1.04	0.93	0.60	1.08	1.24
Male	BOLEV	35	1.75	1.54	1.52	1.44	0.84	0.77	0.80	1.24
Male	BOLEV	40	3.26	3.30	3.13	2.35	1.61	1.40	1.92	2.43
Male	OLEV	5	0.98	1.41	1.48	1.34	0.82	0.57	0.67	1.04
Male	OLEV	10	1.21	1.70	1.79	2.07	1.84	0.92	1.06	1.51
Male	OLEV	15	0.97	1.78	1.48	1.64	2.06	1.87	1.26	1.58
Male	OLEV	20	0.68	1.51	1.78	1.33	1.59	2.39	1.75	1.58
Male	OLEV	25	0.66	0.99	1.15	1.46	1.57	2.12	1.91	1.41
Male	OLEV	30	0.56	0.67	0.85	1.21	1.84	1.31	1.39	1.12
Male	OLEV	35	0.68	0.71	0.66	0.91	1.35	1.58	1.23	1.02
Male	OLEV	40	0.85	1.18	0.86	1.30	1.69	2.12	1.78	1.40
Male	ALEV	5	0.52	0.92	0.85	0.86	0.94	0.60	0.64	0.76
Male	ALEV	10	0.67	1.62	1.55	1.54	1.48	1.45	1.27	1.37
Male	ALEV	15	0.45	1.52	1.58	1.71	1.77	1.70	1.59	1.47
Male	ALEV	20	0.48	0.66	1.13	1.71	1.63	2.21	1.60	1.35
Male	ALEV	25	0.24	0.48	0.84	1.05	1.82	1.81	1.97	1.17
Male	ALEV	30	0.25	0.55	0.61	0.82	1.38	1.56	1.49	0.95
Male	ALEV	35	0.20	0.35	0.40	0.53	0.77	1.20	1.61	0.72
Male	ALEV	40	0.12	0.38	0.64	0.64	0.82	1.12	1.56	0.75
Male	HIGHER	5	0.52	0.70	0.74	0.98	0.53	0.56	0.34	0.63
Male	HIGHER	10	1.37	1.29	1.27	1.48	1.16	0.94	0.38	1.13
Male	HIGHER	15	1.11	1.49	1.92	1.46	2.07	1.86	1.19	1.59
Male	HIGHER	20	1.00	1.03	1.39	1.92	1.78	2.02	1.46	1.52
Male	HIGHER	25	1.06	0.98	1.39	1.73	1.99	1.83	1.26	1.46
Male	HIGHER	30	0.96	1.02	1.01	1.46	1.94	2.11	0.89	1.34
Male	HIGHER	35	0.88	0.86	0.64	1.01	1.08	1.52	1.09	1.01
Male	HIGHER	40	0.92	0.70	0.95	1.00	0.75	1.13	1.04	0.93
Male	DEGREE	5	0.34	0.56	0.54	0.67	0.39	0.66	1.00	0.60
Male	DEGREE	10	0.56	1.33	1.45	1.95	1.47	2.55	2.34	1.66
Male	DEGREE	15	0.62	1.34	1.91	2.18	1.59	2.65	3.33	1.95
Male	DEGREE	20	0.61	1.16	1.99	2.41	2.08	3.10	3.28	2.09
Male	DEGREE	25	0.40	0.98	1.50	1.92	2.57	2.83	3.55	1.97
Male	DEGREE	30	0.39	0.72	0.76	1.51	2.07	2.21	3.01	1.52
Male	DEGREE	35	0.34	0.83	0.96	1.14	1.54	1.45	2.64	1.27
Male	DEGREE	40	0.32	0.62	0.46	0.85	1.27	0.87	1.07	0.78

Female	**NOQUAL**	**5**	1.34	0.77	0.43	0.37	0.08	0.10	0.05	0.45
Female	**NOQUAL**	**10**	1.14	0.70	0.50	0.46	0.17	0.03	0.08	0.44
Female	**NOQUAL**	**15**	0.95	0.95	0.70	0.48	0.23	0.16	0.10	0.51
Female	**NOQUAL**	**20**	1.15	1.05	0.97	0.73	0.55	0.21	0.18	0.69
Female	**NOQUAL**	**25**	1.53	1.45	1.27	0.96	0.68	0.48	0.28	0.95
Female	**NOQUAL**	**30**	2.23	1.89	1.75	1.39	1.30	0.61	0.44	1.37
Female	**NOQUAL**	**35**	2.27	2.13	1.66	1.49	1.28	0.81	0.53	1.45
Female	**NOQUAL**	**40**	3.82	3.71	3.15	2.14	1.90	1.24	1.47	2.49
Female	**BOLEV**	**5**	0.47	0.62	0.68	0.57	0.16	0.15	0.14	0.40
Female	**BOLEV**	**10**	0.65	0.49	0.60	0.62	0.38	0.17	0.14	0.44
Female	**BOLEV**	**15**	0.43	0.51	0.33	0.43	0.48	0.36	0.44	0.43
Female	**BOLEV**	**20**	0.29	0.50	0.38	0.43	0.30	0.44	0.59	0.42
Female	**BOLEV**	**25**	0.36	0.43	0.58	0.58	0.55	0.33	0.61	0.49
Female	**BOLEV**	**30**	0.41	0.46	0.48	0.51	0.75	0.49	0.89	0.57
Female	**BOLEV**	**35**	0.40	0.57	0.48	0.55	0.66	0.67	0.63	0.57
Female	**BOLEV**	**40**	0.60	0.65	0.73	0.65	0.72	0.74	1.08	0.74
Female	**OLEV**	**5**	0.93	1.37	1.62	1.46	1.09	0.52	0.49	1.07
Female	**OLEV**	**10**	0.76	0.96	1.64	1.67	1.86	0.77	0.53	1.17
Female	**OLEV**	**15**	0.31	0.47	0.82	0.89	1.54	1.31	0.67	0.86
Female	**OLEV**	**20**	0.18	0.34	0.68	0.75	1.18	1.14	1.04	0.76
Female	**OLEV**	**25**	0.18	0.30	0.48	0.80	1.00	1.12	0.89	0.68
Female	**OLEV**	**30**	0.16	0.34	0.45	0.67	1.08	1.02	0.81	0.65
Female	**OLEV**	**35**	0.20	0.16	0.25	0.49	0.86	1.04	0.70	0.53
Female	**OLEV**	**40**	0.20	0.31	0.46	0.44	0.68	0.99	0.93	0.57
Female	**ALEV**	**5**	0.24	0.21	0.39	0.62	0.59	0.59	0.64	0.47
Female	**ALEV**	**10**	0.20	0.40	0.51	0.61	0.87	1.15	0.61	0.62
Female	**ALEV**	**15**	0.06	0.12	0.28	0.41	0.52	1.08	0.83	0.47
Female	**ALEV**	**20**	0.02	0.04	0.11	0.32	0.50	0.81	0.50	0.33
Female	**ALEV**	**25**	0.01	0.05	0.09	0.16	0.33	0.60	0.59	0.26
Female	**ALEV**	**30**	0.01	0.02	0.13	0.10	0.33	0.57	0.54	0.24
Female	**ALEV**	**35**	0.04	0.08	0.06	0.12	0.32	0.42	0.47	0.21
Female	**ALEV**	**40**	0.01	0.04	0.01	0.07	0.13	0.31	0.56	0.16
Female	**HIGHER**	**5**	0.34	0.32	0.30	0.47	0.33	0.26	0.26	0.33
Female	**HIGHER**	**10**	0.38	0.48	0.68	0.78	0.69	0.54	0.58	0.59
Female	**HIGHER**	**15**	0.28	0.50	0.48	0.67	0.78	0.72	0.73	0.59
Female	**HIGHER**	**20**	0.34	0.35	0.60	0.73	0.81	0.79	0.71	0.62
Female	**HIGHER**	**25**	0.33	0.36	0.53	0.78	0.95	0.56	0.83	0.62
Female	**HIGHER**	**30**	0.27	0.48	0.56	0.58	0.93	0.92	0.98	0.68
Female	**HIGHER**	**35**	0.22	0.37	0.31	0.52	0.64	0.77	0.79	0.52
Female	**HIGHER**	**40**	0.33	0.29	0.33	0.36	0.62	0.48	0.62	0.43
Female	**DEGREE**	**5**	0.10	0.22	0.37	0.47	0.54	0.72	1.09	0.50
Female	**DEGREE**	**10**	0.08	0.31	0.56	1.02	0.91	1.76	1.96	0.94
Female	**DEGREE**	**15**	0.02	0.17	0.42	0.66	0.71	1.55	1.75	0.75
Female	**DEGREE**	**20**	0.07	0.09	0.17	0.53	0.81	1.74	1.82	0.75
Female	**DEGREE**	**25**	0.08	0.14	0.22	0.37	0.86	1.52	1.63	0.69
Female	**DEGREE**	**30**	0.08	0.14	0.19	0.27	0.72	0.93	1.85	0.60
Female	**DEGREE**	**35**	0.04	0.09	0.24	0.26	0.27	0.68	1.07	0.38
Female	**DEGREE**	**40**	0.10	0.20	0.10	0.19	0.07	0.36	0.74	0.25

Notes: All figures in this table are calculated from the GHS 1972-2002.

APPENDIX 3.2

Results using weekly earnings and headcount employment

Figure A3.1: Relative wage and relative supply in the UK, headcount employment 1972-2002

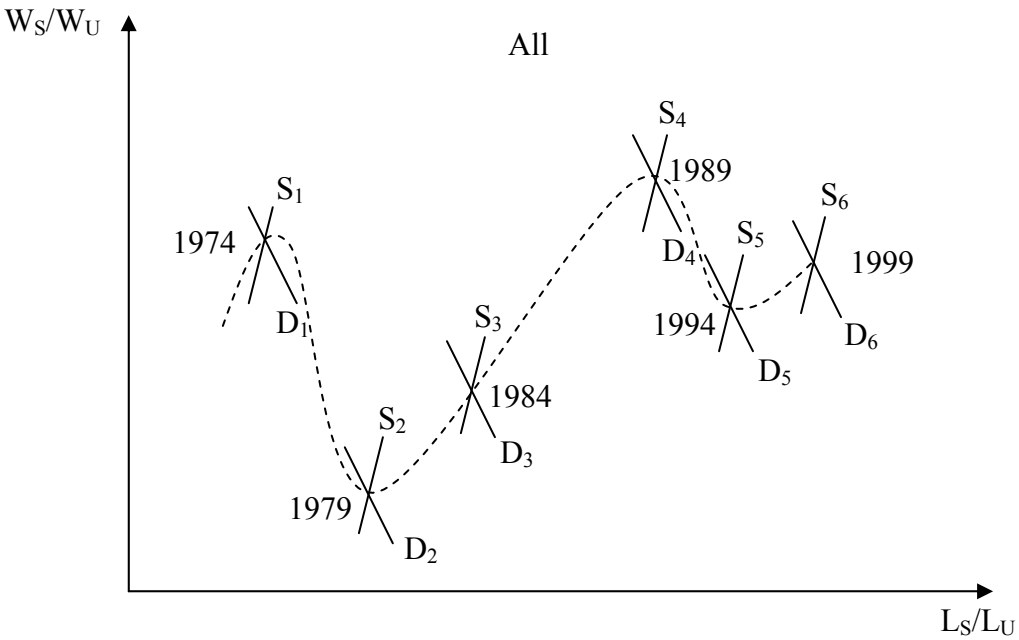


Figure A3.2: Price and quantity changes for 96 demographic cells (weekly earnings and headcount employment)

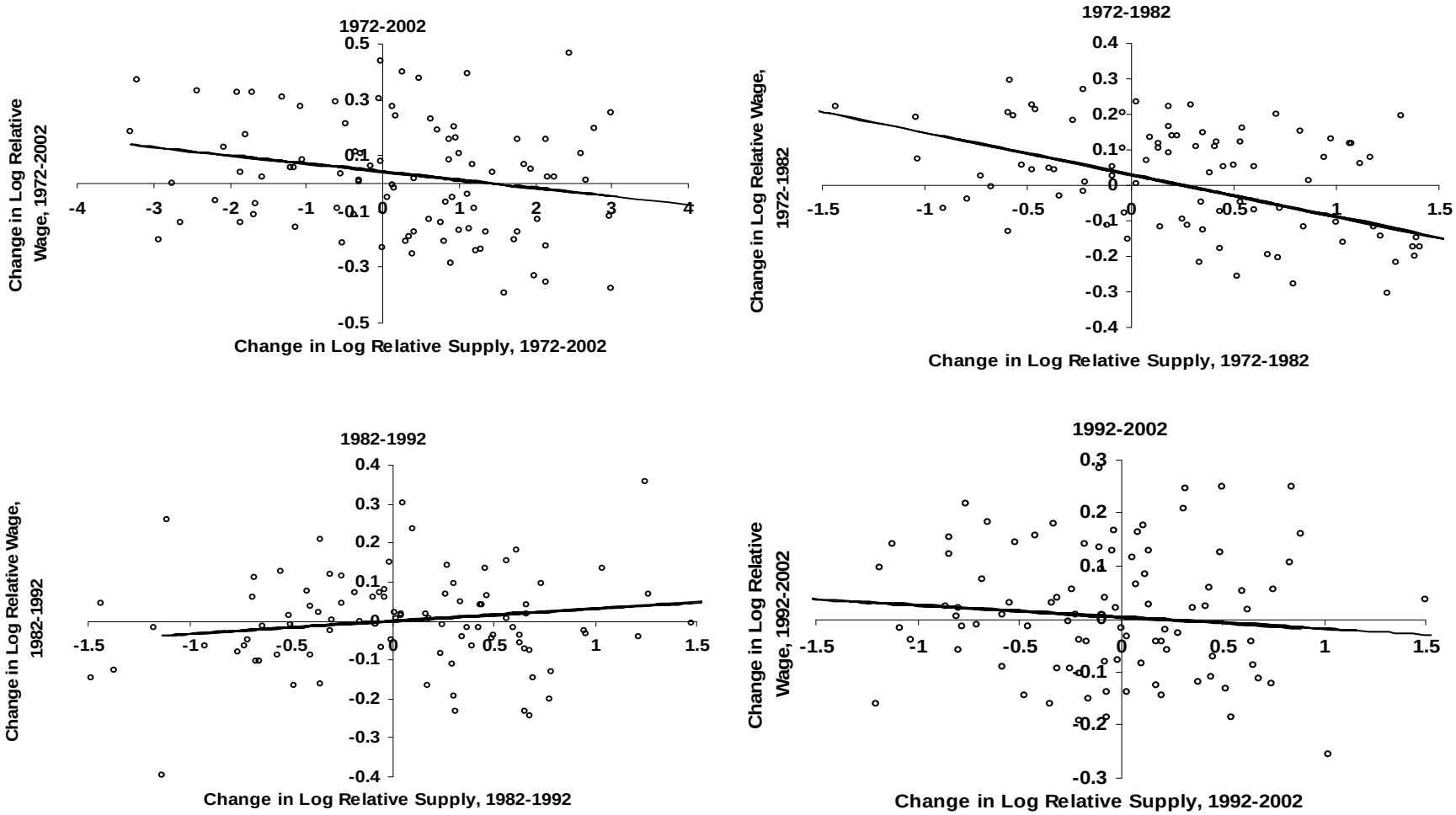


Table A3.4: Relative supply changes in the UK, headcount employment, 1972-2002

Group	Share of headcount employment (%) 1972	1977	1982	1987	1992	1998	2002
Gender:							
Men	49.0	58.1	56.1	48.0	46.9	50.5	50.5
Women	51.0	41.9	43.9	52.0	53.1	49.5	49.5
Education:							
No qualification	61.0	46.7	38.5	33.9	26.9	14.4	11.9
O-level	10.5	15.8	19.7	21.2	25.7	25.4	21.8
Degree	2.4	6.0	7.7	8.8	9.6	17.8	22.7
Experience (men):							
1-5 years	6.9	7.8	7.4	7.4	5.4	4.5	5.0
26-30 years	5.9	6.6	6.3	5.2	6.9	6.4	6.5
	Relative labour supply (employment measured in *efficiency units*, %)						
Group	**1972**	**1977**	**1982**	**1987**	**1992**	**1998**	**2002**
Gender:							
Men	59.4	68.4	66.4	58.6	57.5	60.1	59.7
Women	40.6	31.6	33.6	41.4	42.5	39.9	40.3
Education:							
No qualification	55.1	40.1	32.5	27.6	21.2	10.4	8.6
O-level	10.3	14.8	17.6	19.1	23.0	21.9	18.4
Degree	4.5	10.6	13.3	15.1	16.0	25.9	32.2
Experience (men):							
1-5 years	5.1	5.4	5.0	5.2	3.6	2.9	3.2
26-30 years	8.1	8.7	8.3	7.4	9.7	8.9	8.9
	Change in log form relative labour supply (employment measured in *efficiency units*, multiplied by 100)						
Group	**1972 -1977**	**1977 -1982**	**1982 -1987**	**1987 -1992**	**1992 -1998**	**1998 -2002**	**1972 -2002**
Gender:							
Men	14.1	-3.0	-12.5	-1.9	4.5	-0.7	0.6
Women	-25.0	6.1	20.8	2.7	-6.5	1.0	-0.9
Education:							
No qualification	-31.7	-20.9	-16.6	-26.1	-71.4	-19.3	-186.0
O-level	35.7	17.5	8.5	18.3	-4.6	-17.5	57.8
Degree	86.9	22.6	12.5	5.5	48.2	21.9	197.6
Experience (men):							
1-5 years	6.2	-7.1	4.1	-37.3	-22.6	10.1	-46.5
26-30 years	8.0	-5.3	-11.7	27.0	-8.2	-0.1	9.6

Note: Figures in this table represent the headcount employment shares and relative labour supply measured in *efficiency units* (average relative weekly wage of each demographic cell over the last thirty years) using the GHS 1972-2002. Samples include all workers in the counter sample.

Table A3.5: Inner products of changes in relative weekly wages and changes in relative supply (headcount employment measured in *efficiency units*) for 96 demographic groups

	5-year centred interval				
5-year centred interval	**1974**	**1979**	**1984**	**1989**	**1994**
Inner Products of actual changes:					
1979	-0.0160				
1984	-0.0100	0.0028			
1989	0.0023	0.0136	0.0036		
1994	-0.0228	0.0199	0.0027	-0.0090	
1999	-0.0146	0.0409	0.0219	-0.0053	0.0080
Inner Products of changes in detrended data:					
1979	-0.0031				
1984	0.0026	-0.0039			
1989	-0.0022	-0.0152	-0.0042		
1994	-0.0014	-0.0028	0.0009	-0.0021	
1999	-0.0017	-0.0009	-0.0003	-0.0116	-0.0037

Table A3.6: Inner products of changes in relative weekly wages and changes in relative supply (headcount employment measured in *efficiency units*) for 96 demographic groups

	3-year centred interval				
3-year centred interval	**1973**	**1978**	**1983**	**1988**	**1993**
Inner Products of actually changes:					
1978	-0.0221				
1983	-0.0139	0.0046			
1988	-0.0107	0.0089	0.0005		
1993	-0.0296	0.0207	0.0036	-0.0048	
2001	-0.0464	0.0346	0.0119	-0.0043	0.0012
Inner Products of changes in detrended data:					
1978	-0.0060				
1983	0.0033	-0.0029			
1988	0.0018	-0.0149	-0.0039		
1993	-0.0016	-0.0066	0.0005	-0.0020	
2001	-0.0076	-0.0027	-0.0055	-0.0184	-0.0133

CHAPTER FOUR:
INSTITUTIONAL EFFECTS ON SKILL PREMIUM

4.1 Introduction

Wage inequality in the United Kingdom, as we have seen in the last two chapters, has substantially increased in the last three decades, which is much higher than that in continental European countries. Schmitt (1995) argues that a portion of the changes in overall inequality in Britain during the 1970s and 1980s was due to the decline and subsequent recovery of financial returns to labour market skills. Analysis of the wage distribution in the UK by Gosling, Machin and Meghir (2000) also emphasizes the importance of skill (education) attainment of recent cohorts and changes over time in the skill (education) wage premium.

Moreover, Harmon, Oosterbeek and Walker (2003) compare the estimated education return across the whole of wage distribution to infer the extent to which education exacerbate or reduce underlying inequality. Their results suggest education returns are higher for those in the top deciles of the income distribution compared to those in the bottom deciles and this inequality may have increased in recent years. Our results in the Chapter 2 also show that changes in skill (education) attainment and wage premium are closely associated with the increasing earnings inequality (see Figure 2.4-2.5 and Table 2.3). Even though the supply-demand analysis on skill (education) can induce the changes of relative wage (see Figure 3.3-3.4 and Table 3.2-3.3), we are not clear what are underpinning factors for changes in the supply-demand for skills. In this chapter, we analyze the links between labour market institutions and the skill (education) premium.

Changes in skill premiums are driven by both supply and demand factors and the institutional environment. Even though the increasing skill premium in the UK can be broadly explained by interaction between relative demand and supply for skill, the existing literature has tried to isolate the causal factors underpinning these market changes. The most popular candidate is skill-biased technical change (SBTC). In fact, there is strong evidence of the empirical association between proxies for SBTC (computers or other ICT facilities) and the widened wage gap of the UK and US in the 1980s (see Krueger 1993, Machin and Van Reenen 1998, Autor, Katz and Krueger 1998, Katz and Autor 2000, Machin 2001 and O'Mahony et al 2008).

An alternative explanation focuses on changes in product demand largely associated with large trade deficits in the 1980s (see trade deficits in Nickell 2006, Table C). Wood (1994, 1995 and 1998) argues that the growth of manufacturing imports from newly industrializing economies have led to a sharp decline in unskilled manufacturing employment and a shift in employment toward other skill-intensive sectors. Hence, the decline of manufacturing decreases the relative demand for unskilled workers and increases earnings inequality. However, the trade explanation is not convincing for many labour economists (see Schmitt 1995, and Machin and Van Reenen 1998). And even trade economists such as Krugman and Lawrence (1993) and Sachs and Shatz (1994) also point that the effect of international trade on relative demand for skill is surprising small. Hence, on the whole the evidence seems to lean towards the SBTC explanation (Machin, 1996).

The widening wage gap in the UK has been accompanied by institutional reform in the labour market since the Thatcher-era. Labour policy directed by US-style flexibility may be part of the causation of the widening wage structure. In

Chapter 3, a steadily growing relative demand interacted with labour supply shifts appears to only broadly explain changes of relative wages of males. However, during the 1980s and the 2000s, the positive associations between relative wages and relative supply still exist for both males and females even after we detrended the data. The acceleration of relative demand for skilled workers after the 1970s is beyond what a simple supply-demand model can explain. This chapter aims to analyze the effects of changes in labour market institutions (such as trade unions, taxation/unemployment benefits and the national minimum wages) on the skill premium.

With the same access to technology and international competition, and having had a similar education expansion, the increasing skill premium in the UK, in contrast to the stable wage structure in continental European countries can only be explained by a different institutional environment. Hence, Acemoglu (2003a) argues that changes in the supply and demand for skills are unlikely to fully account for the marked differences in skill premium across countries. The "Krugman hypothesis" states that the rise in wage inequality in the Anglo-Saxon countries as well as the rise in unemployment in continental Europe are "two sides of the same coin", namely a fall in the relative demand for unskilled workers under different wage setting institutions (Krugman 1994, Nickell and Bell 1996 and Puhani 2003, also see Figure 1.1 in Chapter 1).

A substantial amount of research on wage inequality has regarded and examined labour market institutions as important factors that may affect the wage

response of markets to shifts in the relative demand for skills.[22] One strand of this research has studied how specific labour market institutions affect wage differentials in the UK. First of all, the possibility of there being a connection between the wage differentials and trade unions has been studied in a large literature. Casual inspection shows a striking association between movements in union density over time and changes in the earnings dispersion. Schmitt (1995) has calculated that the decline in union density could account for 21 percent of the rise in the pay premium for a university degree during 1978-1988. Machin (1997) obtains more dramatic results that the male variance would have been 40 percent less if the 1980s levels of union coverage had prevailed in 1991. Bell and Pitt (1998) also conclude the deunionization between the early 1980s and 1990s widened the male earnings distribution by about 20 percent.[23]

The latest finding of Addison et al (2007) may be the only one to analyze the effect of trade unions on the British wage gap by gender and private/public sector, allowing for worker education. They point out that deunionization is shown to account for surprising little of the increase in earnings dispersion in the private sector for either males or females. The lower union decline in the public sector, however, has actually stronger effect. Additionally, in the public sector, trade unions no longer reduced earnings dispersion as much as they once did by virtue of their growing tendency to organize more skilled groups. But, it is still not very clear why deunionization has such a different effect on the wage differentials in the private and

[22] The long reference list includes Katz, Loveman and Blanchflower (1995), Blau and Kahn (1996), Machin (1996, 1997), Gottschalk and Joyce (1998), Card et al (2003) and Koeniger et al (2004 and 2007).

[23] Card (2001) for the United States, Card et al. (2004) for a comparison of the United States, the United Kingdom, and Canada, and Kahn (2000) for OECD countries have also found that higher union density is associated with lower wage inequality.

public sector. This chapter will push the discussion further and explore the union effect on the skill premium over the last three decades in the UK.

Moreover, Dickens et al. (1999) and papers in the special session on the British minimum wages in the Economic Journal 2004 have found that national minimum wages reduce wage inequality by increasing the bottom deciles of the pay distribution without a negative impact on employment (see Dickens and Manning 2004, Machin and Wilson 2004, Stewart 2004 and the summary of Metcalf 2004 in this session). DiNardo et al. (1996) and Lee (1999) also find the same effect of minimum wages for the United States. Again, this chapter will push the minimum wages discussion further.

For other labour market institutions, the different effects of the tax wedge and unemployment benefits on skilled and unskilled workers may affect the skill premium. Harmon, Oosterbeek and Walker (2003) argue that the resulting inequality from different education return may be dealt with through redistributive tax and social security policy. Brewer et al (2008) argue that even though the current government has increased taxes on people with high incomes, this has not prevented them from racing further away from the average level of living standards across the country. They think that the outlook for inequality in Britain may depend more on the outlook for the stock market than on government tax and benefit policies. This chapter will push these arguments further and investigate the different effects of the tax wedge and benefits on skill premiums.

Even though much literature shows that institutional factors such as trade unions, minimum wages and the tax/benefit system are important to explain changes

of skill premiums, recent literature still contains much disagreement concerning whether institutional factors are quantitatively more important than pure market forces for changes in the skill premium in the UK. How to disentangle the institutional factors from pure demand and supply, and assess their respective importance is still a big problem for empirical research. Such an assessment is a further aim of this chapter.

Most previous institution-specific empirical studies only use cross-section data at country level (see Blau and Khan 1996). The only two cases of longitudinal data are Wallerstein (1999, for 16 developed countries in 1980, 1986 and 1992), and Koeniger et al (2004 and 2007, for 11 developed countries over 1973-1998). Our analysis builds on Koeniger et al (2004 and 2007), but we construct a balanced panel data of six skill (education) groups in the United Kingdom over 1972-2002 from several micro-economic datasets. Using these data, we investigate the effects of both aggregated and disaggregated supply-demand-institution factors for distinct skill groups on skill premiums in the UK, and quantitatively assess respective importance.

For instance, trade unions in skilled and unskilled groups have different effects on the skill premium, because trade unions have different weights on welfare of skilled and unskilled workers in its objective function (see Koeniger et al 2004 and equation (A17) in Appendix 4.1). Unemployment rates in different skill groups are used as control variables for labour market conditions, i.e. business cycle. Since wages of different skill groups have different responsiveness to market conditions, unemployment rates in different skill groups also affect the skill premium over time. The analysis has required attaining data on trade union density, tax and benefit rates, unemployment rates, technology index and industry shifts index by skill level for the

period 1972-2002 as well. Hence, we can examine the associations between various skill premiums and supply-demand-institution changes by skill levels over a much longer period than previous research. Finally, cross-national analysis at country level cannot tell us whether the story is the same for the private and public sector. The public-private distinction will also be our contribution.

The remainder of the paper is organised as follows. Section 2 reviews the theoretical model based on Koeniger et al (2004) and motivates the estimation log-linear equation. Section 3 provides our empirical specification and introduces the basic framework of our panel data. Section 4 describes the main data sources and measurement of variables used in our empirical specification. Section 5 estimates empirical results. The last section concludes.

4.2 A model of trade union bargaining

Our empirical work is based on the union bargaining model provided by Koeniger et al (2004). In this section, we review this model, in which labour market institutions alter the outside option of skilled and unskilled workers differently, and thus affect relative labour demand as well as the wage differentials. Labour supply is regarded as an exogenous factor and only reflected into the control variable for market condition. This model then evaluates how institutions affect wage differentials, giving union bargaining with employers over the wage. Institutions such as union density, the tax wedge, unemployment benefits and minimum wages influence outcomes by changing the outside option of workers. Thus, if labour market institutions improved the outside option for unskilled workers more than for skilled workers, bargaining position of unskilled workers would be strengthened and tend to compress the skill premiums.

Changes of institutions as well as market conditions, technologies and industrial structure are reflected in the following equation[24]:

$$\ln\left(\frac{\overline{w_H}}{\overline{w_L}}\right) \cong f(\underset{+}{tud_H}, \underset{-}{tud_L}) + g(\underset{+}{tax_H}, \underset{-}{tax_L}) + h(\underset{+}{repr_H}, \underset{-}{repr_L}) + i(\underset{-}{MW})$$
$$+ j(\underset{-}{u_H}, \underset{+}{u_L}) + k(\underset{+}{ind_H}, \underset{+}{ind_L}, \underset{+}{comp_H}, \underset{-}{comp_L},) \qquad (4.1)$$

In equation (4.1), H denotes high skilled workers while L is low skilled workers. The skill premium, i.e. log form gross wage differentials for skilled workers, $\ln\left(\frac{\overline{w_H}}{\overline{w_L}}\right)$, mainly depends on trade union density (tud), tax wedge (tax), benefit replacement ratios (repr), unemployment rates (u), industrial structure shifts (ind) and technology (comp) by skill, with the addition of the minimum wage variable (MW).

Skill premiums depend on human capital and forgone earnings, and should be remarkably constant over the long run. However, short and medium run factors, including variables of institutions, market conditions, technology and industrial structure in equation (4.1) also affect skill premiums. Now, we go through the variables in the order they appear in the equation and present our arguments underlying equation (4.1) as follows.

Let us start with trade unions. Koeniger et al (2004) make union bargaining central to their derivation of equation (4.1), but many of their arguments hold in a competitive market as well, as we will explain. Firstly, skill premiums would be smaller if unions favoured unskilled workers (tud_L) more than skilled workers (tud_H). Figure 4.1a describes the trade union effect for unskilled workers. The horizontal axis

[24] See details of derivation in Appendix 4.1.

represents the employment of unskilled workers (L_U), and the vertical axis represents the wages of unskilled workers (W_U). As demand (D_1) and supply (S_1) cross, the original equilibrium is at the point A where unskilled workers have wage W_1 and employment L_1. In the face of SBTC, the demand curve for unskilled workers would drop from D_1 to D_2.

Without trade union bargaining, demand curve D_2 and supply curve S_1 achieve the new equilibrium B where unskilled workers have lower wage W_2 and lower employment L_2. Flexible wages of unskilled workers are low enough for them to keep their jobs or find new jobs. In addition, some unskilled workers may quit voluntarily. However, trade unions will interfere. Since trade unions negotiate the wage, employers have "rights to manage" to decide employment and maximize their profit. If trade unions bargain wages for unskilled workers, unskilled workers may move to point C at the demand curve D_2 where they keep the same wage as before i.e.W_1, but have lower employment level L_3. Since unskilled workers would supply labour L_1 at the wage level of W_1, unemployment L_1-L_3 appears in the model. Thus, trade union bargaining for unskilled workers will decrease the skill premium, but make more unskilled workers unemployed.

Different effects of union bargaining are likely to appear for skilled workers. In Figure 4.1b, the original equilibrium is at the point A where skilled workers have wage W_1 and employment L_1. In the face of SBTC, the demand curve for skilled workers would increase from D_1 to D_2. Without trade union bargaining, the demand curve D_2 and supply curve S_1 achieve the new equilibrium B where skilled workers have higher wage W_2 and higher employment L_2. Since trade unions mainly support

the "median" union member[25], objective function of trade unions is dependent on the skill composition within trade unions. Hence, trade union bargaining should favour unskilled/semi-skilled workers more than skilled workers, since they are the major part of union membership.

However, skilled workers have become more important for trade unions than in the 1970s, as the overall employment composition shifts to more skilled structure as the education has expanded over the last thirty years. In Panel A of Figure 2.1, the NOQUAL group was the largest group (about 61.5 percent in 1972) in the total employment before 1994. In 2002, only about 15 percent of total workers has not any qualifications. At the same time, the employment share of workers with A-levels and above qualifications was more than 50 percent in 2002. Thus, trade unions also bargain wages for semi-skilled/skilled workers and push their wages to a higher level W_3 with lower employment level L_3. Since skilled workers would supply labour L_4 at the wage level of W_3, unemployment L_4-L_3 appears in the model. Therefore, trade union bargaining for skilled workers increases the skill premium, while trade union bargaining for unskilled workers decreases it. The overall effect of trade union on the skill premium depends upon whether unions favour unskilled workers (tud_L) more than skilled workers (tud_H).

Secondly, Koeniger et al (2004) mark up earnings tax as a part of the gross wages for both skilled and unskilled workers. This result also holds in a competitive market model with individual bargaining. Figure 4.2 shows that the steep line S_U is the inelastic supply curve of unskilled workers, and the flat line S_S is the elastic supply curve of skilled workers. For unskilled workers, without taxation, the supply

[25] See a summary for the median voter model in Congleton (2002).

curve S_U crosses the demand curve D_G at point A, where unskilled workers have wage W_U and employment L_1.

As the tax wedge is imposed, the demand curve decreases from D_G to D_N. The gross wages of unskilled workers increase a little from W_U to W_{UG}. However, there is a big fall in the take home wage from W_U to W_{UN} and more unskilled workers unemployed (L_1-L_2). The same analysis can be applied for skilled workers. The elastic supply of skilled may mark up the gross wage from W_S to W_{SG}. Figure 4.2 shows that the mark-up effects on skilled workers' wage (W_{SG}-W_S) may be more than that on unskilled workers (W_{UG}-W_U). The tax wedge in Figure 4.2 increases the skill premium. Thus, the skill premium based on gross wages is associated with earnings tax only from the mark-up effect, which occurs with or without union bargaining. Higher tax rates for skilled workers (tax_H) increase the skill premium, while higher tax rates for unskilled workers (tax_L) decrease it. These results are consistent with the findings in Brewer et al (2008) that even though the current government has increased taxes on people with high incomes, this has not prevented them from racing further away from the average level of living standards across the country.

A similar analysis can be applied for unemployment benefit (repr) and unemployment rates (u) in equation (4.1). For example, higher replacement ratios of unemployment benefit mean a better outside option for workers. Hence, the employment rent is less than with lower replacement ratios and workers have better bargaining position for higher wages. The effect of higher benefit replacement ratios can be reflected as a decrease of labour supply from S_1 to S_2 in Figure 4.3. The original equilibrium A is replaced by the new equilibrium B with higher wages from W_1 to W_2 and more unemployed workers (L_1-L_2). These effects on wages are

presumably different for skilled and unskilled workers. Thus, higher replacement ratios for skilled workers ($repr_H$) increase the skill premium, while higher replacement ratios for unskilled workers ($repr_L$) decrease it. The overall effect of unemployment benefit depends on a comparison between its respective wage effect on skilled and unskilled workers.

On the other hand, higher unemployment rates decrease the reemployment probability of workers and worsen the outside option for workers. As the contemporaneous unemployment rate increases in a recession, workers cannot bargain strongly for wages and they may accept lower wage to keep employed (the spot market matters, see Devereux and Hart 2007). This situation is reflected as an increase of labour supply from S_2 to S_1 in Figure 4.3, which gets back the original equilibrium point A where workers have lower wages (W_1) and higher employment (L_1) compared with equilibrium point B. Koeniger et al (2004)'s argument about the effect of unemployment on wages is consistent with the wage cyclicality literature that wages are negatively associated with the unemployment rate as business cycle proxy.[26] Thus, higher unemployment rates for skilled workers (u_H) are likely to decrease the skill premium, while higher unemployment rates for unskilled workers (u_L) are likely to increase it.

Thirdly, as DiNardo et al (1996) reveals, a minimum wage can directly compress the skill premium by binding wages of unskilled workers, whereas wages of skilled workers are not directly affected. Hence, the minimum wages will cut off all unskilled wages below it and make the skill premium smaller.

[26] Devereux and Hart (2006) prove the negative associations between the real wage and the unemployment rates in the UK using the New Earnings Survey (NES). I analyze real wage cyclicality of three countries: Italy, Germany and the UK in the next two chapters.

Finally, we also need to discuss industrial structure and technology variables in equation (4.1). Industrial structure shifts may reflect the demand for service from both international competition and the rising income of the whole society. On one hand, the growth of manufacturing imports from newly industrializing economies decreases the price of labour-intensive manufacturing goods as well as the demand for unskilled workers. International competition has led to a sharp decline in unskilled manufacturing employment and a shift in employment towards the service sector. Hence, industrial structure shifts from increasing international competition are good for skilled workers but bad for unskilled workers, and might increase earnings inequality.

On the other hand, the rising income of the whole society induces more demand for services. This might lead to greater demand for unskilled workers in occupations where it is difficult to substitute technology, e.g. care assistants (see Auto, Levy and Murnane 2003). Levy and Murnane (2006, Figure 2, p12) also find the employment share of personal and sale service in 1999 was higher than that in 1969, which are the only two increasing unskilled occupations. The rise of service sector may reflect increasing demand on unskilled workers in the service sector, hence decrease earnings inequality. Thus, even more likely to increase the skill premium, industrial shifts may have a complex effect on skill premiums.

Skill premiums are also affected by medium and short run shocks from technology. New technologies adopted by skilled workers ($comp_H$) increase their marginal products and push up the skill premium, while new technologies adopted by unskilled workers ($comp_L$) also increase their marginal products and decrease the skill

premium. However, if new technologies are complementary to skills (see Acemoglu 1998), total factor productivity of skill-intensive sectors (for example, computer software industry) grows faster than labour-intensive sectors (for example, textile industry). Technological changes may have higher wage effect on skilled workers than on unskilled workers. Hence, the overall effect of technology is skill biased and pushes up the skill premium.

4.3 Empirical specification

Koeniger et al (2007) test their model by using cross-country data. They conclude: "Our empirical results show that stricter employment protection legislation, more generous benefit replacement ratios, longer benefit duration, higher union density, and a higher minimum wage are associated with lower male wage inequality. We find that changes in these institutions can explain a substantial part of observed changes in male wage inequality — at least as much as is explained by our trade and technology measures." (Koeniger et al 2007, p352). Their study therefore sheds light on the cross-country comparison of wage inequality. My research analyzes skill premiums in the UK using their approach.

Our empirical work uses a two-step estimation procedure, which is designed to get round the Moulton (1986) problem of explaining earnings based on individual data with variables based on aggregate data. He argues that individuals in the same year/area will share some common component of variance that is not entirely attributable either to their measured characteristics (e.g. gender and age) or to any aggregate variable in the year/area. In this case, the error component in an OLS regression will be positively correlated across people in the same year/area, causing

the estimated standard error of the aggregated variable to be downward biased.[27] In step 1, we use all individual observations to estimate education wage differentials as proxies of skill premiums over time. This equation is given by:

$$\ln w_{it} = \alpha_0 + \sum_{t=1}^{T} n_t Y_t + \sum_{t=1}^{T} b_t B_{it} Y_t + \sum_{t=1}^{T} o_t O_{it} Y_t + \sum_{t=1}^{T} a_t A_{it} Y_t + \sum_{t=1}^{T} h_t H_{it} Y_t + \sum_{t=1}^{T} d_t D_{it} Y_t + \beta X_{it} + \varepsilon_{it} \tag{4.2}$$

where w_{it} is the real gross hourly wage rate, Y_t denotes a year dummy representing the base line group of NOQUAL; B_{it} denotes a dummy variable for workers with below O-level qualification; O_{it} denotes a dummy variable for the O-level group; A_{it} denotes a dummy variable for workers with A-levels; H_{it} denotes a dummy variable for workers with higher educational qualification but not degrees; and D_{it} denotes a dummy variable for worker with degree equivalent or above qualification. These categories are explained in details in Table 2.1.

X_{it} is a vector of the main additional factors that may influence wages including potential labour market experience, present employment tenure, marital status, ethnicity and region, and ε_{it} is a random error term. Correspondingly, n_t (t=1…T, T=29 in this research) are the estimated coefficients of the NOQUAL group, which are the wages of this group in year t relative to their wages in the first sample year, 1972. Following the same method, b_t, o_t, a_t, h_t and d_t are the estimated incremental wage effects of the different education groups: BOLEV, OLEV, ALEV, HIGHER and DEGREE over the baseline group NOQUAL in year t. These coefficients are shown in Figure 4.4 below (also see the first column in Appendix 4.2)

[27] A similar two-step procedure is used in the wage cyclicality (beginning with Solon et al 1994, see also Devereux and Hart 2006) and wage curve literature (Nijkamp and Poot, 2005, p 434).

In step 2, we estimate the institutional effect on the skill premium, i.e. the incremental wage effect of each educated group in the first step. We stack b_t, o_t, a_t, h_t and d_t from equation (4.2) to form a skill premium variable s_{jt}, which is the skill premium of each education group relative to the baseline NOQUAL group in the same year. Hence, a panel dataset is built to find the links between the skill premium and labour market institutions:

$$s_{jt} = \theta_1 tud_{jt} + \theta_1^n tud_{nt} + \theta_2 tax_{jt} + \theta_2^n tax_{nt} + \theta_3 repr_{jt} + \theta_3^n repr_{nt} + \theta_4 MW$$
$$+ \theta_5 u_{jt} + \theta_5^n u_{nt} + \theta_6 ind_{jt} + \theta_6^n ind_{nt} + \theta_7 comp_{jt} + \theta_7^n comp_{nt} + TREND + \upsilon_j + \upsilon_t + \upsilon_{jt}$$

(j= b, o, a, h and d) (4.3)

where s_{jt} is the skill premium for education group j in the year t, and labour market institutions indicators and those control variables of labour market conditions (i.e. unemployment rates as the proxy for business cycle), industrial shifts and technology are defined in equation (4.1). All variables of the baseline group (tud_{nt}, tax_{nt} $repr_{nt}$, u_{nt}, ind_{nt} and $comp_{nt}$) are also put into equation (4.3) to control for changes in the baseline group. TREND is a time trend; υ_j is a vector of education group dummies; υ_t are year dummies[28]; and υ_{jt} is the stochastic error term.

We concentrate on a study on skill premiums. Equation (4.3) assumes the existence of a long run equilibrium relation between skill premiums and institutions. Also, the adjustment should be contemporaneous. However, much literature shows an increasing trend in the skill premium (for example, Gosling, Machin and Meghir 2000, Figure 3.2, p642) as well as a decline of trade unions since the 1970s (for example, Bell and Pitt 1998, Figure 1, p516 and Disney et al 1998, Figure 1-3, p3-4). Since our

[28] I have dropped 10 year dummies to avoid the linear dependent problem with the time trend variable (*TREND*) and all variables of the baseline group (tud_{nt}, tax_{nt} $repr_{nt}$, u_{nt}, ind_{nt} and $comp_{nt}$).

panel data have a 29-year period, the skill premium of each group is probably non-stationary. Hence, a co-integration problem may exist in the links between skill premiums and institutional variables. De-trending and simply differencing the data cannot resolve all problems.[29] If there is some inertia in the adjustment process a re-parameterisation of equation (4.3) - as in equation (4.4) below - might be preferable. Thus, we put an Error Correction Mechanism (ECM) into equation (4.3) to clear the long-term relationship between the *level* of skill premiums and *level* of institutions.

Ammermueller et al (2007) use the same ECM approach in their wage curve research for Italy and Germany with panel data. We follow their approach, but only put the ECM in trade union density variables (tud_{jt} and tud_{nt}) to save degrees of freedom, since trade unions are regarded as the most important institutional factor in literature and only the union density variable shows non-stationarity over the entire period. The error-correction specification is:

$$\begin{aligned}\Delta s_{jt} &= \theta_0 tud_{jt-1} + \theta_1 \Delta tud_{jt} + \theta_0^n tud_{nt-1} + \theta_1^n \Delta tud_{nt} - as_{jt-1} \\ &+ \theta_2 tax_{jt} + \theta_2^n tax_{nt} + \theta_3 repr_{jt} + \theta_3^n repr_{nt} + \theta_4 MW \\ &+ \theta_5 u_{jt} + \theta_5^n u_{nt} + \theta_6 ind_{jt} + \theta_6^n ind_{nt} + \theta_7 comp_{jt} + \theta_7^n comp_{nt} + TREND + \upsilon_j + \upsilon_t + \upsilon_{jt}\end{aligned}$$

(j= b, o, a, h and d) (4.4)

Thus, in the above specification the long run equilibrium, between the *level* of the skill differentials and *level* of trade union density is embodied in an ECM.

Furthermore, some interesting assumptions can be tested. When $|a| \approx 1$, $\theta_0 = \theta_1$ and $\theta_0^n = \theta_1^n$, equation (4.4) reduces to a simple long-term level regression such as

[29] Simply de-trending and differencing to remove the non-stationary trend can avoid the spurious regression problem, but it also removes the any long-run information (see Harris 1995, p1).

equation (4.3). Also, if a≈0 the relationship becomes a skill premium growth model; alternatively, when 0<|a|<1 we get a more standard partial adjustment model. The coefficient *a* measures the stickiness of skill premiums to the changes of trade unions: the closer a is to unity (in absolute value), the faster is the adjustment of skill premiums to decline of trade unions. We use Stata's fixed effect programme (*xtreg, fe*, see Stata, 2003b) to estimate equation (4.3) and (4.4).

4.4 Data description

4.4.1 Wage level and skill premiums

The wage variable used here is the real gross hourly wage in 1995 pounds, which is from the GHS 1972-2002 and defined in the same way as in Chapter 2 and Chapter 3. Following the tradition of research (see Schmitt 1995, Dickens 2000 and Koeniger et al 2004, 2007), we concentrate on male full-time workers.[30] Then, we have 138,103 observations (114, 491 workers in the private sector and 23,612 workers in the public sector) in the first step regression based on equation (4.2).

The coefficients of year dummies derived from the first step (n_t), is presented in the Panel A of Figure 4.4 by sector (see Table A4.1 and A4.2 in Appendix 4.2). This graph illustrates the cumulative real wage growth of the NOQUAL group, which displays the log ratio of this group's earnings in each year relative to its level of real earnings in 1972. Hence, as a major part of workers in the NOQUAL group, the private sector graph here is very similar to the 10th percentile graph in Panel B of Figure 2.4, and have increased by about 30 percent (n_{2002}–n_{1972}≈0.3) over the entire

[30] Female participation rate was quite low in the 1970s, only about 30% (see Table 3.1). For high skilled females, there is no enough observation to construct institutional variables such as trade union density in the 1970s. For example, Table A4.4 in Appendix 4.3 shows a lot of missing values in high skilled females in the 1970s. For other institution variables, we met the same problem. Hence, we have to give up estimation of the equations for females even they are included in chapters 2 and 3.

period. However, real wages of unskilled workers in the public sector show big difference from the private sectors after the 1970s, which supports the sample division in our further analysis.

Moreover, the coefficients of other year dummies in the first step (b_t, o_t, a_t, h_t and d_t) are stacked up to build the dependent variable (s_{jt}, j=b, o, a, h and d) used in the second step regression. With this panel data of 5 groups over 29 years, we have 145 observations (5×29) for both private and public sector in the second step regression based on equation (4.3), which is presented in the Panel B and C of Figure 4.4 (see Table A4.1 and A4.2 in Appendix 4.2).

Panel B and C shows skill premiums of education groups (b_t, o_t, a_t, h_t and d_t), which are wages of each education group relative to the wage level of the NOQUAL group in the same year. For example, in Panel B, the line of DEGREE group shows that wages of workers with degrees was about 55.92 percent higher than workers in the NOQUAL group in 1979. But, in 1998, wages of workers with degrees was about 83.33 percent higher than workers in the NOQUAL group. Hence, degree premium had increased about 27.41 percent from 1979 to 1998 (=83.33-55.92).

Furthermore, we can see that skill premiums in both sectors share the same pattern of "higher skill level equals higher skill premium" in Panel B and C in Figure 4.5 as we find in the repeated cross section results in Table 2.4. And, in the private sector, the skill premiums of the lower skilled groups (BOLEV, OLEV and ALEV) increase more slowly than those of the higher skilled groups (HIGHER and DEGREE) since the 1970s. This result is consistent with what we find in the repeated cross-section regressions in Chapter 2 (see Table 2.3) and findings in Walker and Zhu (2003)

using different data sources. However, in the public sector, we cannot find an increasing trend of the skill premium for any education group. Thus, the worsening of wage inequality since the 1970s is perhaps caused by the increasing skill premiums in the private sector rather than in the public sector.

4.4.2 Institutional variables

In this part, we describe the institutional variables such as trade unions, tax wedge, unemployment benefit and the NMW used in this chapter. Besides the GHS 1992-2002, another three datasets have been used to measure those institutions: the UK Family Expenditure Survey (FES 1982-2002), the Family and Working Lives Survey (FWLS 1994/1995) and the British Household Panel Survey (BHPS 1991-2002). The FES is a continuous survey of household expenditure and income, which has been in existence since 1957.[31] Annual samples of around 10,000 households (about 1 in 2000 of all United Kingdom households) are selected each year. Approximately 60 percent of these households co-operate by providing information about the household and personal incomes and certain payments that recur regularly (e.g. rent, gas and electricity bills, telephone accounts and insurances).

The FWLS is a life and work history data, which provide representative information about people living in Britain. The dataset was collected in the period 1994/1995 and the final sample consists of information for 11,237 respondents. The focus of the survey is not only on current living conditions, but also a broad variety of *retrospective* questions about the family and working lives of the respondents. In this way, the survey tries to get information about the basic event history of the family and

[31] The FES was replaced by a new survey in 2001, the Expenditure and Food Survey (EFS). Thus, the last two years' data are from the EFS 2001 and EFS 2002, in which they have the same definition. We will not differentiate the two surveys in later discussion.

working lives beginning with the 16th birthday of the respondents. Hence, the FWLS provides time series information on socio-economic characteristics of person and household; training and education including on and off the job; detail on current job and key past events in particular union membership; spells of unemployment and details of benefits claims since the 1970s.[32]

The BHPS was designed as an annual survey of each adult (16+) member of a nationally representative sample of more than 5,000 households in the UK, making a total of approximately 10,000 individual interviews yearly. The same individuals are re-interviewed in successive waves. A development in 1999/2000 was the addition of two samples from Scotland and Wales to increase the relatively small sample sizes for these regions. In 2001/2002, an additional sample from Northern Ireland was added. Thus, the BHPS sample also remains broadly representative of the whole population of the UK as it changed through the 1990s and beyond.

The main purpose of using these additional datasets is to compile a time series on union density by education level. Information on union membership (*tud*) since the 1970s, along with worker's characteristics is not available in any single British dataset. The GHS does not provide information about the trade union membership except in one year (1983). The FES can provide indirect information, via a question on membership of a trade union or professional body. In the income section of the survey, individuals are asked if there are any deductions from pay for subscriptions to friendly societies, trade unions or professional bodies. This measure of trade union density has been used by several studies (e.g. Disney and Cameron 1990, Lanot and Walker 1998,

[32] The FWLS is stored in TDA (Transition Data Analysis) software. See more details about the FWLS, programme in TDA syntax for union membership, and the event history dataset used to derive union density variables by skill and sector (tud_{nt} and tud_{jt}) in Appendix 4.3.

and in particular, Bell and Pitt 1998, Figure 1, p516), which have used response to this question as evidence of union membership.

Presumably, it is possible to falsely classify some union members as non-union workers. Individual who do not pay their union subscription directly at source will not be included in this definition of union membership. Bell and Pitt (1998) argues that this trade union measure is reliable by comparing it with the Workplace Industrial Relations Survey (WIRS) in 1980 and 1990. However, as we will see later, trade union density derived from the FES is very unstable. And, the variable for union membership deduction in the FES is only available after 1981 while our investigation covers the period 1972-2002. A further well-known problem with the FES is that it cannot provide continuous and accurate information about workers' skill level and employment status. Hence, we only use the FWLS and BHPS to derive union density by skill.

Figure 4.5 compares the trade union density changes in different datasets, in which we can find trade union density derived from the FES is almost the same as that from the FWLS in 1982. In the next five years, however, trade union density in the FES dramatically dropped about 15 percent. This big drop cannot be found in the FWLS and the data from the Certification Office (The "Bain and Price" series, see Disney et al 1998 Figure 1, and Bell and Pitt 1998 Figure 1). Hence, the overall union density of all male workers in the FES seems much lower than in the FWLS, the BHPS or the "Bain and Price" series. This result confirms our doubts on the reliability of union density derived from the FES' union due question. Whether there are deductions from pay for subscriptions seems an inferior indicator for union

membership. Thus, we give up trade union density from the FES and use the FWLS and BHPS to build union density by skill level. [33]

Our union density variable is from the FWLS for the period 1972-1994, and for the period 1995-2002, it is from the BHPS. In Figure 4.5, the change of union density between 1991 and 1995 is very similar in the FWLS and BHPS, for both all workers and for the private sector. This similarity shows that the average union density has a consistent pattern for the two datasets. For the BHPS, the union questions were only asked for those who moved job in 1992-1994 (but for everyone in other years), so we did not include the period 1992-1994 in this figure and do not use these data in the analysis.

Figure 4.6 presents trade union density by skill level and sector over the last thirty years (see details in Appendix 4.2). The combination of the FWLS and BHPS reveals the trade union density in the semi-skilled groups (BOLEV, OLEV and ALEV) is higher than the unskilled (NOQUAL) and high skilled groups (HIGHER and DEGREE) in the private sector.[34] For workers in all skill groups in the private sector, trade union density tends to decline after 1979, during which earnings inequality moves in the opposite direction. However, the situation in the public sector flips, in which union density of unskilled (NOQUAL) and high skilled groups (HIGHER and DEGREE) is higher than that in semi-skilled groups (BOLEV, OLEV and ALEV).

[33] Moreover, in the FES, there is no variable about private and public sector of workers after 1986. Even with private/public sector information during the period 1982-1986, the union density of the FES-private is also much lower than that of the FWLS-private, just as the overall union density.

[34] The main concern about the FWLS and BHPS may be whether the educational qualifications in these two datasets are consistent with the qualification system in the GHS. The FWLS categorize educational qualification into 53 groups (see details in Appendix 4.3), as the BHPS can provide accurate information about 13 kinds of education and trainings qualifications. We have compared these qualifications and found they are the same one as in the GHS (see Table 2.1). Thus, we are confident on that the skill variables in the GHS, FWLS and BHPS are comparable.

And, we do not find a clear decline of unions in the public sector since the 1970s. It is perhaps the reason for the different wage structure in these two sectors.

Moving on to the tax and benefit system, the division into private and public sectors is not necessary since the tax wedge and replacement ratios do not depend on sector. Concerning the different tax wedge (*tax*) for skilled and unskilled workers, the GHS does not provide information about tax deductions from gross earnings. We therefore use the FES, which is a better dataset for tax expenditure. The FES 1972-2002 in fact provides tax wedges by skill level. The tax rate is defined here as the proportion of income tax deduction (Pay As You Earn amount) relative to normal gross wages.

As for benefit indices, they measure the proportion of unemployment benefits relative to average earnings before tax. The GHS provides information for unemployment benefit over the entire period 1972-2000.[35] For practical purpose, we also put income support and incapacity benefit into our benefit indices since both of them will increase the outside option of workers.[36] However, a problem arises that unemployed workers can only provide the actual amount of benefit received not their earnings. Hence, the replacement ratios of benefits (*repr*) are estimated as the proportion of unemployment benefits they received relative to their estimated earnings in a standard earnings equation.

[35] After 1996, the British unemployment benefit changed its name to job seeker allowance. I have kept on using the unemployment benefit term in the discussion.
[36] Since the data about housing benefit (particular for council tax) are not consistent over time in the GHS, we do not include it.

The theoretical model in Koeniger et al (2004) implies that tax wedge is only a mark up factor in the gross wages. The relative tax wedge between skilled and unskilled workers should be positively correlated with the skill wage differentials. From the panel A of Figure 4.7, we see that the tax wedge gap between high skilled and low skilled group has been wider since the 1970s. This trend is consistent with the increasing skill premium we found in the last chapter and the findings in Brewer et al (2008) that government has imposed large rises in taxation to fund higher benefit payments and tax credits in recent years.

On the other hand, the Koeniger et al (2004) model implies that the replacement ratios should be negatively correlated with the skill differential, if unemployment benefit is more generous for unskilled workers. Panel B of Figure 4.7 describes a higher benefit index for the low skilled groups. The interesting point is that the increase of benefit index of the DEGREE group during 1980-1985, in contrast to the decline in other groups. This result can help explain the degree premium increase in the 1980s.

Finally, as far as the minimum wages (*mw*) are concerned, the UK National Minimum Wage Act came into force on 1 April 1999. We build a variable being zero before 1998, and taking the log form of national minimum wages after 1998 as a proxy for this policy change (see NMW values after 1998 in Metcalf 2004, Table 1).

4.4.3 Control variables

The unemployment rate of each skill group plays an important role for the skill premium because it represents the labour market conditions (i.e. business cycle) and

outside options of skilled and unskilled workers. We calculate the unemployment rate by skill level over the entire period using the GHS 1972-2002.[37] The theoretical model of Koeniger et al (2004) implies that there is a negative (positive) relationship between the unemployment rate of skilled (unskilled) workers and the skill premium, *ceteris paribus*.

Panel A of Figure 4.8 shows the different pattern of movement of each group over the business cycle. Obviously, the lower educated workers are more vulnerable when the labour market is loose. We also see that the unemployment gap between lower skilled and higher skilled worker became wider in the 1980s and early years of 1990s. Higher unemployment rates of unskilled worker worsen their outside option and also decrease the collective bargaining power of their trade unions. Thus, the skill premium should increase if the unemployment rate of unskilled workers increases faster than that of skilled workers.

As frequently used in the literature, industrial structure shifts can be represented by the employment movement from the manufacturing to the service sector as in Schmitt (1995). In this chapter, the proxy of the industrial shifts is the employment proportion of manufacturing workers within each skill group (*ind*). Panel B of Figure 4.8 shows the employment shifts mainly happen in the low skilled groups such as NOQUAL, BOLEV, OLEV and ALEV, which have continuous declines in manufacturing employment proportions. For workers in the high skilled groups of HIGHER and DEGREE, there is not much change in the manufacturing ratio. In the early years of the 1980s, the manufacturing employment proportions even increased

[37] We compare the unemployment rates in the GHS with other data sources such as the Labour Force Surveys (LFS) and the BHPS. We find not much difference in these three data sources. Hence, we use the GHS here for consistency.

in high skilled groups. This result may also contribute to the increasing skill premium in the 1980s.

As for SBTC, we use computer usage density (*comp*) as a proxy. Computer usage is a widely applied measure of skill biased technology (Kruger 1993). The disadvantage of this proxy is that the computer usage variable is not available before 1984 in the GHS. Hence, I assume computer use in years before 1976 is zero and interpolate the years between 1975 and 1984. Panel C of Figure 4.8 shows sparse computer usage and a slow climb during years before 1980. Then, the acceleration of computer usage in the upper skill groups (ALEV, HIGHER and DEGREE), supports the increased skill premiums in the 1980s. Especially for the DEGREE group, computer usage increased from about 25 percent in 1980 to about 65 percent in 1995, much faster than low skilled groups (for example, only from about 10 percent to about 25 percent for the NOQUAL group). This pattern is also consistent with the dramatically increasing degree premium in the 1980s and early 1990s. On the other hand, it is widely realised the diffusion of computers has become so widespread after the 1990s that a simple headcount may no longer measure the SBTC-induced demand shifts (Machin 2001, p772). Indeed, we find that lower skilled groups have a fast convergence process to those high skilled groups for computer usage after 1995. This convergence implies that computer usage may be an inferior indicator of skill biased technology for recent years.

4.5 Empirical results

In this section, we explore the associations between institutions and skill premiums using equation (4.3) and (4.4). Contribution analysis for every explanatory variable to the changes in the skill premium is presented using equation (4.4).

4.5.1 Basic results

Table 4.1 presents the fixed effect results from equation (4.3) by the private and public sector. We concentrate on the private sector which is majority of workforce. Firstly, there are significant associations between the skill premium and trade union density of high skilled groups (tud_{jt}) in the private sector. A point increase of trade union density in the skilled group will increase the skill premium by 0.15 percent. As the theoretical model predicts, a point increase of trade union density in the baseline unskilled group will decrease the skill premium by 0.21 percent, but this effect is not significant. Thus, our results suggest that trade unions have different effects on wages of workers at different skill levels.

Secondly, the tax wedge shows a significant mark up effect for unskilled workers as the theoretical model predicts. A one point increase of the unskilled workers' tax wedge (tax_{nt}) decreases the skill premium by about 1.7 percent. As the theoretical model predicts, the same change in the skilled workers' tax wedge (tax_{jt}) increases the skill premium by about 1.03 percent, but insignificant. However, the benefit index has no significant effect on the skill premium. Neither does the minimum wage variable show significant effects on the skill premium in Table 4.1.

Thirdly, unemployment rates should reflect the business cycle and the outside options of workers. Workers can bargain more strongly if the labour market is tight. Yet, from Table 4.1, there is no significant effect of market conditions on the skill premium. Many researchers point out that more unskilled workers may join the employment as labour market is tight and push the overall wages down (see Solon et al 1994 for the US and Devereux and Hart 2006 for the UK). Since employment

composition within each education group also changes over the business cycle, it is not surprising to see insignificant effect of market conditions on skill premiums. Hence, the insignificant overall wage cyclicality here may just show the composition biases.[38]

As for other variables, we find significant effect of industrial shifts in skilled workers (-0.23) on the skill premium in Table 4.1. Moreover, the computer usage variables show significant positive associations with workers' wages, implying new technologies can improve productivity of all workers. A one point increase in computer usage of skilled workers ($comp_{jt}$) is associated with a 0.29 percent increase of the skill premium, while that of unskilled workers ($comp_{nt}$) decreases about 0.57 percent of the skill premium. This result suggests that adaptation of new technology for unskilled workers is even more important to decrease the skill premium.

For all estimations in the public sector, there is no significant result except unemployment rate (0.69) and industrial shifts (1.45) of unskilled workers, implying more static skill premiums in the public sector. Skill wage premium in the public sector can respond to the market condition (business cycle) of unskilled workers. As the unemployment rate of unskilled workers increases, their wage will decrease and push up the skill premium. Similarly, more unskilled workers are employed in the public manufacturing will increase the skill premium. It seems that the wage setting in the public sector does not follow the model of Koeniger et al (2004). Instead, bureaucratic and administered price models may be needed to explain wage

[38] See more details in the next two chapters, in which we discuss the wage cyclicality and control the composition effect using panel data.

management in the public sector (see a summary in Kaufman 2007 using transaction costs theory).

4.5.2 Results of ECM specification

The fixed effect results in Table 4.1 would be biased by co-integration problems if the skill premium and trade union density were non-stationary. Augmented Dickey-Fuller (ADF) Unit root test shows that the degree premium in the private sector is non-stationary over the entire period, even more non-stationary during the period 1979-1998. And, trade union densities of all education groups in the private sector are non-stationary over the entire period.[39] Hence, results in Table 4.1 may be biased by co-integration problem. Table 4.2 tries the fixed effect ECM model using the better specification in equation (4.4). This improvement in methodology will clear up the relationship between institutions and the skill premium.

The main improvement is that institutional effects on the skill premium are more important and significant in the private sector. A one point increase of trade union density in the skilled group (tud_{jt}) still increases the skill premium by 0.18 percent. However, the effect of trade unions on skill premiums becomes bigger and significant for unskilled workers. A one point increase of trade union density in the unskilled group (tud_{nt}) will decrease the skill premium by 0.59 percent.

[39] ADF test shows that the degree premium is non-stationary over the entire period (t value:-2.68, MacKinnon p value: 7.8%), especially during the period 1979-1998 (t value:-1.60, MacKinnon p value: 48.4%). Skill premiums of other groups are all stationary over the entire period. Trade union densities of all groups are non-stationary over the entire period (t value: -0.55 for NOQUAL, -0.199 for BOLEV, 0.709 for OLEV, -0.834 for ALEV, -0.324 for HIGHER and -0.624 for DEGREE). Thus, the co-integration problem is serious for the regression for specific sub-groups and sub-periods.

Next, the tax wedge show the right mark up effect as the model expects, but insignificant; the benefit variable of high skilled workers ($repr_{jt}$) is also insignificant as in Table 4.1. However, the benefit variable of the unskilled group ($repr_{nt}$) becomes significant. One point increase of benefit variable of unskilled workers can decrease the skill premium by about 0.39 percent.

Furthermore, as the theoretic model predicts, unemployment rates of skilled workers (u_{jt}) now show a negative association with the skill premium (-0.47). Hence, the higher unemployment rate of skilled workers will bring down their wages and decrease the skill premium. This is consistent with the model of Koeniger et al (2004) and the wage cyclicality literature (Solon et al 1994 for the USA and Devereux and Hart 2006 for the UK). Moreover, more skilled workers in the private sector are employed in manufacturing will decrease the skill premium (-0.24). The technology change also shows the right direction for both skilled (0.26) and unskilled groups (-0.44). More computer usage in the unskilled workers appears to increase their wages and decrease skill premiums.

For the public sector, we find that trade union density of unskilled workers is negatively associated with skill premiums in long run (-0.4), but positive in short run (0.64). However, skilled workers in the public sector do not benefit from their trade unions. Acemoglu, Aghion and Violante (2001) also find that trade unions compress wages of skilled members to compensate unskilled members (in the public sector, skilled and unskilled are to a large extent in the same unions, e.g. Unison). Another interesting point worthy of mention is the ECM variable, which is the lagged skill premium variable, s_{jt-1}. Its coefficient is 0.71 in the private sector but around 1 in the public sector, and both significant. This result confirms our argument that the short

run wage adjustments in the private sector are more rapid than in the public sector. In fact, there may be no ECM in the public sector since the skill premium there appears to be static. A compensation model in Acemoglu, Aghion and Violante (2001), or a bureaucratic and administered price model (Kaufman 2007) may be better for explaining wage management in the public sector.

Table 4.3 estimates the contribution of each explanatory variable in equation (4.2) to the changes in the degree premium over three typical periods: 1972-1979 and 1979-1998 and 1998-2002. All figures in Table 4.3 are calculated by using estimates in Table 4.2 and data in Table A4.1 (see Appendix 4.2). For simplicity, we only concentrate on the institutional effects on the degree premium (as a proxy to earnings inequality) in the private sector and ignore insignificant estimates in Table 4.2.

The top panel shows changes in degree premium and changes in those explanatory variables such as trade union density, tax wedge, benefit replacement ratios, unemployment rates, manufacturing ratios and computer usage for both groups (NOQUAL and DEGREE). The middle panel shows effects of each explanatory variable on the degree premium. The bottom panel is the overall contribution of explanatory variable in different period. In analysis below, we concentrate on the long period 1979-1998, during which the degree premium (see Panel B of Figure 4.4) as well as earnings inequality (see Panel A of Figure 2.4) have increased to the highest level in our sample years.[40]

[40] The degree premium (see Panel B of Figure 4.4) and earning inequality (see Panel A of Figure 2.4) change in a similar pattern in these three periods. We regard the degree premium as a proxy of earnings inequality (90th-10th percentile differential) in this part. Thus, our analysis on the degree premium can be applies on earnings inequality.

From Table 4.3, the decline of trade union is the most important factor for the increasing degree premium during the period 1979-1998. The union decline in the DEGREE group (-30.75 percent) decreases the degree premium by about 5.53 percent (=0.18×30.75). At the same time, however, trade union density decline in the unskilled group (NOQUAL, -25.29 percent) increases the degree premium by about 14.92 percent (=0.59×25.29), that is, about half of total rise in degree premium (27.4 percent). Hence, the union decline in these two groups has a combined effect of 9.39 percent (=14.92-5.53) increase on the degree premium, which is about 34.24 percent (=9.39/27.4) of the rise in degree premium. This result is consistent with literature on trade union effect on earnings such as Schmitt (1995, about 21 percent of the rise in degree premium), Machin (1997, about 40 percent of the rise in male variance) and Bell and Pitt (1998, about 20 percent of the male earnings distribution).

Following the same way, we calculate the overall effect of the tax and benefit system. The increasing benefit replacement ratio in unskilled workers (6.54 percnet) can reduce the degree premium by about 2.55 percent, which is about 9.31 percent (=2.55/27.4) of the rise in degree premium. The market condition variable (as a proxy of business cycle) and the industrial shifts variable can only account for a small part, 3-4 percent of the rise in degree premium.

Moreover, the increasing computer usage in the DEGREE group (61.21 percent) increase the degree premium by about 15.91 percent (=0.26×61.21). At the same time, however, the increasing computer usage in the unskilled group (24.31 percent) decreases the degree premium by about 10.69 percent (=0.44×24.31). Hence, the increasing computer usage in these two groups has a combined effect of 5.22 percent (=15.91-10.69) increase on the degree premium, which accounts for about

19.04 percent (=5.22/27.4) of the rise in degree premium during this period. Therefore, our results are consistent with the cross-country results of Koeniger et al (2007, p352), which claim "changes in these institutions can explain a substantial part of observed changes in male wage inequality — at least as much as is explained by our trade and technology measures."

4.5.3 Sensitivity Tests

Results of sensitivity tests are summarised in Table 4.4. For simplicity, we only concentrate on the institutional effects on skill premiums in the private sector. Column (a) use weekly earnings as the dependent variable; Column (b) still uses hourly wage as the dependent variable and the six-skill-level framework, but only run the regression for the sub-group sample of low skilled workers (BOLEV and OLEV); Column (c) only takes the results from years after 1979. Since both the degree premium and trade union density are non-stationary after 1979, we only apply the fixed effect ECM model equation (4.4) to avoid the co-integration problem.

In column (a), the skill premium equation (4.4) also works on weekly earnings. Trade union density of unskilled workers (-0.57) has bigger effect on the skill premium than that of skilled workers (0.19). Hence, the similar decline in trade union for skilled and unskilled worker should increase the skill premium. Moreover, unemployment benefits of unskilled workers can decrease skill premium (-0.45), while that of skilled workers is insignificant. Thus, our conclusions from hourly earnings estimation still remain for weekly earnings.[41]

[41] This result also suggests that weekly working hours are not sensitive to these explanatory variables.

In column (b), a one point increase of trade union density in the low skilled group (BOLEV and OLEV, tud_{jt}) can increase the skill premium by 0.23 percent in long run and by 0.27 percent in short run, while a one point increase of trade union density in the unskilled group (tud_{nt}) will decrease the skill premium by 0.31 percent. Hence, the overall effect of union decline also pushes up skill premiums of low skilled workers.

As far as special periods are concerned, column (c) show that the effect of trade union is much more prominent in the years after 1979, and only changes in trade union density of unskilled workers are important. A one point increase of trade union density in the unskilled group (tud_{nt}) will decrease the skill premium by 1.58 percent. Unemployment benefits of unskilled workers can decrease skill premium (-0.4), while that of skilled workers is insignificant. Thus, our conclusion from the entire period still holds for the special period of 1980-2002.

4.6 Conclusions

This chapter analyzes the links between institutions and the skill premiums in the UK, controlling for other explanatory variables such as labour market conditions, industrial structure shifts and skill-biased technology. We find the institutional factors such as trade union, the tax and benefit system are very important for skill premiums hence earnings inequality.

For the skill premium in the private sector, institutions are more important for the unskilled baseline group than the skilled groups. The trade union decline after 1979 is associated with different effect on wages of skilled and unskilled workers and

pushes the skill premium up. By using the fixed effect ECM model, we find that the trade union decline in unskilled workers can explain about half of the rise in degree premium over the period 1979-1998. The overall effect of trade union in all workers can explain about one-third of degree premium increase in the same period. Trade union effect is also significant for skill premiums of low skilled workers and higher in years after 1979 than in the 1970s. Although the mark-up effects of tax wedge are not significant in this fixed effect ECM model, unemployment benefits of unskilled workers in the private sector reduce skill premiums by about 9.31 percent over the period 1979-1998.

For the public sector, we also find the significant effect of the trade union of unskilled workers on skill premiums. However, skill premiums in the public sector appear to be more static than in the private sector. A compensation model (Acemoglu et al 2001) or a bureaucratic and administered price model (Kaufman 2007) might be better for explaining wage management in the public sector.

Figure 4.1: Effects of trade union bargaining on wages by skill

Figure 4.1a: Trade union effect on wages of unskilled workers

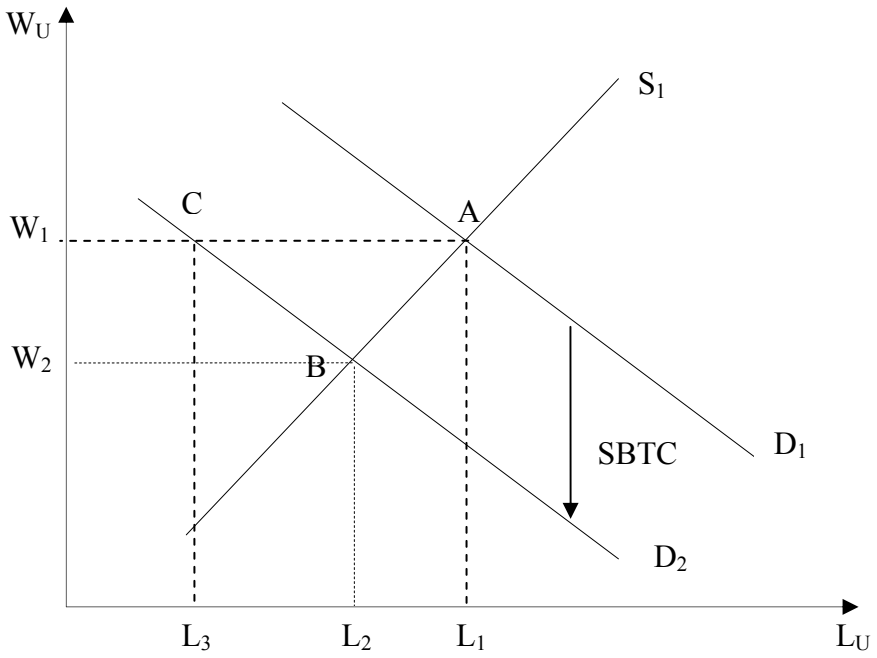


Figure 4.1b: Trade union effect on wages of skilled workers

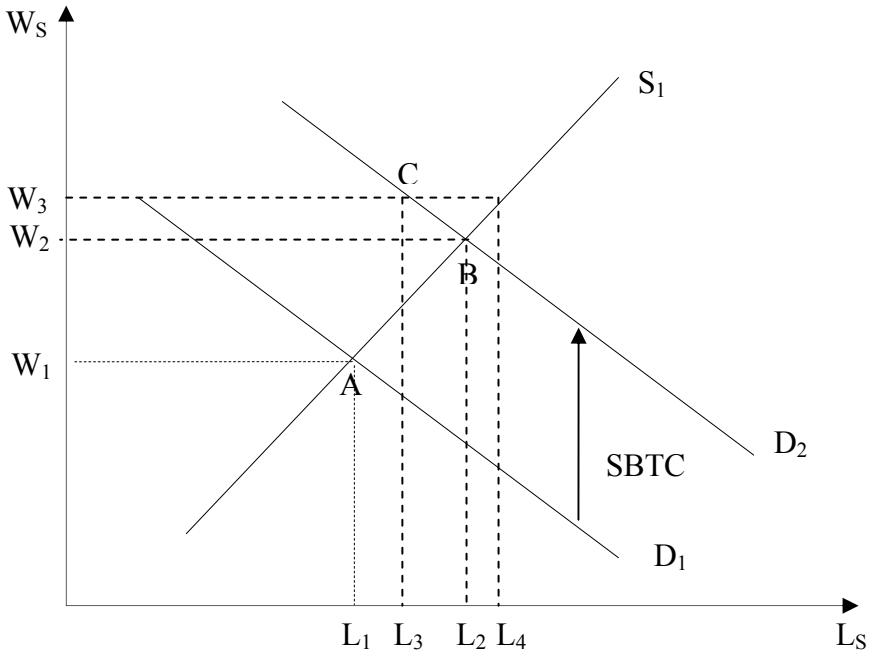


Figure 4.2: Tax wedge effect on wages by skill

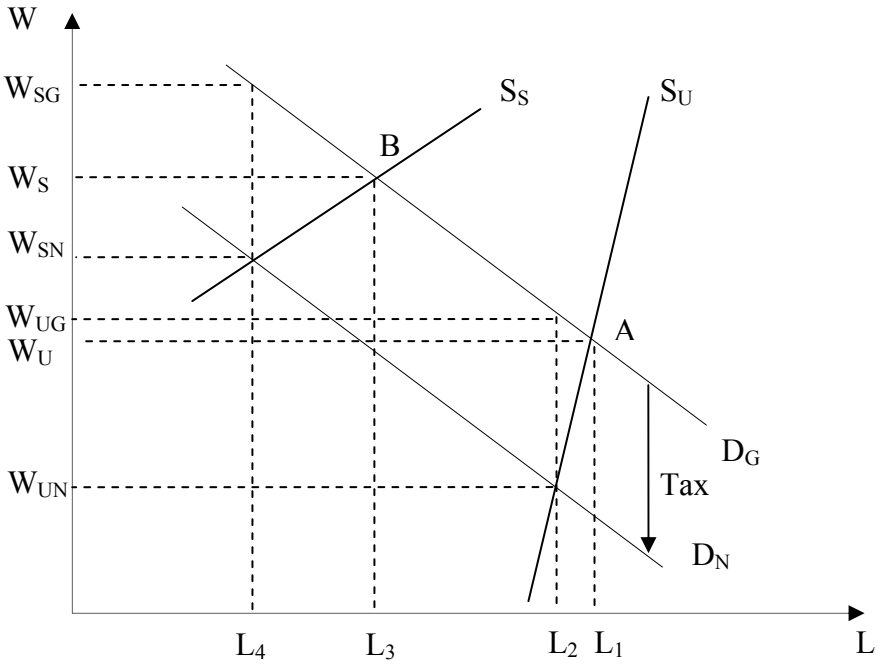


Figure 4.3: Effects of unemployment benefit and unemployment on wages

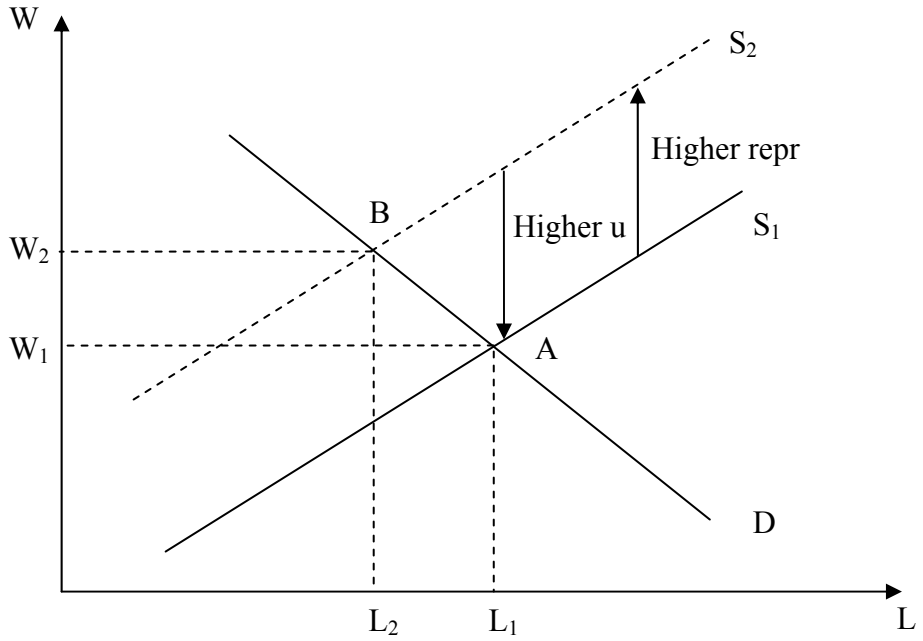
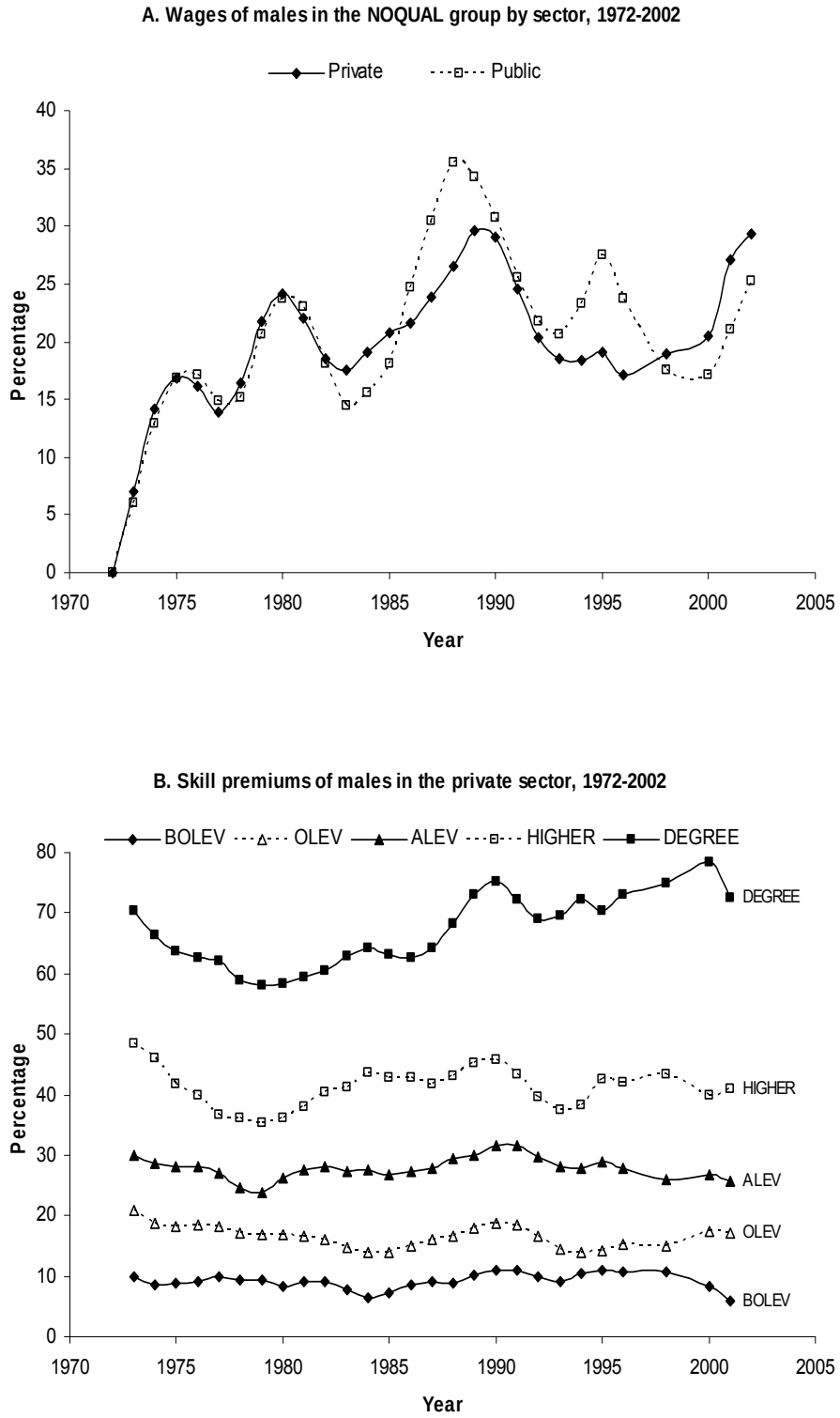
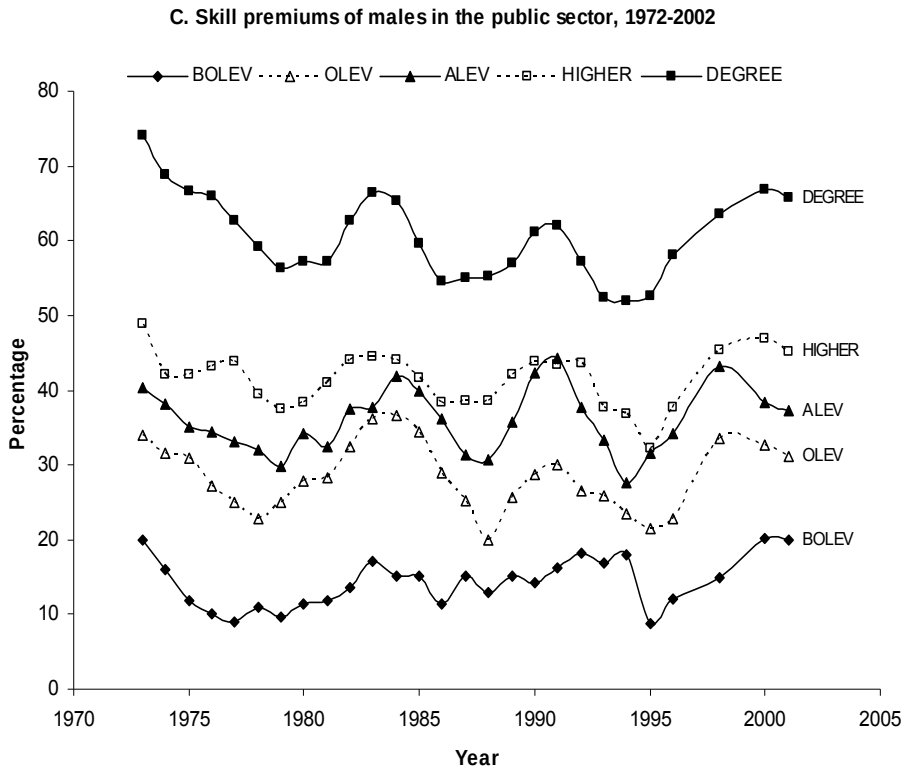


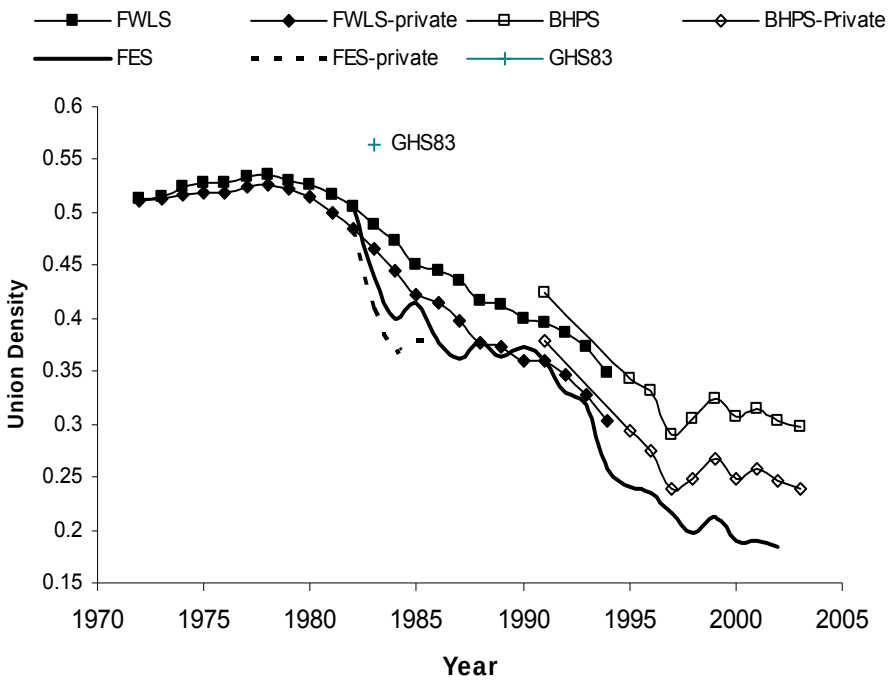
Figure 4.4: Relative wages of the baseline group and skill premiums by sector, estimates from equation (4.2)





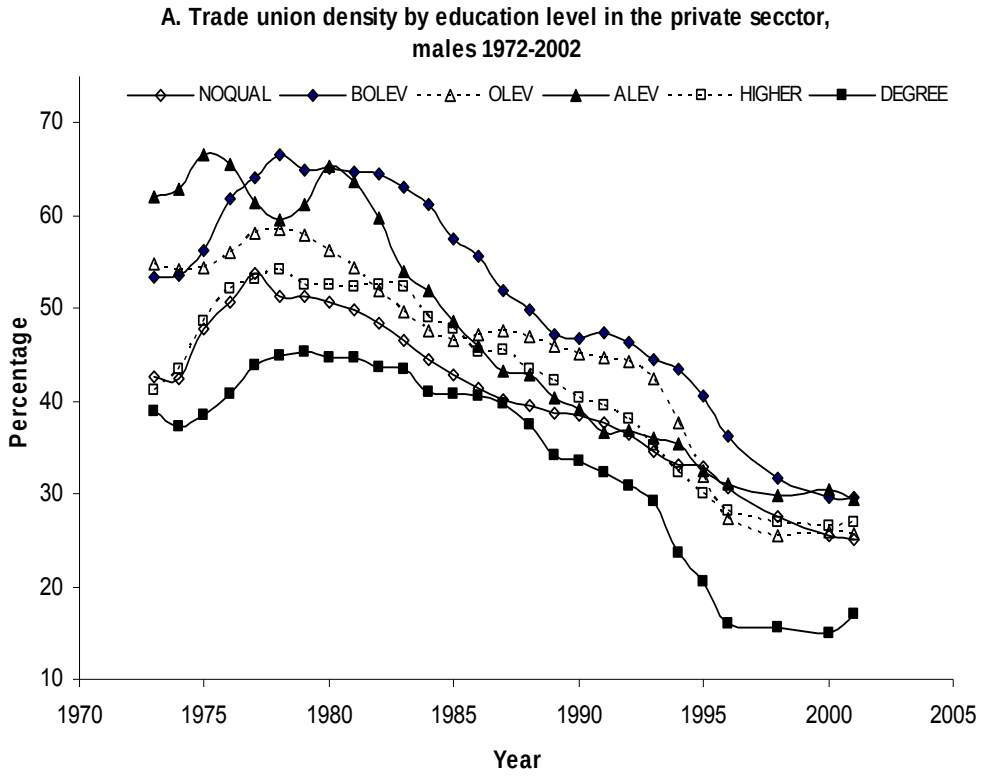
Note: All results are calculated from equation (4.2) by private/public sector using the GHS 1972-2002. There are 114, 491 workers in the private sector and 23,612 workers in the public sector. Wages are deflated based on 1995 pounds. Wage samples include only male full-time workers (weekly working hours >35) aged 16-66 years who were not self-employed. In order to smooth out the trend, the 3-year moving averages are presented.

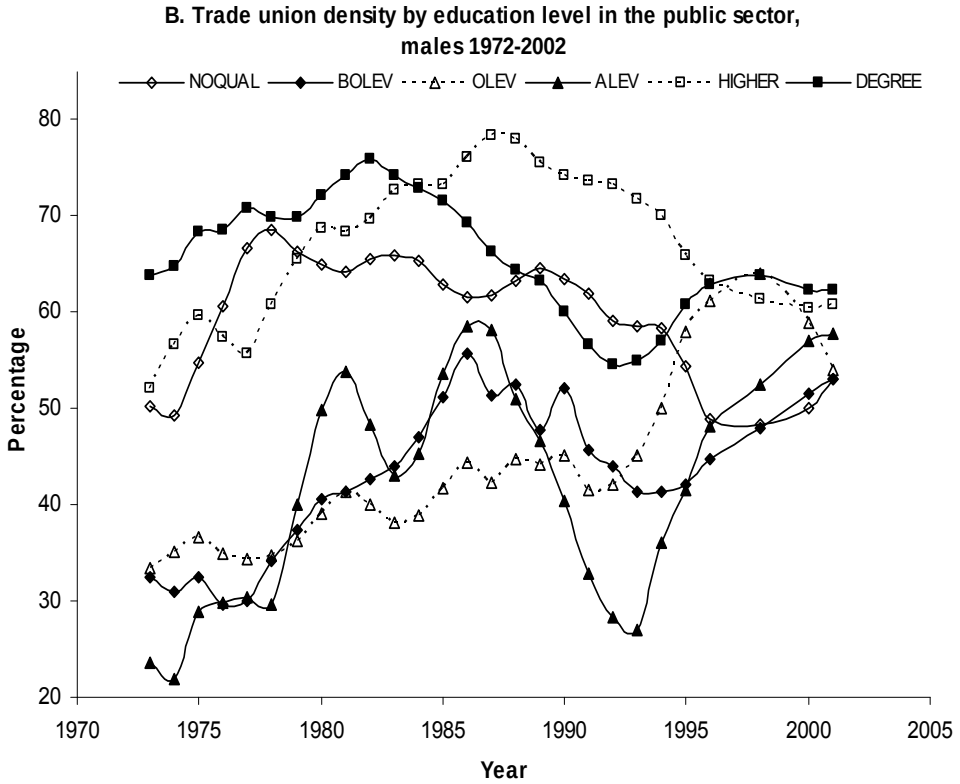
Figure 4.5: Trade union density in the UK, males 1972-2002



Note: All figures are calculated from the GHS 1983, the FES 1982-2002, the FWLS 1994/1995 and the BHPS 1991-2002.

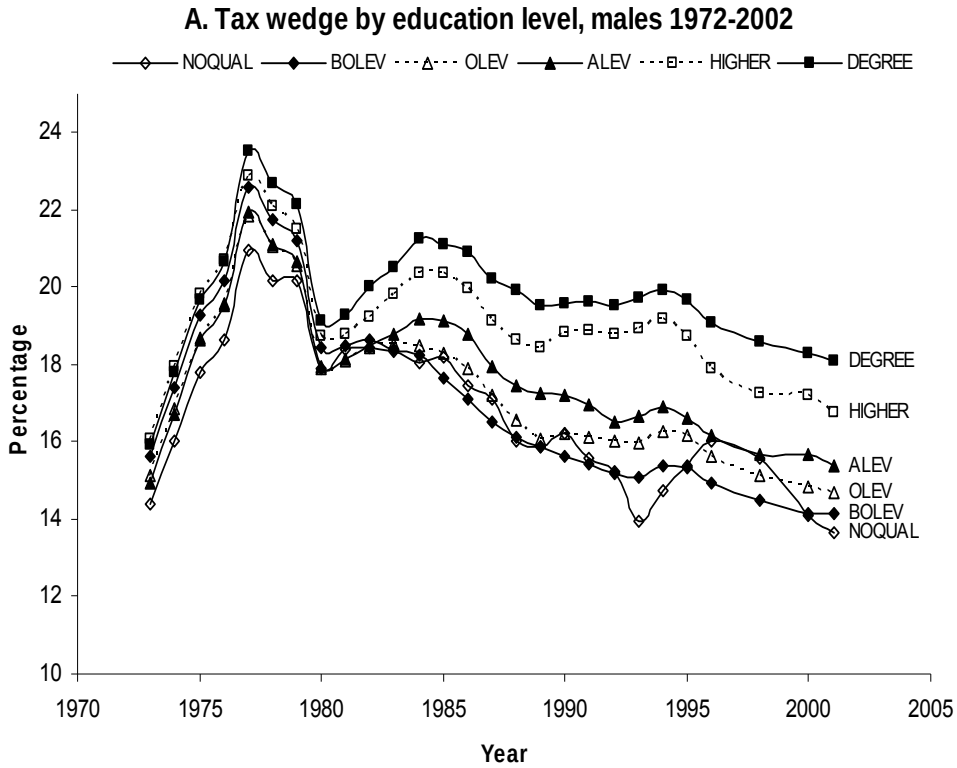
Figure 4.6: Trade union density in the UK by education level and sector, males 1972-2002

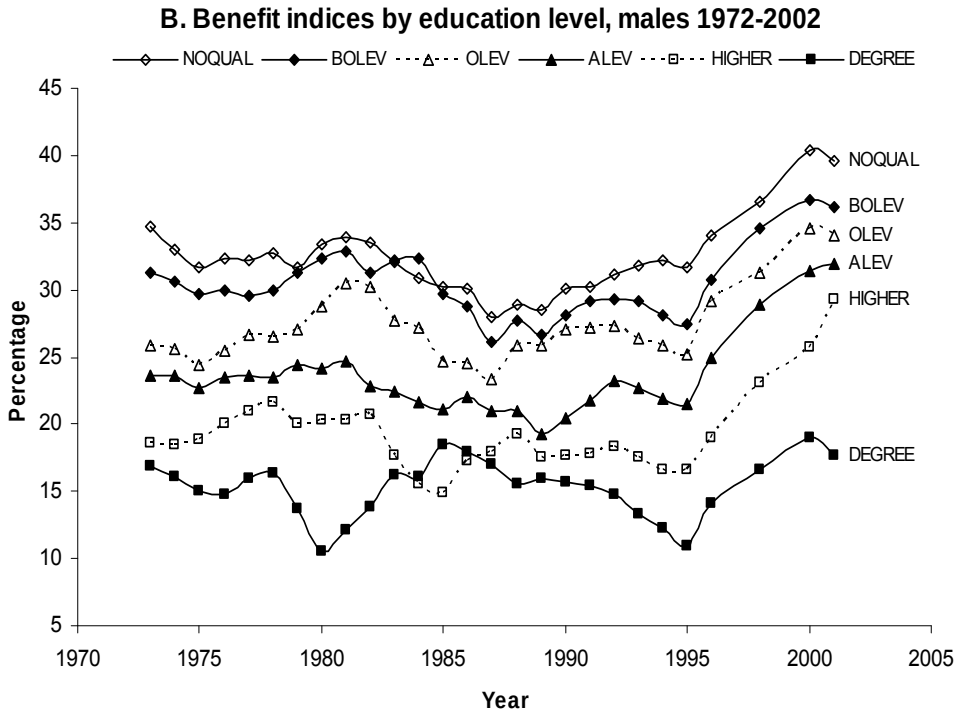




Note: All figures are calculated from the combined dataset of the FWLS 1994/1995 and the BHPS 1991-2002.

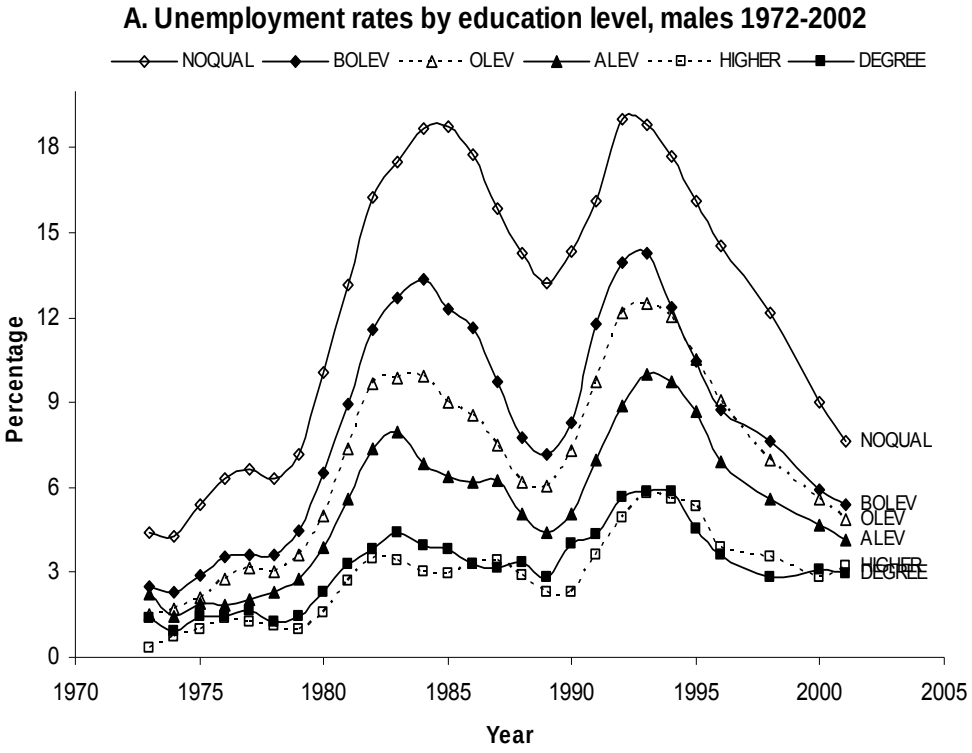
Figure 4.7: The tax and benefit system in the UK by education level, males 1972-2002

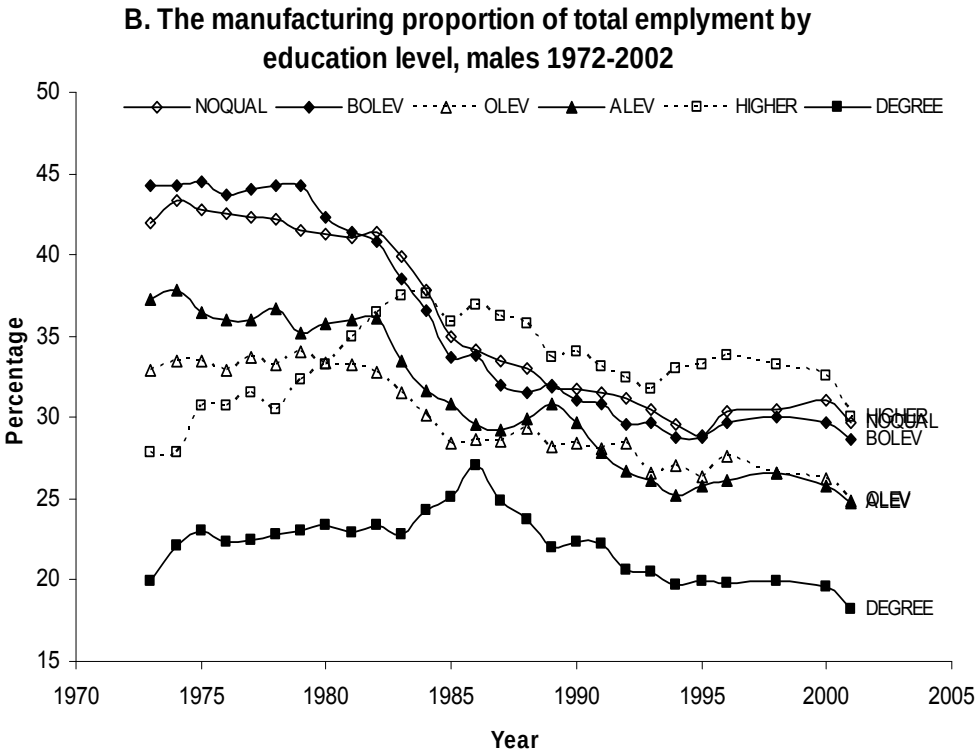


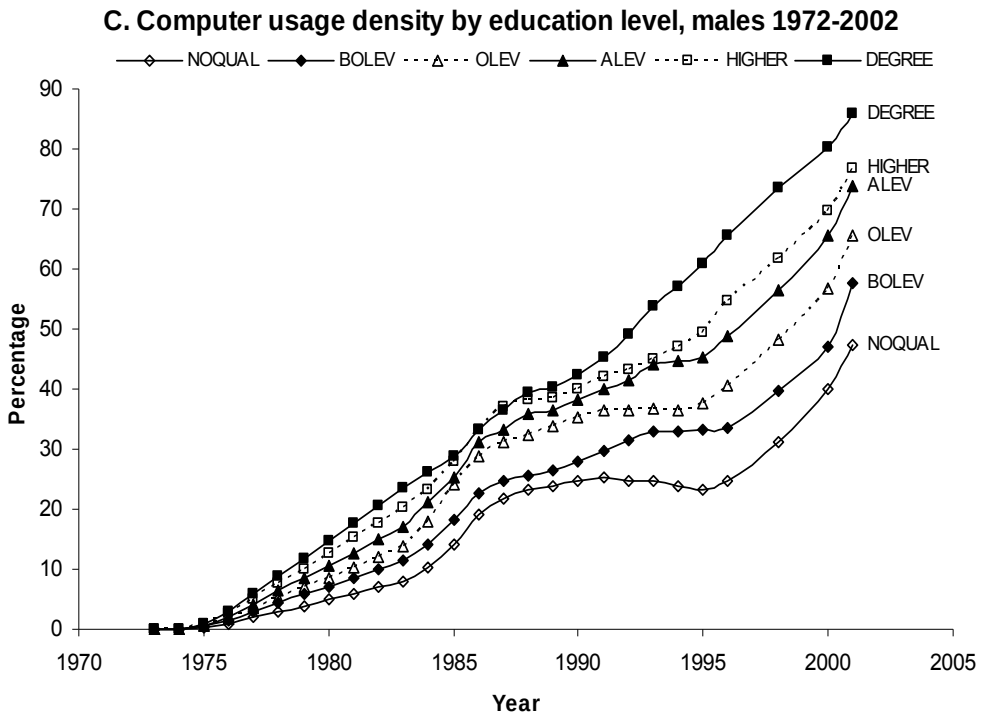


Note: All figures are calculated from the GHS 1972-2002 and the FES 1972-2002.

Figure 4.8: Unemployment rates, manufacturing ratio and computer usage in the UK by education level, males 1972-2002







Note: All figures are calculated from the GHS 1972-2002.

Table 4.1: Institutions and the skill premium, male 1972-2002, estimation from equation (4.3)

Dependent variable: the skill premium (s_{jt}, j = b, o, a, h and d)	Private	Public
Trade union density (tud_{jt})	0.15*	-0.03
	(0.09)	***(0.06)***
Trade union density (tud_{nt})	-0.21	-0.09
	(0.17)	***(0.15)***
Tax wedge (tax_{jt})	1.03	-0.15
	(0.82)	***(1.13)***
Tax wedge (tax_{nt})	-1.70**	-0.80
	(0.84)	***(1.05)***
Benefit index ($repr_{jt}$)	-0.13	-0.16
	(0.15)	***(0.19)***
Benefit index ($repr_{nt}$)	-0.19	0.39
	(0.24)	***(0.25)***
Unemployment rate (u_{jt})	-0.25	0.50
	(0.28)	***(0.37)***
Unemployment rate (u_{nt})	-0.01	0.69**
	(0.21)	***(0.31)***
Manufacturing proportion (ind_{jt})	-0.23*	-0.08
	(0.14)	***(0.17)***
Manufacturing proportion (ind_{nt})	-0.23	1.45**
	(0.49)	***(0.32)***
Computer usage ($comp_{jt}$)	0.29***	-0.09
	(0.11)	***(0.16)***
Computer usage ($comp_{nt}$)	-0.57***	0.50
	(0.19)	***(0.30)***
Minimum wages (MW)	1.08	-
	(3.24)	-
Observations	140	140
Groups	5	5
R^2 (within)	0.50	0.66
Group dummies	Yes	Yes
Year dummies	Yes	Yes
Year trend	Yes	Yes

Notes: Estimated standard errors are under the coefficients. ***, ** and * denote significance at 1%, 5% and 10% levels for two-tail tests. We use Stata's fixed effect programme (*xtreg, fe*, see STATA 2003b) to estimate equation (4.3).

Table 4.2: Institutions and the skill premium, male 1972-2002, estimation from equation (4.4)

Dependent variable: growth rate of the skill premium (ds_{jt}, j = b, o, a, h and d)	Private	Public
Trade union density (tud_{jt})	0.18**	0.03
	(0.10)	***(0.07)***
Trade union density ($dtud_{jt}$)	0.12	-0.12
	(0.10)	***(0.07)***
Trade union density (tud_{nt})	-0.59***	-0.40**
	(0.26)	***(0.20)***
Trade union density ($dtud_{nt}$)	-0.24	0.64***
	(0.23)	***(0.13)***
s_{jt-1}	-0.71***	-1.12***
	(0.09)	***(0.10)***
Tax wedge (tax_{jt})	0.46	-0.01
	(0.80)	***(1.11)***
Tax wedge (tax_{nt})	-0.72	-0.78
	(0.95)	***(1.04)***
Benefit index ($repr_{jt}$)	-0.05	-0.20
	(0.15)	***(0.19)***
Benefit index ($repr_{nt}$)	-0.39*	0.63**
	(0.26)	***(0.29)***
Unemployment rate (u_{jt})	-0.47*	0.59
	(0.28)	***(0.37)***
Unemployment rate (u_{nt})	0.07	0.47*
	(0.31)	***(0.30)***
Manufacturing proportion (ind_{jt})	-0.24*	-0.15
	(0.14)	***(0.17)***
Manufacturing proportion (ind_{nt})	0.15	0.38
	(0.41)	***(0.35)***
Computer usage ($comp_{jt}$)	0.26***	-0.06
	(0.11)	***(0.16)***
Computer usage ($comp_{nt}$)	-0.44***	0.47
	(0.17)	***(0.30)***
Minimum wages (MW)	-	-
	-	-
Observations	140	140
Groups	5	5
R^2 (within)	0.61	0.82
Group dummies	Yes	Yes
Year dummies	Yes	Yes
Year trend	Yes	Yes

Notes: Estimated standard errors are under the coefficients. ***, ** and * denote significance at 1%, 5% and 10% levels for two-tail tests. We use Stata's fixed effect programme (*xtreg, fe*, see STATA 2003b) to estimate equation (4.4).

Table 4.3: Contribution of explanatory factors to the degree premium, the private sector

	1972-1979	1979-1998	1998-2002
a. Changes of each variable, percentage			
Degree premium (s_{dt})	-17.67	27.41	-17.56
Trade union density (tud_{dt})	4.55	-30.75	5.78
Trade union density (tud_{nt})	8.41	-25.29	-1.29
Tax wedge (tax_{dt})	3.83	-0.36	-0.55
Tax wedge (tax_{nt})	3.40	-1.40	-1.32
Benefit index ($repr_{dt}$)	-2.60	5.66	-3.97
Benefit index ($repr_{nt}$)	-3.40	6.54	-2.13
Unemployment rate (u_{dt})	-0.72	2.16	-0.42
Unemployment rate (unt)	1.05	5.59	-4.29
Manufacturing proportion (ind_{dt})	7.72	-3.74	-4.18
Manufacturing proportion (ind_{nt})	0.38	-6.70	-4.42
Computer usage ($comp_{dt}$)	11.83	61.21	16.57
Computer usage ($comp_{nt}$)	3.96	24.31	22.49
b. Effects of changes in each explanatory variable, percentage			
Trade union density (tud_{dt})	0.82**	-5.53**	1.04**
Trade union density (tud_{nt})	-4.96***	14.92***	0.76***
Tax wedge (tax_{dt})	-	-	-
Tax wedge (tax_{nt})	-	-	-
Benefit index ($repr_{dt}$)	-	-	-
Benefit index ($repr_{nt}$)	1.32*	-2.55*	0.83*
Unemployment rate (u_{dt})	0.34*	-1.02*	0.20*
Unemployment rate (unt)	-	-	-
Manufacturing proportion (ind_{dt})	-1.85*	0.90*	1.00*
Manufacturing proportion (ind_{nt})	-	-	-
Computer usage ($comp_{dt}$)	3.08***	15.91***	4.31***
Computer usage ($comp_{nt}$)	-1.74***	-10.69***	-9.90***
c. Overall contribution of each factor, percentage			
Trade union density	23.45	34.24	-10.26
Tax wedge	-	-	-
Benefit index	-7.50	-9.31	-4.72
Unemployment rate	-1.92	-3.71	-1.13
Manufacturing proportion	10.49	3.28	-5.71
Computer usage	-7.55	19.04	31.82

Notes: All figures in Table 4.3 are calculated using estimates in Table 4.2 and data in Table A4.1 (see Appendix 4.2). ***, ** and * denote significance at 1%, 5% and 10% levels for two-tail tests. Significance of each variable in the middle panel is from Table 4.2.

Table 4.4: Institutions and the skill premium (Sensitivity Tests), male 1972-2002, estimation from equation (4.4)

Dependent variable: growth rate of the skill premium (ds_{jt}, j = b, o, a, h and d)	(a) Weekly earnings	(b) Semi-skilled	(c) 1980-2002
Trade union density (tud_{jt})	0.19**	0.23*	0.14
	(0.10)	*(0.13)*	*(0.15)*
Trade union density ($dtud_{jt}$)	0.11	0.27**	0.05
	(0.10)	*(0.12)*	*(0.14)*
Trade union density (tud_{nt})	-0.57**	-0.31**	-1.58***
	(0.27)	*(0.16)*	*(0.69)*
Trade union density ($dtud_{nt}$)	-0.22	0.01	-0.62
	(0.24)	*(0.13)*	*(0.43)*
s_{jt-1}	-0.64***	-0.68***	-0.82***
	(0.09)	*(0.16)*	*(0.11)*
Tax wedge (tax_{jt})	0.54	-0.45	-0.05
	(0.83)	*(0.42)*	*(1.04)*
Tax wedge (tax_{nt})	-0.83	0.58	-0.51
	(0.98)	*(0.39)*	*(0.57)*
Benefit index ($repr_{jt}$)	0.00	0.03	-0.03
	(0.15)	*(0.16)*	*(0.17)*
Benefit index ($repr_{nt}$)	-0.45*	0.05	-0.40**
	(0.27)	*(0.18)*	*(0.21)*
Minimum wages (MW)	-	-	1.66
	-	-	*(2.32)*
Observations	140	56	105
Groups	5	2	5
R^2 (within)	0.58	0.60	0.58
Group dummies	Yes	Yes	Yes
Year dummies	Yes	No	Yes
Year trend	Yes	Yes	Yes

Notes: as for Table 4.2.

APPENDIX 4.1
The union bargaining model in Koeniger et al (2004)

(1) Perfect competition

This appendix reviews the union bargaining model in Koeniger et al (2004) and derives the empirical specification for the Chapter 4. In this model, institutions affect the wage differential by altering labour demand and the surplus of producers and workers. Koeniger et al (2004) firstly consider the perfect competitive situation in a 2×2 model: there are two sectors in the economy that produce two goods (k=1, 2). Workers can be skilled or unskilled (j=h, l). The economy is endowed with H skilled and L unskilled workers who inelastically supply labor. Both sectors employ skilled and unskilled labor but with different technology, which has different TFP and skill requirement. The production function in both sectors is assumed to be Cobb-Douglas with constant returns to scale:[42]

$$Y_k = a_k h_k^{\alpha_k} l_k^{1-\alpha_k} \text{ , k=1, 2} \tag{A1}$$

where a_k is the total factor productivity (TFP) in sector k; and α_k is the skill intensity in sector k, $0<\alpha_k<1$ and $\alpha_1> \alpha_2$.

In a perfect competitive market, there is no entry barrier and risk to both producers and workers. Then, the inelastic labor supply will be fully employed by two sectors. And, employment of skilled and unskilled workers in the economy is denoted as h and l, which are equal to the endowment: $h= h_1+h_2=H$ and $l= l_1+l_2=L$. The price of output in sector k is P_k, which is given for a small open economy. The wage of skilled/unskilled workers is equal to the value of marginal product of labor inputs when producers maximize profit, i.e. Max $P_kY_k-(w_hh_k+ w_ll_k)$. Since there is no entry barrier for workers, the skilled/unskilled workers can have the same wage in each sector:

$$w_h = \frac{\alpha_1 Y_1 P_1}{h_1} = \frac{\alpha_2 Y_2 P_2}{h_2} \tag{A2}$$

$$w_l = \frac{(1-\alpha_1) Y_1 P_1}{l_1} = \frac{(1-\alpha_2) Y_2 P_2}{l_2} \tag{A3}$$

[42] The year subscript t is dropped here to simplify equation form.

The system of four equations in (A2) and (A3) determines wages and skill ratios in both sectors. Using $\varphi_k=h_k/l_k$ to denote the skill ratio in sector k, the relative wage between skilled and unskilled workers within the same sector is:

$$\frac{w_h}{w_l} = \frac{\alpha_1}{1-\alpha_1}\varphi_1^{-1} = \frac{\alpha_2}{1-\alpha_2}\varphi_2^{-1} \tag{A4}$$

That is, if the relative demand hence the skill intensity (α_1 and α_2) does not change, the increase in relative supply of skilled workers will decreases the relative wage of skilled workers. This result does not depend on the different TFP of each sector (a_1 and a_2) and prices of products (P_1 and P_2). Rearranging equation (A4): $\varphi_1 = \frac{\alpha_1}{\alpha_2}\frac{1-\alpha_2}{1-\alpha_1}\varphi_2$, it shows that the skill ratio in sector 1 is higher than that in sector 2 ($\varphi_1 > \varphi_2$), since it applies more skill-biased technology than sector 2 ($\alpha_1 > \alpha_2$). Hence sector 1 is a skill intensive sector like the computer software industry while sector 2 is a labor intensive sector like textile industry. By using equation (A1), the relative wage between skilled and unskilled workers across sectors implies that

$$\begin{aligned}\frac{w_h}{w_l} &= \frac{a_1}{a_2}\frac{P_1}{P_2}\frac{\alpha_1}{1-\alpha_2}\varphi_1^{\alpha_1-1}\varphi_2^{-\alpha_2} \\ &= \frac{a_2}{a_1}\frac{P_2}{P_1}\frac{\alpha_2}{1-\alpha_1}\varphi_1^{-\alpha_1}\varphi_2^{\alpha_2-1}\end{aligned} \tag{A5}$$

Just as the relative wage within the same sector, the negative co-variation between relative wage and relative supply still hold, given TFP of each sector (a_1 and a_2) and prices of products (P_1 and P_2). However, the cross-sector relative wage depends on the relative supply in two sectors (φ_1 and φ_2). Thus, if one more skilled worker entered a sector, the relative wage of skilled worker within and cross sector would decrease.[43]

[43] This process can be described in a simple way: as one more skilled worker joins the sector 1, the marginal product of skilled worker in sector 1 hence price of skill in the whole economy would decrease. All producers in the economy can save wage cost and have higher profit. More potential producers will join the economy and push the wage of unskilled workers up. Thus, the simple supply-demand framework in Chapter 3 is consistent with current 2×2 model in Koeniger et al (2004).

Moreover, the higher are the relative TFP ($\frac{a_1}{a_2}$) and relative prices of products ($\frac{P_1}{P_2}$) between the skill-intensive sector 1 and labor-intensive sector 2, the higher is relative wage of skilled workers. Within and between-sector relative wages must be the same under perfect competition, hence equation (A4) and the first part of equation (A5) can be combined as:

$$\frac{w_h}{w_l} = \frac{a_1}{a_2}\frac{P_1}{P_2}\left(\frac{\alpha_1}{\alpha_2}\right)^{\alpha_1-1}\left(\frac{1-\alpha_2}{1-\alpha_1}\right)^{\alpha_1-1}\frac{\alpha_1}{1-\alpha_2}\varphi_2^{\alpha_1-\alpha_2-1} \tag{A6}$$

Using equation (A6) and the second part of equation (A4), the relative demand for skill and hence the skill ratio in the labor intensive sector 2 is:[44]

$$\varphi_2 = \left[\frac{a_2}{a_1}\frac{P_2}{P_1}\left(\frac{\alpha_2}{\alpha_1}\right)^{\alpha_1}\left(\frac{1-\alpha_2}{1-\alpha_1}\right)^{1-\alpha_1}\right]^{\frac{1}{\alpha_1-\alpha_2}} \tag{A7}$$

Equation (A7) shows that the higher relative TFP ($\frac{a_2}{a_1}$) and relative prices of products ($\frac{P_2}{P_1}$) increase the relative demand for skill in the sector 2. Plugging equation (A7) back into equation (A6), the equilibrium relative wage under perfect competition is:

$$\frac{w_h}{w_l} = \left(\frac{a_1}{a_2}\right)^{\frac{1}{\alpha_1-\alpha_2}}\left(\frac{P_1}{P_2}\right)^{\frac{1}{\alpha_1-\alpha_2}}\left(\frac{\alpha_1}{\alpha_2}\right)^{\frac{\alpha_2}{\alpha_1-\alpha_2}}\left(\frac{1-\alpha_1}{1-\alpha_2}\right)^{\frac{1-\alpha_1}{\alpha_1-\alpha_2}}\frac{\alpha_1}{1-\alpha_2} \tag{A8}$$

Thus, the relative wage of skilled workers at equilibrium depends on three main factors: (1) relative TFP ($\frac{a_1}{a_2}$); (2) relative price ($\frac{P_1}{P_2}$); (3) skill-biased technology within two sectors (α_1 and α_2). Since sector 1 uses a more skill-biased technology, $\alpha_1 > \alpha_2$, the relative skilled wage increases as the relative price of the skill-intensive good and relative TFP of skill-intensive sector increase. However, the relationship between the relative skill wage and the skill-biased technology within sectors (α_1 and α_2) is dependent on more assumptions hence inconclusive.

[44] Because of the symmetric structure of equations, the results from the first part of equation (A5), i.e. the relative wage of skilled workers in sector 1 to unskilled worker in sector 2 is the same as that by using the second part of equation (A5) i.e. the relative wage of skilled workers in sector 2 to unskilled worker in sector 1. Thus, we only need to discuss the first part of equation (A5).

(2) Institutional Environment

Koeniger et al (2004) loosen the perfect competition assumption firstly by assuming a sunk cost (C>0) of setting up a production sector. It builds a natural barrier for potential producer to enter any sector. The producers should make sure that the capital value of production is strictly positive to compensate for this sunk cost before they enter the production sector.

The second loosened assumption is the zero business risk. The production unit may be closed down for exogenous reasons with Poisson probability ρ. Hence, the full employment assumption is correspondingly given up. As ρ production units are closed down, the same probability (ρ) of employed workers are collectively dismissed by producers. This dismissal will incur a once-for-all cost to producers, ($\Delta_j=\varepsilon_j w_j$, j=h, l) which is a fixed proportional to wage cost for each skilled or unskilled worker. If the production units are closed down, producers would lose not only the all production capital but also this dismissal cost. For the whole production sector k, the collective dismissal costs are $\varepsilon_h w_h h_k+\varepsilon_l w_l l_k$. Then, the outside option for the whole production in sector k is worsened to the collective dismissal costs. Following the rational expectation assumption, the business risk in economy with the possible dismissal cost is expected by rational producers and workers. Thus, this dismissal cost does not change labour demand, but only worsen the outside option of producers and become a mark-up of wages.

The government gives benefit to unemployed workers as a proportion of wage they earned, that is $\gamma_j w_j$, j=h, l, where γ_j is the replacement ratio. It is assumed that the benefit can cover all unemployed worker. Hence, the government budget for unemployment benefit is: $\gamma_h w_h(H-h) + \gamma_l w_l(L-l)$. Government taxes labor income of skilled and unskilled workers using mark-up rates, τ_h and τ_l to finance the unemployment benefits. The balance of fiscal budget of government implies:

$$\tau_h w_h h+ \tau_l w_l l= \gamma_h w_h(H-h) + \gamma_l w_l(L-l) \qquad \text{(A9)}$$

Since rational producers can also expect the tax rate on wage, income tax will be absorbed by demand through the mark-up on the wage. Koeniger et al (2004) denote the capital value of production in sector k as V_k and market interest rate as r. Following free entry for production, producers can only get the average return on

capital. The expected value of production in each sector at the end of this period is only the time value, which is the original value multiply one plus the market interest rate, i.e. $(1+r)V_k$.

On the other hand, capital value at the end of period comprises three parts: (1) income from production, i.e. $P_k Y_k$; (2) production cost including wage and income tax: $(1+\tau_h)w_h h_k+(1+\tau_l)w_l l_k$; (3)expected residual capital value of production: $-\rho(\varepsilon_h w_h h_k+\varepsilon_l w_l l_k)+(1-\rho)V_k$. Thus, the time value of production is equal to the production profit and expected residual value, that is:$(1+r)V_k=P_k Y_k-[(1+\tau_h)w_h h_k+(1+\tau_l)\, w_l l_k]+[-\rho(\varepsilon_h w_h h_k+\varepsilon_l w_l l_k)+(1-\rho)V_k]$. Rearrange it into the form of:

$$(r+\rho)V_k= P_k Y_k - [(1+\tau_h+\rho\varepsilon_h)\, w_h h_k+(1+\tau_l+\rho\varepsilon_l)\, w_l l_k] \qquad \text{(A10)}$$

Hence, the profit of the production must cover the market return and business risk of its capital value. Moreover, free entry for producers implies that the producers have been setting up production units until the capital value of production is just equal to the sunk cost, i.e. $V_k= C$. Since the capital value is beyond the outside option $\underline{V_k}=0$, sunk costs generate quasi-rents after firms have entered the market. Once firms have sunk their investment and hired the workers, collective bargaining decreased the producer's outside option from $\underline{V_k}=0$ to $\underline{V_k}=-(\varepsilon_h w_h h_k+\varepsilon_l w_l l_k)$. Thus, the rent of production becomes even bigger, $C+(\varepsilon_h w_h h_k+\varepsilon_l w_l l_k)$, which can be appropriated by producers or workers. Workers collectively bargain with producers to share these rents. Thus, collective dismissal costs worsen the outside option for producers and create a hold-up problem that allows workers to collectively bid up their wage.

Koeniger et al (2004) only consider the perfect competition with C=0 under the described institutional environment. Producers maximize the capital value of production in equation (A10) as done in the last part. Since the dismissal cost and income tax only mark up wage, the equilibrium relative wage in equation (A8) can be rewritten as:

$$\frac{(1+\tau_h+\rho\varepsilon_h)w_h}{(1+\tau_l+\rho\varepsilon_l)w_l}=\left(\frac{a_1}{a_2}\right)^{\frac{1}{\alpha_1-\alpha_2}}\left(\frac{P_1}{P_2}\right)^{\frac{1}{\alpha_1-\alpha_2}}\left(\frac{\alpha_1}{\alpha_2}\right)^{\frac{\alpha_2}{\alpha_1-\alpha_2}}\left(\frac{1-\alpha_1}{1-\alpha_2}\right)^{\frac{1-\alpha_1}{\alpha_1-\alpha_2}}\frac{\alpha_1}{1-\alpha_2} \qquad \text{(A11)}$$

The gross wages before any tax and deduction are defined as $\overline{w_k} \equiv (1+\tau_k)w_k$.[45] Multiplying equation (A11) by $\frac{1+\tau_h}{1+\tau_l}$ and taking logs, noting the ln(1+x)≈x for small x, the log form wage differentials are:

$$\ln\left(\frac{\overline{w_h}}{\overline{w_l}}\right) \approx c + \rho(\varepsilon_l - \varepsilon_h) + (\alpha_1 - \alpha_2)^{-1}[\ln(\frac{P_1}{P_2}) + \ln(\frac{a_1}{a_2})] \qquad \text{(A12)}$$

where $c(\alpha_1, \alpha_2) = \frac{\alpha_2}{\alpha_1 - \alpha_2}\ln(\frac{\alpha_1}{\alpha_2}) + \frac{1-\alpha_1}{\alpha_1 - \alpha_2}\ln(\frac{1-\alpha_1}{1-\alpha_2}) + \ln(\frac{\alpha_1}{1-\alpha_2})$.

Thus, the skill premium increases when the relative price ($\frac{P_1}{P_2}$) of skill intensive goods or TFP ($\frac{a_1}{a_2}$) of sector 1 increases. The higher is the dismissal cost of skilled workers, the smaller is skill premium. However, log wage differentials of skilled workers increase as the dismissal cost of unskilled workers increases. It implies that the expected firing cost is passed to workers in a competitive economy even workers attempt to mark up the wages. Thus, the expected dismissal costs ($\rho\varepsilon_k$) of skilled or unskilled workers decrease their gross wages if there is no collective bargaining from workers in the competitive market. The overall effect of dismissal cost on the skill premium depends on whether the dismissal cost is skill-biased, that is, the sign of $(\varepsilon_l - \varepsilon_h)$.

Moreover, gross wages hence the wage differentials do not depend on mark up taxes because the Cobb-Douglas production function is unit elastic: the fall in labor demand and thus net wages w_k exactly offsets the direct positive effect of income tax τ_k on gross wage $\overline{w_k}$. Under perfect competition, employed workers can be replaced so that they cannot bid up their wages *ex post*. Instead, this is no longer the case if unions bargain for workers.

(3) Workers' behaviour and trade union

Workers are assumed risk-neutral and have an infinite horizon. As described in the last part, if workers are employed, they can earn wage w_j (j=h, l). Employed workers

[45] It is the gross earnings before any deduction, as we observe empirically in the GHS. Empirically, the gross wages of skilled or unskilled workers do not include the expected firing cost.

are collectively dismissed by producers with business risk ρ, then unemployed workers receive a once-for-all dismissal fee $\varepsilon_j w_j$ and unemployment benefit $\gamma_j w_j$ thereafter. If the once-for-all dismissal fee is small enough, it will not enter the expectation of workers since they have infinite horizon. Obviously, as the replacement ratio γ_j is less than one in the usual situation, the capital value of employment, W_j is more than that of unemployment, U_j. Since workers supply labor inelastically with exogenous business risk, they cannot decrease the wage hence employment capital value by increasing labor supply. Thus, there is employment rent existing, which provides rent-seeking space for trade union.

The capital value of employment at the end of period t comprises two parts: (1) income from employment, i.e. w_j; (2) the expected residual capital value of employment: $\rho U_j+(1-\rho)W_j$ as workers have probability of ρ to be dismissed by producers. Thus, the time value of employment is equal to wage and the expected residual value of employment, that is: $(1+r)W_j=w_j+\rho U_j+(l-\rho)W_j$. It can be rearranged into the form:

$$rW_j= w_j - \rho(W_j - U_j) \tag{A13}$$

Thus, the financial return of employment is wage depreciated by business risk. Following the same line, the capital value of unemployment at the end of period t also comprises two parts: (1) income from unemployment, that is, the unemployment benefit $\gamma_j w_j$; (2) the expected residual capital value of unemployment: $\theta_j W_j+(1-\theta_j)U_j$, where θ_j is the probability of reemployment. As ρ producers are closed down in period t, there are ρ fresh producers taking their places in the market, which will employ hρ skilled workers and lρ unskilled workers from the unemployed workers. Then, unemployed workers have chances to be reemployed by producers: $\theta_h \equiv \frac{h\rho}{H-h}$ and $\theta_l \equiv \frac{l\rho}{L-l}$. Thus, the time value of unemployment is equal to the unemployment benefit and the expected residual value of employment, that is: $(1+r)U_j = \gamma_j w_j + \theta_j W_j + (1-\theta_j)U_j$. We can rearrange it into the form of:

$$rU_j= \gamma_j w_j+ \theta_j (W_j - U_j) \tag{A14}$$

Thus, the financial return of unemployment is the unemployment benefit appreciated by reemployment chances. Koeniger et al (2004) have implicitly assumed that $U_h \geq W_l$ so that it is not optimal for skilled workers to perform unskilled tasks. Consequently, the skilled workers would rather keep unemployed than be employed as unskilled workers.

Moreover, since the replacement ratio $\gamma_j<1$ so that the capital value of employment is bigger than that of unemployment, workers find it optimal to supply labor inelastically. Subtracting equation (A13) from equation (A14), we can find the employment rent is:

$$W_j - U_j = \frac{1-\gamma_j}{r+\rho+\theta_j} w_j = \frac{1-\gamma_j}{r+\rho u_j^{-1}} w_j \qquad \text{(A15)}$$

where u_j ($u_h \equiv \frac{H-h}{H}$ and $u_l \equiv \frac{L-l}{L}$) is the unemployment rate of j=h, l, so that the $\rho+\theta_j=\rho u_j^{-1}$. Thus, an increase in wage (w_j) or unemployment rate (u_j) brings an increase in the employment rent, while higher market interest rate (r), replacement ratio (γ_j) or business risk (ρ) will decrease the employment rent.

Producers and a workers' union bargain over how to split the production surplus in the two sectors. It is assumed the trade unions can bargain at the country level which covers the both sectors. However, nothing prevents interpreting k as the suitable unit of disaggregation such as firm, profession, sector or industry. Koeniger et al (2004) adopt the right-to-manage framework, in which unions and employer associations bargain over the wage. Producers then unilaterally choose employment so that labor is on the labor demand curve. They argue that although the right-to-manage setup is not the best solution in economy since producers and unions could bargain efficiently over both wages and employment, right-to-manage for producers is considered more realistic by most economists.

In this right-to-mange model, the Nash bargaining problem is

$$\max_{w_j} \ \Psi^{\sigma} \sum_{k=1}^{2} (V_k - \underline{V_k})$$

$$s.t.\ l_k = l_k^D(w_h, w_l) \ and \ \ h_k = h_k^D(w_h, w_l) \qquad \text{(A16)}$$

where σ is the relative bargaining power of the union, superscript D denotes the demand curve and $(V_k - \underline{V_k})$ is the production surpluses. And, the trade unions' objective function is defined as

$$\Psi_k \equiv \psi\,(W_h - U_h) + (W_l - U_l) \tag{A17}$$

The union only cares about employed workers and ψ denotes the relative weight of skilled employed workers in unions' objective function. The larger is the weight of skilled workers (ψ), the more employment rent of skilled workers would enter unions' objective function. As we will see later, larger ψ increase the relative union objective elasticity for skilled workers and then decrease the relative skilled wage.[46] Moreover, since the collective dismissal cost in sector k has decreased the producer's outside option from $\underline{V_k} = 0$ to $\underline{V_k} = -(\varepsilon_h w_h h_k + \varepsilon_l w_l l_k)$. From equation (A10), the total production surpluses are:

$$\sum_{k=1}^{2}(V_k - \underline{V_k}) = (r+\rho)^{-1}\left[\sum_{k=1}^{2} P_k Y_k - (1+\tau_h - r\varepsilon_h)w_h h - (1+\tau_l - r\varepsilon_l)w_l l\right]$$

. The first-order condition of equation (A16) for skilled wages implies that the total earnings of the skilled workers are:

$$w_h h = \frac{e_h \sigma (r+\rho)\sum_{k=1}^{2}(V_k - \underline{V_k})}{(1+\tau_h - r\varepsilon_h)(1+\sum_{k=1}^{2}\frac{h_k}{h}e_{h,k})} \tag{A18}$$

where $e_h \equiv (\partial\Psi/\partial w_h)(w_h/\Psi)$ and $e_{h,k} \equiv (\partial h_k/\partial w_h)(w_h/h_k)$ denote the elasticity of the union objective and labor demand with respect to skilled wage, w_h. Analogous derivation for unskilled wage allows writing the relative total earnings of the skilled workers as

$$\frac{w_h h}{w_l l} = \frac{1+\tau_l - r\varepsilon_l}{1+\tau_h - r\varepsilon_h}\,\frac{1+\sum_{k=1}^{2}\frac{l_k}{l}e_{l,k}}{1+\sum_{k=1}^{2}\frac{h_k}{h}e_{h,k}}\,\frac{e_h}{e_l} \tag{A19}$$

[46] Note that, being different from Acemoglu et al. (2001), trade unions in Koeniger et al (2004) do not cross-subsidize between workers. Both skilled and unskilled workers earn their marginal product. However, interactions between both factors arise, as long as the production technology implies some complementarities between factors. The larger ψ encourages producers to substitute unskilled workers by skilled workers. As described later, it will increase the total earnings of skilled workers along the demand curve, with decreasing wage and increasing employment. Thus, if trade union paid more attention on employment rent of skilled workers, the relative wage for skilled worker would decrease.

Therefore, if trade unions pay more attention on the employment rent of skilled workers, that is, higher ψ, the elasticity of the union objective for skilled workers would increase and hence the earnings share of skilled workers, *ceteris paribus*. The Cobb-Douglas production function implies that the second term on the right hand side of equation (A19), that is, $\frac{1+\sum_{k=1}^{2}\frac{l_k}{l}e_{l,k}}{1+\sum_{k=1}^{2}\frac{h_k}{h}e_{h,k}}$ equals 1.[47] By using equation (A1)-(A3) and (A10), with producers maximizing the capital value of production, the labour demand for skilled and unskilled workers is:

$$h = h_1 + h_2 = \frac{\alpha_1 Y_1 P_1 + \alpha_2 Y_2 P_2}{w_h(1+\tau_h+\rho\varepsilon_h)} \tag{A20}$$

$$l = l_1 + l_2 = \frac{(1-\alpha_1)Y_1P_1 + (1-\alpha_2)Y_2P_2}{w_l(1+\tau_l+\rho\varepsilon_l)} \tag{A21}$$

Thus, the relative labor demand φ=h/l is the ratio of (A20) to (A21):

$$\varphi = h/l = \frac{(1+\tau_l+\rho\varepsilon_l)}{(1+\tau_h+\rho\varepsilon_h)}\frac{w_l}{w_h}\frac{\alpha_1 Y_1P_1+\alpha_2 Y_2P_2}{(1-\alpha_1)Y_1P_1+(1-\alpha_2)Y_2P_2} \tag{A22}$$

It is not surprising that relative demand negatively depends on the relative wage. Given stable institutional environment, the Cobb-Douglas technology implies that the total labor share is constant unless prices or TFP change. Using equation (A15) and (A17), the relative union objective elasticity with respect to wage is:

$$\frac{e_h}{e_l} = \psi\,\frac{1-\gamma_h}{1-\gamma_l}\frac{r+\rho u_l^{-1}}{r+\rho u_h^{-1}}\frac{w_h}{w_l} \tag{A23}$$

Replacing the h/l and e_h/e_l by using equation (A22) and (A23) and multiplying two sides of equation (A19) by $\frac{1+\tau_h}{1+\tau_l}$, the relative gross wage is:

$$\frac{(1+\tau_h)w_h}{(1+\tau_l)w_l} = \psi^{-1}\frac{1-\gamma_l}{1-\gamma_h}\frac{r+\rho u_h^{-1}}{r+\rho u_l^{-1}}\frac{\alpha_1\frac{Y_1}{Y_2}\frac{P_1}{P_2}+\alpha_2}{(1-\alpha_1)\frac{Y_1}{Y_2}\frac{P_1}{P_2}+(1-\alpha_2)}\frac{(1+\tau_l+\rho\varepsilon_l)}{(1+\tau_h+\rho\varepsilon_h)}\frac{1+\tau_h-r\varepsilon_h}{1+\tau_l-r\varepsilon_l}\frac{1+\tau_h}{1+\tau_l} \tag{A24}$$

[47] This apply L'HÔpital's rule for the CES function and use the limit to the Cobb-Douglas case.

Taking logs and using again that ln(1+x)≈x for small x, the proxy of wage inequality, i.e. the relative gross wages of skilled workers under the supply-demand-institution framework for our empirical test:

$$\ln\left(\frac{\overline{w_h}}{\overline{w_l}}\right) \cong -\ln\psi + (\tau_h - \tau_l) - (\rho + r)(\varepsilon_h - \varepsilon_l) + (\gamma_h - \gamma_l) + \ln\eta(\underset{-}{u_h}, \underset{+}{u_l}) + \ln\pi(\underset{+}{\frac{\alpha_1}{\alpha_2}}, \underset{+}{\frac{P_1}{P_2}}) \tag{A25}$$

with $\eta(u_h, u_l) = \frac{r + \rho u_h^{-1}}{r + \rho u_l^{-1}}$ and $\pi(\frac{\alpha_1}{\alpha_2}, \frac{P_1}{P_2}) = \frac{\alpha_1 \frac{Y_1}{Y_2}\frac{P_1}{P_2} + \alpha_2}{(1-\alpha_1)\frac{Y_1}{Y_2}\frac{P_1}{P_2} + (1-\alpha_2)}$

The empirical specification used in Chapter 4 is based on the equation (A25):[48]

$$\begin{aligned}\ln\left(\frac{\overline{w_H}}{\overline{w_L}}\right) \cong\ & f(\underset{+}{tud_H}, \underset{-}{tud_L}) + g(\underset{+}{tax_H}, \underset{-}{tax_L}) + h(\underset{+}{repr_H}, \underset{-}{repr_L}) + i(\underset{-}{MW}) \\ & + j(\underset{-}{u_H}, \underset{+}{u_L}) + k(\underset{+}{ind_H}, \underset{+}{ind_L}, \underset{+}{comp_H}, \underset{-}{comp_L},)\end{aligned} \tag{4.1}$$

[48] The EPL index is not included in the empirical specification since the EPL index appears to be stable in the UK for the last thirty years. See a summary of EPL in Daniel and Siebert (2005, Figure 4 and 5).

APPENDIX 4.2
The dataset for regressions in Chapter 4

Table A4.1: Dataset used for equation (4.3) and (4.4), private sector

a. Baseline group (NOQUAL, n, %)									
Skill level	**Year**	n_t	tud_{nt}	tax_{nt}	$repr_{nt}$	u_{nt}	ind_{nt}	$comp_{nt}$	**MW**
NOQUAL	1972	0.00	42.96	13.44	36.36	5.55	40.24	0.00	0.00
NOQUAL	1973	7.01	43.01	13.90	35.45	4.20	42.79	0.00	0.00
NOQUAL	1974	14.02	42.10	15.78	32.29	3.37	43.00	0.00	0.00
NOQUAL	1975	21.30	42.24	18.41	31.04	5.24	44.27	0.00	0.00
NOQUAL	1976	15.41	58.70	19.25	31.67	7.50	40.90	0.99	0.00
NOQUAL	1977	11.91	50.86	18.27	34.21	6.30	42.54	1.98	0.00
NOQUAL	1978	14.45	51.84	25.34	30.81	6.03	43.33	2.97	0.00
NOQUAL	1979	22.92	51.37	16.84	32.97	6.60	40.61	3.96	0.00
NOQUAL	1980	27.85	50.72	18.37	31.35	8.81	40.70	4.95	0.00
NOQUAL	1981	21.57	49.92	18.50	35.73	14.70	42.39	5.94	0.00
NOQUAL	1982	16.79	48.74	18.29	34.73	15.95	39.91	6.93	0.00
NOQUAL	1983	17.38	46.37	18.53	30.01	18.10	41.86	7.92	0.00
NOQUAL	1984	18.44	44.17	18.15	31.63	18.52	37.93	8.91	0.00
NOQUAL	1985	21.33	43.01	17.40	31.06	19.34	33.81	14.13	0.00
NOQUAL	1986	22.74	41.29	19.10	27.81	18.40	33.32	19.15	0.00
NOQUAL	1987	20.87	39.72	15.89	31.44	15.47	35.20	23.86	0.00
NOQUAL	1988	28.15	39.33	16.32	24.84	13.77	31.95	21.94	0.00
NOQUAL	1989	30.42	39.36	15.83	30.38	13.61	31.88	23.71	0.00
NOQUAL	1990	30.46	37.61	15.43	30.08	12.25	31.65	26.13	0.00
NOQUAL	1991	26.33	38.50	17.35	29.95	17.26	31.62	24.09	0.00
NOQUAL	1992	17.05	36.60	13.99	30.63	18.78	31.33	25.48	0.00
NOQUAL	1993	17.80	34.27	14.37	32.74	20.94	30.63	24.98	0.00
NOQUAL	1994	20.73	32.75	13.48	32.12	16.83	29.62	24.06	0.00
NOQUAL	1995	16.83	32.22	16.43	31.65	15.39	28.58	22.79	0.00
NOQUAL	1996	19.59	33.70	16.20	31.05	16.06	28.62	23.12	0.00
NOQUAL	1998	14.94	26.08	15.44	39.51	12.19	33.91	28.27	1.28
NOQUAL	2000	22.46	23.07	15.11	39.18	8.33	28.96	41.94	1.31
NOQUAL	2001	23.95	27.12	11.76	42.29	6.58	30.49	49.59	1.41
NOQUAL	2002	34.80	24.79	14.13	37.38	7.90	29.49	50.76	1.44
b. Educated groups (BOLEV, OLEV, ALEV, HIGHER and DEGREE, j=b, o, a, h and d, %)									
Skill level	**Year**	s_{jt}	tud_{jt}	tax_{jt}	$repr_{jt}$	u_{jt}	ind_{jt}	$comp_{jt}$	**MW**
BOLEV	1972	12.83	57.67	14.68	31.48	3.55	43.88	0.00	0.00
BOLEV	1973	10.16	49.26	15.13	32.01	2.27	44.11	0.00	0.00
BOLEV	1974	6.31	53.04	17.11	30.49	1.60	44.95	0.00	0.00
BOLEV	1975	9.53	58.21	19.94	29.22	2.99	43.71	0.00	0.00
BOLEV	1976	10.42	57.25	20.79	29.23	4.03	44.71	1.44	0.00
BOLEV	1977	7.53	69.83	19.83	31.24	3.66	42.49	2.88	0.00
BOLEV	1978	11.38	64.89	27.14	28.26	3.14	44.81	4.32	0.00
BOLEV	1979	9.04	65.05	18.22	30.22	4.10	45.59	5.76	0.00
BOLEV	1980	7.64	64.94	18.23	35.33	6.23	42.56	7.20	0.00
BOLEV	1981	8.08	65.00	18.81	31.37	9.13	38.89	8.64	0.00
BOLEV	1982	11.38	64.33	18.44	31.98	11.47	42.89	10.08	0.00
BOLEV	1983	7.63	64.14	18.65	30.43	14.20	40.78	11.52	0.00
BOLEV	1984	3.96	60.89	18.02	34.35	12.37	31.78	12.96	0.00
BOLEV	1985	7.49	58.58	18.01	32.14	13.42	36.99	18.07	0.00
BOLEV	1986	10.23	53.16	16.97	22.59	11.15	32.50	24.03	0.00
BOLEV	1987	8.17	55.01	16.39	31.40	10.37	32.01	25.68	0.00

BOLEV	1988	9.16	47.44	16.17	24.28	7.65	31.35	24.09	0.00
BOLEV	1989	9.46	46.88	15.85	27.42	5.25	31.32	27.10	0.00
BOLEV	1990	11.76	46.81	15.53	28.20	8.65	33.17	28.00	0.00
BOLEV	1991	11.58	46.73	15.54	28.72	10.92	28.76	28.33	0.00
BOLEV	1992	9.19	48.51	15.14	30.36	15.77	30.68	32.70	0.00
BOLEV	1993	9.19	43.93	14.87	28.80	15.19	29.35	33.44	0.00
BOLEV	1994	8.99	40.71	15.29	28.33	11.84	28.98	33.03	0.00
BOLEV	1995	13.48	45.43	15.91	27.36	9.99	28.05	31.95	0.00
BOLEV	1996	10.60	35.42	14.83	26.79	9.56	29.11	34.48	0.00
BOLEV	1998	7.86	27.78	14.01	38.25	6.75	32.03	33.78	1.28
BOLEV	2000	13.83	32.03	14.58	38.72	6.53	29.05	50.69	1.31
BOLEV	2001	2.91	28.81	13.85	33.25	4.57	27.94	56.68	1.41
BOLEV	2002	1.09	28.11	14.02	36.62	5.14	29.01	65.77	1.44
OLEV	1972	23.63	54.46	14.16	25.41	2.14	31.65	0.00	0.00
OLEV	1973	22.38	55.91	14.65	27.93	1.25	35.19	0.00	0.00
OLEV	1974	16.79	54.05	16.54	24.08	1.25	31.82	0.00	0.00
OLEV	1975	17.25	52.38	19.34	24.90	2.73	33.41	0.00	0.00
OLEV	1976	20.59	56.87	20.21	24.18	2.40	35.04	1.73	0.00
OLEV	1977	17.79	58.59	19.19	27.14	3.19	30.20	3.47	0.00
OLEV	1978	16.06	58.72	26.18	28.64	3.80	35.95	5.20	0.00
OLEV	1979	17.61	58.06	17.77	23.69	2.00	33.44	6.93	0.00
OLEV	1980	17.20	56.78	17.66	28.74	5.07	32.89	8.67	0.00
OLEV	1981	15.39	54.13	18.31	33.79	7.92	33.61	10.40	0.00
OLEV	1982	17.06	52.12	18.34	28.94	9.07	33.37	12.13	0.00
OLEV	1983	16.01	49.60	18.63	27.92	11.95	31.42	13.87	0.00
OLEV	1984	11.46	46.85	18.65	26.45	8.49	29.64	15.60	0.00
OLEV	1985	13.89	46.10	18.21	27.04	9.33	29.25	24.39	0.00
OLEV	1986	16.70	46.80	18.06	20.58	9.30	26.23	32.02	0.00
OLEV	1987	14.47	48.35	17.47	25.97	7.05	30.44	29.98	0.00
OLEV	1988	16.83	47.26	16.08	23.69	6.10	28.83	31.89	0.00
OLEV	1989	18.65	45.47	16.11	27.85	5.30	28.62	34.81	0.00
OLEV	1990	18.67	44.91	16.03	26.13	6.69	27.01	35.08	0.00
OLEV	1991	18.91	44.87	16.45	27.12	9.94	29.50	35.63	0.00
OLEV	1992	18.05	44.21	15.90	28.18	12.55	27.89	38.61	0.00
OLEV	1993	12.90	43.55	15.67	26.44	13.95	28.03	35.17	0.00
OLEV	1994	12.27	39.43	16.35	24.67	11.06	23.92	36.19	0.00
OLEV	1995	16.58	30.14	16.75	26.47	11.11	29.13	37.69	0.00
OLEV	1996	13.33	26.22	15.37	24.54	9.45	26.10	38.86	0.00
OLEV	1998	15.63	25.35	14.81	36.54	6.71	27.59	45.00	1.28
OLEV	2000	16.09	24.99	15.19	32.90	4.81	25.96	60.97	1.31
OLEV	2001	20.57	27.41	14.46	34.31	5.29	25.35	64.75	1.41
OLEV	2002	14.78	24.63	14.35	35.07	4.53	23.40	71.31	1.44
ALEV	1972	31.05	65.84	13.84	23.50	3.78	34.38	0.00	0.00
ALEV	1973	31.70	54.82	14.50	24.94	1.12	39.17	0.00	0.00
ALEV	1974	27.36	65.37	16.39	22.21	1.71	38.07	0.00	0.00
ALEV	1975	26.95	68.11	19.26	23.61	1.53	36.30	0.00	0.00
ALEV	1976	29.90	65.95	20.20	22.21	2.42	35.15	2.13	0.00
ALEV	1977	27.66	62.61	19.07	24.57	1.64	36.65	4.26	0.00
ALEV	1978	23.16	55.62	26.54	23.89	2.07	36.17	6.39	0.00
ALEV	1979	23.28	60.17	17.65	22.18	3.15	37.25	8.51	0.00
ALEV	1980	25.00	68.01	17.83	26.97	3.00	32.16	10.64	0.00
ALEV	1981	30.52	67.75	18.36	23.30	5.53	37.85	12.77	0.00
ALEV	1982	27.24	55.42	18.31	23.78	8.32	37.89	14.90	0.00
ALEV	1983	26.65	55.82	18.78	21.22	8.33	32.62	17.03	0.00
ALEV	1984	27.81	50.40	19.33	22.18	7.30	29.82	19.16	0.00

ALEV	1985	28.07	49.57	19.37	21.62	4.90	32.37	27.76	0.00
ALEV	1986	24.53	45.50	18.71	19.64	7.00	30.25	29.33	0.00
ALEV	1987	29.53	42.51	18.20	24.96	6.61	26.09	36.55	0.00
ALEV	1988	29.38	41.52	16.87	18.29	5.21	31.47	33.55	0.00
ALEV	1989	29.70	44.39	17.27	19.80	3.43	32.17	37.65	0.00
ALEV	1990	30.53	35.35	17.56	19.62	4.64	28.92	38.54	0.00
ALEV	1991	34.61	37.48	16.78	21.77	7.21	27.84	38.32	0.00
ALEV	1992	29.83	36.92	16.56	23.95	9.10	26.67	43.03	0.00
ALEV	1993	24.74	36.38	16.24	23.81	10.27	25.76	42.64	0.00
ALEV	1994	29.78	34.89	17.22	20.15	10.70	25.99	46.73	0.00
ALEV	1995	29.03	35.03	17.26	21.64	8.21	23.74	44.38	0.00
ALEV	1996	27.97	27.76	15.29	22.62	7.23	27.62	44.99	0.00
ALEV	1998	26.46	30.52	15.95	30.59	5.33	26.89	57.34	1.28
ALEV	2000	23.59	30.89	15.72	33.31	4.26	25.25	67.46	1.31
ALEV	2001	30.23	30.06	15.38	30.34	4.39	25.16	72.15	1.41
ALEV	2002	22.94	26.94	15.04	32.19	3.71	23.89	81.95	1.44
HIGHER	1972	51.40	41.62	15.06	19.56	0.49	28.38	0.00	0.00
HIGHER	1973	50.35	36.05	15.59	18.33	0.15	25.35	0.00	0.00
HIGHER	1974	43.83	45.76	17.60	17.82	0.39	29.87	0.00	0.00
HIGHER	1975	44.07	48.64	20.59	19.25	1.58	28.48	0.00	0.00
HIGHER	1976	37.54	51.52	21.26	19.55	1.06	33.85	2.53	0.00
HIGHER	1977	38.33	55.85	20.29	21.32	1.47	30.00	5.06	0.00
HIGHER	1978	34.49	52.06	27.13	21.91	1.24	30.62	7.58	0.00
HIGHER	1979	35.53	54.53	18.78	21.59	0.67	30.88	10.11	0.00
HIGHER	1980	35.93	51.22	18.61	16.70	1.03	35.54	12.64	0.00
HIGHER	1981	36.80	51.50	18.85	22.73	2.95	33.33	15.17	0.00
HIGHER	1982	41.10	54.16	18.83	21.37	4.08	35.94	17.70	0.00
HIGHER	1983	43.03	52.02	19.94	17.99	3.40	40.09	20.22	0.00
HIGHER	1984	39.76	50.76	20.65	13.58	2.88	36.55	22.75	0.00
HIGHER	1985	47.65	44.17	20.56	15.17	2.87	36.10	27.14	0.00
HIGHER	1986	40.62	48.07	19.89	16.11	3.15	35.17	34.37	0.00
HIGHER	1987	40.00	43.52	19.48	20.56	3.77	39.59	38.54	0.00
HIGHER	1988	44.28	44.61	18.00	17.26	3.29	33.96	38.55	0.00
HIGHER	1989	45.08	42.27	18.35	19.81	1.61	33.74	37.32	0.00
HIGHER	1990	46.55	39.39	18.95	15.59	2.04	33.52	39.81	0.00
HIGHER	1991	45.63	39.51	19.21	17.75	3.31	34.82	43.03	0.00
HIGHER	1992	37.61	39.43	18.55	20.08	5.49	31.00	43.50	0.00
HIGHER	1993	35.16	35.00	18.61	17.03	5.93	31.41	43.52	0.00
HIGHER	1994	39.81	31.25	19.69	15.58	6.04	32.88	48.12	0.00
HIGHER	1995	40.09	30.47	19.25	17.37	4.82	34.69	49.22	0.00
HIGHER	1996	47.61	28.14	17.27	16.93	5.19	32.01	50.95	0.00
HIGHER	1998	38.48	25.90	17.18	22.68	1.59	34.70	63.86	1.28
HIGHER	2000	43.82	26.47	17.35	29.48	3.82	32.89	70.54	1.31
HIGHER	2001	37.40	27.27	17.02	25.11	3.18	30.03	74.70	1.41
HIGHER	2002	41.20	27.31	15.91	33.23	2.59	27.18	84.76	1.44
DEGREE	1972	73.59	40.74	14.78	17.73	1.93	16.80	0.00	0.00
DEGREE	1973	73.46	38.66	15.58	16.46	0.76	20.49	0.00	0.00
DEGREE	1974	64.41	37.47	17.38	16.56	1.45	22.61	0.00	0.00
DEGREE	1975	60.97	35.59	20.44	15.07	0.48	23.37	0.00	0.00
DEGREE	1976	65.70	42.27	21.19	13.62	2.44	23.22	2.96	0.00
DEGREE	1977	61.25	44.55	20.28	15.43	1.45	20.37	5.92	0.00
DEGREE	1978	59.22	44.81	29.09	18.69	1.11	23.63	8.88	0.00
DEGREE	1979	55.92	45.30	18.62	15.12	1.21	24.52	11.83	0.00
DEGREE	1980	59.10	45.68	18.69	7.13	2.01	20.84	14.79	0.00
DEGREE	1981	59.81	43.32	20.10	9.48	3.67	24.82	17.75	0.00

DEGREE	1982	59.24	44.76	19.00	19.65	4.15	23.14	20.71	0.00
DEGREE	1983	62.19	42.80	20.92	12.21	3.60	22.04	23.67	0.00
DEGREE	1984	67.14	42.58	21.57	16.86	5.51	23.36	26.63	0.00
DEGREE	1985	63.39	37.59	21.28	19.26	2.69	27.43	28.52	0.00
DEGREE	1986	59.19	41.79	20.46	19.33	3.28	24.45	31.47	0.00
DEGREE	1987	65.40	42.19	20.93	15.30	3.95	29.30	39.67	0.00
DEGREE	1988	68.01	35.41	19.31	16.30	2.22	20.96	37.89	0.00
DEGREE	1989	71.13	34.48	19.43	15.07	3.82	21.07	40.90	0.00
DEGREE	1990	80.38	32.33	19.87	16.33	2.46	24.11	42.03	0.00
DEGREE	1991	73.85	33.66	19.40	15.75	5.66	21.96	44.41	0.00
DEGREE	1992	62.88	31.11	19.55	14.25	4.88	20.75	49.65	0.00
DEGREE	1993	70.68	28.05	19.58	14.24	6.53	19.32	53.34	0.00
DEGREE	1994	75.06	28.45	19.97	11.44	6.11	21.29	58.31	0.00
DEGREE	1995	70.89	14.46	20.22	11.11	4.92	18.42	59.70	0.00
DEGREE	1996	65.27	18.80	18.79	10.42	2.52	20.24	64.28	0.00
DEGREE	1998	83.33	14.55	18.26	20.78	3.37	20.78	73.04	1.28
DEGREE	2000	76.25	13.47	18.67	18.53	2.60	18.67	83.15	1.31
DEGREE	2001	75.52	16.99	17.92	17.85	3.37	19.27	84.95	1.41
DEGREE	2002	65.77	20.33	17.71	16.81	2.95	16.60	89.61	1.44

Table A4.2: Dataset used for equation (4.3) and (4.4), public sector

a. Baseline group (NOQUAL, n, %)									
Skill level	**Year**	n_t	tud_{nt}	tax_{nt}	$repr_{nt}$	u_{nt}	ind_{nt}	$comp_{nt}$	**MW**
NOQUAL	1972	0.00	53.55	13.64	35.55	5.07	40.65	0.00	0.00
NOQUAL	1973	7.75	45.13	14.32	34.57	4.26	42.80	0.00	0.00
NOQUAL	1974	10.43	51.88	16.04	31.47	3.18	43.32	0.00	0.00
NOQUAL	1975	20.63	50.84	18.68	30.72	4.76	45.01	0.00	0.00
NOQUAL	1976	19.35	61.61	19.46	31.56	6.87	41.01	0.99	0.00
NOQUAL	1977	11.47	69.66	18.48	33.76	5.52	43.25	1.98	0.00
NOQUAL	1978	13.72	68.64	26.32	30.18	5.28	43.36	2.97	0.00
NOQUAL	1979	20.14	67.16	17.02	32.35	5.88	40.59	3.96	0.00
NOQUAL	1980	27.86	63.20	18.34	30.54	8.19	41.11	4.95	0.00
NOQUAL	1981	23.19	64.31	18.52	35.97	14.74	42.33	5.94	0.00
NOQUAL	1982	18.03	65.33	18.36	33.26	14.07	40.72	6.93	0.00
NOQUAL	1983	12.96	67.06	18.61	29.34	16.90	42.55	7.92	0.00
NOQUAL	1984	12.23	65.60	18.25	31.80	20.02	37.30	8.91	0.00
NOQUAL	1985	21.71	63.34	17.55	31.09	19.16	33.28	14.13	0.00
NOQUAL	1986	20.39	59.87	19.08	27.56	18.83	32.97	19.15	0.00
NOQUAL	1987	31.96	61.50	15.94	31.03	15.28	34.99	23.86	0.00
NOQUAL	1988	38.96	64.17	16.16	23.68	13.10	31.73	21.94	0.00
NOQUAL	1989	35.47	64.12	15.89	30.58	13.21	32.03	23.71	0.00
NOQUAL	1990	28.15	65.69	15.51	30.56	11.33	31.39	26.13	0.00
NOQUAL	1991	28.51	60.31	17.32	29.84	17.29	31.58	24.09	0.00
NOQUAL	1992	20.04	60.09	13.92	30.70	18.61	31.05	25.48	0.00
NOQUAL	1993	16.75	57.08	14.20	31.93	20.18	30.34	24.98	0.00
NOQUAL	1994	25.05	58.25	13.74	32.34	15.66	29.94	24.06	0.00
NOQUAL	1995	28.07	59.58	16.51	31.17	14.80	27.94	22.79	0.00
NOQUAL	1996	29.51	45.23	16.10	31.69	16.10	29.17	23.12	0.00
NOQUAL	1998	13.53	41.67	15.66	40.68	11.13	34.35	28.27	1.28
NOQUAL	2000	9.70	58.34	15.59	40.56	9.21	28.38	41.94	1.31
NOQUAL	2001	28.17	50.02	12.34	42.23	7.03	29.81	49.59	1.41
NOQUAL	2002	25.23	50.75	13.86	38.48	8.12	29.13	50.76	1.44

b. Educated groups (BOLEV, OLEV, ALEV, HIGHER and DEGREE, j=b, o, a, h and d, %)									
Skill level	**Year**	s_{jt}	tud_{jt}	tax_{jt}	$repr_{jt}$	u_{jt}	ind_{jt}	$comp_{jt}$	**MW**
BOLEV	1972	19.89	36.20	14.76	31.57	3.44	43.99	0.00	0.00
BOLEV	1973	19.75	25.51	15.05	32.57	2.26	43.93	0.00	0.00
BOLEV	1974	20.36	35.63	17.07	30.83	1.60	45.92	0.00	0.00
BOLEV	1975	7.74	31.57	19.99	28.70	2.83	44.13	0.00	0.00
BOLEV	1976	7.31	30.45	20.72	28.89	3.89	44.83	1.44	0.00
BOLEV	1977	15.13	26.67	19.77	31.96	3.41	43.40	2.88	0.00
BOLEV	1978	4.20	33.01	27.43	27.72	2.95	45.31	4.32	0.00
BOLEV	1979	13.71	42.98	18.40	29.48	3.74	45.28	5.76	0.00
BOLEV	1980	10.96	35.95	18.16	37.49	6.19	42.46	7.20	0.00
BOLEV	1981	9.65	42.87	18.89	31.48	9.12	39.08	8.64	0.00
BOLEV	1982	14.76	45.39	18.49	33.49	10.19	43.35	10.08	0.00
BOLEV	1983	16.34	40.02	18.49	30.97	13.44	39.79	11.52	0.00
BOLEV	1984	20.44	46.64	18.08	33.50	12.15	32.22	12.96	0.00
BOLEV	1985	8.27	54.65	18.15	31.33	12.15	37.45	18.07	0.00
BOLEV	1986	16.94	52.08	17.07	22.92	11.28	32.13	24.03	0.00
BOLEV	1987	8.82	60.32	16.98	30.61	8.74	33.08	25.68	0.00
BOLEV	1988	19.82	41.75	16.31	21.29	7.85	31.41	24.09	0.00
BOLEV	1989	10.44	55.68	15.98	28.05	4.74	31.05	27.10	0.00

BOLEV	1990	14.99	45.78	15.61	28.61	8.11	33.41	28.00	0.00
BOLEV	1991	17.02	54.72	15.86	28.37	9.86	29.72	28.33	0.00
BOLEV	1992	16.69	36.37	15.14	29.64	15.55	28.02	32.70	0.00
BOLEV	1993	20.94	41.01	14.89	26.98	15.30	28.08	33.44	0.00
BOLEV	1994	13.28	46.43	15.72	28.91	10.78	28.68	33.03	0.00
BOLEV	1995	19.42	36.54	16.00	27.09	9.76	26.02	31.95	0.00
BOLEV	1996	-6.08	43.45	14.78	26.51	9.64	28.50	34.48	0.00
BOLEV	1998	22.99	54.10	14.09	36.26	6.49	32.06	33.78	1.28
BOLEV	2000	28.04	46.16	14.66	39.58	6.43	28.90	50.69	1.31
BOLEV	2001	9.51	54.39	14.05	34.00	3.64	27.77	56.68	1.41
BOLEV	2002	22.48	58.87	13.93	35.38	4.92	28.76	65.77	1.44
OLEV	1972	32.48	32.08	14.22	25.07	1.74	31.85	0.00	0.00
OLEV	1973	35.40	30.16	14.71	27.66	1.17	34.95	0.00	0.00
OLEV	1974	33.73	38.16	16.61	23.09	1.07	32.06	0.00	0.00
OLEV	1975	25.83	36.99	19.46	24.02	2.50	33.79	0.00	0.00
OLEV	1976	33.35	34.66	20.36	23.40	1.96	34.78	1.73	0.00
OLEV	1977	22.18	33.23	19.39	27.69	2.95	30.75	3.47	0.00
OLEV	1978	19.28	35.47	26.73	28.60	3.38	35.09	5.20	0.00
OLEV	1979	27.12	35.63	17.85	22.49	1.72	33.06	6.93	0.00
OLEV	1980	28.57	37.83	17.84	28.47	4.66	32.83	8.67	0.00
OLEV	1981	27.77	43.96	18.37	33.22	7.38	33.80	10.40	0.00
OLEV	1982	28.70	42.04	18.48	28.92	8.58	33.64	12.13	0.00
OLEV	1983	40.93	34.01	18.84	27.49	10.54	32.65	13.87	0.00
OLEV	1984	39.00	38.34	19.00	26.13	8.30	30.30	15.60	0.00
OLEV	1985	29.62	44.15	18.65	26.20	8.59	30.52	24.39	0.00
OLEV	1986	34.58	42.90	18.49	20.29	8.31	27.35	32.02	0.00
OLEV	1987	22.58	45.92	17.56	25.83	7.05	31.19	29.98	0.00
OLEV	1988	18.22	38.11	16.37	23.17	6.17	29.26	31.89	0.00
OLEV	1989	19.04	50.50	16.35	26.54	4.96	29.29	34.81	0.00
OLEV	1990	39.50	43.93	16.65	24.79	6.34	28.02	35.08	0.00
OLEV	1991	27.44	40.94	16.98	26.86	8.89	30.70	35.63	0.00
OLEV	1992	23.27	39.96	16.06	27.17	11.61	28.39	38.61	0.00
OLEV	1993	28.92	45.25	16.19	25.17	12.67	29.76	35.17	0.00
OLEV	1994	25.71	50.28	16.87	22.89	10.17	24.55	36.19	0.00
OLEV	1995	15.41	54.71	16.93	25.28	10.63	29.41	37.69	0.00
OLEV	1996	23.54	69.07	15.60	23.75	8.93	26.01	38.86	0.00
OLEV	1998	29.63	59.82	15.08	34.11	5.72	27.33	45.00	1.28
OLEV	2000	47.29	63.05	15.38	32.53	4.60	25.91	60.97	1.31
OLEV	2001	21.32	53.95	14.67	34.26	4.15	25.36	64.75	1.41
OLEV	2002	25.06	45.28	14.19	35.64	4.56	23.45	71.31	1.44
ALEV	1972	37.93	29.74	13.78	23.33	3.57	33.29	0.00	0.00
ALEV	1973	45.93	14.95	14.65	25.29	1.03	38.40	0.00	0.00
ALEV	1974	37.05	25.87	16.53	21.69	1.54	37.56	0.00	0.00
ALEV	1975	31.54	25.00	19.23	23.49	1.61	35.28	0.00	0.00
ALEV	1976	36.78	35.83	20.03	22.14	2.57	34.72	2.13	0.00
ALEV	1977	35.07	28.71	19.01	24.88	1.67	35.83	4.26	0.00
ALEV	1978	27.54	26.88	26.78	23.83	1.75	36.40	6.39	0.00
ALEV	1979	33.59	33.12	17.63	23.19	3.15	36.64	8.51	0.00
ALEV	1980	28.22	60.31	17.89	25.19	2.90	32.06	10.64	0.00
ALEV	1981	40.50	56.14	18.60	23.35	5.22	38.45	12.77	0.00
ALEV	1982	28.32	45.10	18.76	22.27	8.53	37.56	14.90	0.00
ALEV	1983	43.76	43.58	19.16	19.66	8.11	34.63	17.03	0.00
ALEV	1984	40.93	40.24	19.62	22.12	7.01	30.47	19.16	0.00
ALEV	1985	40.71	52.22	19.75	22.04	4.32	33.70	27.76	0.00
ALEV	1986	37.86	68.64	18.44	18.71	7.60	29.20	29.33	0.00

ALEV	1987	29.90	55.00	18.14	24.72	6.35	25.91	36.55	0.00
ALEV	1988	26.49	51.07	16.89	18.44	5.58	31.60	33.55	0.00
ALEV	1989	35.90	46.94	17.27	19.61	3.25	31.04	37.65	0.00
ALEV	1990	44.79	41.67	17.64	19.62	4.47	29.27	38.54	0.00
ALEV	1991	46.06	32.85	17.23	21.47	6.16	29.05	38.32	0.00
ALEV	1992	41.82	24.00	17.19	23.76	8.47	28.36	43.03	0.00
ALEV	1993	24.93	28.21	16.73	22.85	9.27	27.02	42.64	0.00
ALEV	1994	33.25	29.03	17.28	19.91	10.56	26.41	46.73	0.00
ALEV	1995	24.75	50.98	17.18	21.28	8.60	23.22	44.38	0.00
ALEV	1996	36.90	44.50	15.90	22.05	6.58	27.36	44.99	0.00
ALEV	1998	41.11	48.80	16.06	29.60	5.16	27.00	57.34	1.28
ALEV	2000	51.53	64.05	15.87	34.67	4.38	25.06	67.46	1.31
ALEV	2001	22.29	58.36	15.84	30.25	4.02	26.41	72.15	1.41
ALEV	2002	37.77	51.10	15.44	30.45	3.38	24.89	81.95	1.44
HIGHER	1972	57.97	46.53	15.23	18.47	0.41	27.15	0.00	0.00
HIGHER	1973	46.62	47.56	15.69	19.30	0.35	24.24	0.00	0.00
HIGHER	1974	41.76	62.22	17.85	17.81	0.74	28.80	0.00	0.00
HIGHER	1975	37.94	60.09	20.68	19.15	1.48	28.22	0.00	0.00
HIGHER	1976	46.79	56.80	21.72	19.38	1.15	30.75	2.53	0.00
HIGHER	1977	44.64	55.15	20.46	21.65	1.39	29.31	5.06	0.00
HIGHER	1978	40.01	55.41	27.48	20.78	1.28	30.06	7.58	0.00
HIGHER	1979	33.48	71.91	19.03	20.56	0.78	30.15	10.11	0.00
HIGHER	1980	38.66	69.27	19.34	14.95	1.46	32.23	12.64	0.00
HIGHER	1981	43.13	65.13	19.03	20.23	2.76	30.16	15.17	0.00
HIGHER	1982	41.27	70.70	19.14	20.13	4.10	34.79	17.70	0.00
HIGHER	1983	48.01	73.22	20.02	17.19	3.27	38.66	20.22	0.00
HIGHER	1984	43.97	74.33	20.74	14.68	3.13	33.37	22.75	0.00
HIGHER	1985	40.44	72.17	20.92	14.54	2.86	34.22	27.14	0.00
HIGHER	1986	40.84	73.35	19.99	17.22	3.28	33.53	34.37	0.00
HIGHER	1987	33.90	82.93	19.85	20.86	3.31	39.46	38.54	0.00
HIGHER	1988	41.24	79.09	18.10	16.42	3.53	32.46	38.55	0.00
HIGHER	1989	40.27	72.28	18.52	19.89	1.71	34.33	37.32	0.00
HIGHER	1990	44.42	75.09	19.19	14.69	1.75	33.19	39.81	0.00
HIGHER	1991	46.84	75.19	19.43	18.46	3.29	34.79	43.03	0.00
HIGHER	1992	38.73	70.78	18.59	19.12	5.32	31.20	43.50	0.00
HIGHER	1993	45.05	73.99	19.12	16.76	5.52	31.54	43.52	0.00
HIGHER	1994	29.15	70.51	20.20	15.74	6.66	31.73	48.12	0.00
HIGHER	1995	36.16	65.51	19.03	17.98	5.39	34.42	49.22	0.00
HIGHER	1996	31.05	61.96	17.98	19.27	5.33	31.08	50.95	0.00
HIGHER	1998	46.08	62.36	17.37	22.85	1.25	34.50	63.86	1.28
HIGHER	2000	58.76	59.77	17.84	26.39	3.62	31.42	70.54	1.31
HIGHER	2001	35.84	59.38	16.92	25.36	3.21	30.25	74.70	1.41
HIGHER	2002	40.75	63.57	16.22	35.22	2.60	27.83	84.76	1.44
DEGREE	1972	84.18	60.70	15.06	15.75	1.19	14.84	0.00	0.00
DEGREE	1973	72.55	61.78	15.58	16.46	0.81	20.29	0.00	0.00
DEGREE	1974	65.70	69.09	17.53	17.64	1.95	21.07	0.00	0.00
DEGREE	1975	67.89	63.67	20.64	14.96	0.46	23.17	0.00	0.00
DEGREE	1976	66.51	72.32	21.34	13.72	1.80	21.61	2.96	0.00
DEGREE	1977	63.52	69.64	20.26	15.57	1.54	20.42	5.92	0.00
DEGREE	1978	57.88	70.62	29.49	18.31	1.02	23.49	8.88	0.00
DEGREE	1979	56.05	69.65	18.95	16.89	1.20	23.35	11.83	0.00
DEGREE	1980	54.75	69.45	19.12	9.10	2.10	20.81	14.79	0.00
DEGREE	1981	60.82	77.10	20.22	9.48	3.04	25.01	17.75	0.00
DEGREE	1982	55.86	76.40	19.40	20.27	3.94	22.66	20.71	0.00
DEGREE	1983	71.64	74.14	21.36	11.97	2.44	21.09	23.67	0.00

DEGREE	1984	71.47	72.16	21.79	16.14	5.09	23.60	26.63	0.00
DEGREE	1985	52.94	72.44	21.52	19.45	2.40	26.92	28.52	0.00
DEGREE	1986	54.34	70.21	20.68	21.12	2.42	24.30	31.47	0.00
DEGREE	1987	56.33	65.48	21.06	15.31	3.41	28.19	39.67	0.00
DEGREE	1988	54.64	63.17	19.49	16.10	2.20	20.64	37.89	0.00
DEGREE	1989	54.48	64.66	19.59	13.81	3.35	20.31	40.90	0.00
DEGREE	1990	61.83	62.09	20.15	16.53	2.07	23.08	42.03	0.00
DEGREE	1991	66.98	53.34	19.54	15.56	5.25	21.46	44.41	0.00
DEGREE	1992	57.38	54.43	19.76	13.68	4.04	20.71	49.65	0.00
DEGREE	1993	47.12	56.09	20.01	13.88	5.51	18.82	53.34	0.00
DEGREE	1994	52.78	54.33	20.29	11.33	6.11	20.67	58.31	0.00
DEGREE	1995	55.90	60.43	21.04	10.70	4.03	17.78	59.70	0.00
DEGREE	1996	49.37	67.69	19.26	9.90	2.01	19.78	64.28	0.00
DEGREE	1998	68.69	60.77	18.62	19.89	2.84	21.32	73.04	1.28
DEGREE	2000	72.45	63.02	19.24	17.66	2.14	17.83	83.15	1.31
DEGREE	2001	59.13	63.05	18.57	18.40	2.54	19.06	84.95	1.41
DEGREE	2002	65.47	60.72	18.05	17.26	2.32	17.15	89.61	1.44

APPENDIX 4.3
The family and working lives survey (FWLS 1994/1995)

This Appendix provides technique notes on how to extract data from the FWLS. The FWLS is a life and work history data, which provide representative information about people living in Britain. The dataset was collected in the period 1994/1995 and the final sample consists of information for 11,237 respondents. The focus of the survey is not only on current living conditions, but also a broad variety of *retrospective* questions about the family and working lives of the respondents. In this way, the survey tries to get information about the basic event history of the family and working lives beginning with the 16th birthday of the respondents. Hence, the FWLS provides time series information on socio-economic characteristics of persons and households; training and education including on and off the job; detail on current job and key past events in particular union membership; spells of unemployment and details of benefits claims since the 1970s.

The focus here is on preparing the raw data for cross-sectional and longitudinal analyses with the computer program TDA (Transition Data Analysis), in which the FWLS is stored. The FWLS in TDA is a highly compressed data archive that has been designed for statistical analyses with cross-sectional and longitudinal data. The currently available FWLS raw data are contained in one big ASCII data of 1,551,086 records for 11,237 respondents, in which 1,179,885 records are cross-sectional. Thus, we have 105 cross-sectional records and average about 33 longitudinal records for each respondent (Rohwer 1996, p1-7).

The FWLS has a large sample of individuals, for which employment history can be constructed (also see a summary in Disney et al 1998). We concentrate on trade union density by skill level. Since the FWLS can provide retrospective individual data on employment history and trade union membership as well as workers' characteristics (gender, age and education), we are permitted to build an event history data of union membership over a long time period. Hence, we construct about 48,814 separate employment spells of 11,192 workers since 1970, in which 5,033 workers have ever had union membership.

Firstly, we extract workers' characteristics variables from the cross-sectional data file in the FWLS. We have information about personal identification (PID), record type (RTYPE, cross-sectional records 1-45, 52-54 and 74-130=1, event history records 63-73 =2), interview year (INTY), year of birth (1924 to 1978, S1AY) and sex (S2B_1). We use the year of birth plus 16 to represent the starting year of respondent in the FWLS (SYEAR). Thus, we have enough information to build a cross-sectional dataset.

Secondly, we extract trade union membership variable for the event history data file in the FWLS. We have information about personal identification (RJID), original state (RJORG), destination state (RJDES), starting and ending year of event (RJTSY1 and RJTFY1), trade union membership (RJTUMEM), full/part time status (RJWTIME), labour contract type (RJEMPLT), firm-size of workplace (RJFSIZE), occupation (RJSOC) and industry (RJSIC). We merge this even history dataset with above cross-sectional by personal identification. Thus, we build the event history dataset with worker's characteristics.

Thirdly, we categorize respondent's highest educational/training qualifications in the FWLS. In order to simplify the complicated structure of British qualifications, all qualifications earned by the respondent are categorized into six groups: NOQUAL, BOLEV, OLEV, ALEV, HIGHER and DEGREE as in the GHS analysis. The complete list and brief description of education variables are the same as in the Table 2.1.

The FWLS provides accurate information about 53 kinds of education and trainings qualifications. However, questions about qualifications are a multiple choice way in the FWLS. Respondents can at most provide 6 kinds of qualifications they have. Hence, there are about 318 dummies (=6×53) about qualifications in the FWLS: T22_1_01 ~ T22_1_53, T22_2_01 ~ T22_2_53, T22_3_01 ~ T22_3_53, T35_1_01 ~ T35_1_53, T35_2_01 ~ T35_2_53 and T35_3_01 ~ T35_3_53. In addition, the highest qualification may be in any one of these variables. Thus, I recode these 318 dummy variables into 36 dummies (=6×6) by categorizing 53 qualifications into 6 groups.

Next, I give different value to each group: NOQUAL (0), BOLEV (8), OLEV (10), ALEV (11), HIGHER (14) and DEGREE (15). All qualifications of each respondent are compared to find the maximum value. Thus, we build the education dataset (3highestedu.dat) for respondent's highest qualification. Finally, we merge the education dataset with the trade union dataset to build the dataset for further analysis.

We put some examples in the event history dataset in Table A4.3. In Table A4.3, the event history data of employment and trade union membership are presented for the first thirteen workers in the FWLS. The first column of *pid* is the individual personal identifier; *sex* is gender set as 1 for males and 2 for females; *biryear* is the birth year of individual; *tu* is trade union membership dummy set 1 for yes; *tucn* is counting times of trade union membership; *syear* is the starting year of the event; *fyear* is the finishing year of the event; *ind* is the 4 digit Standard Industrial Classification 92 (SIC 92) of worker's main job; and *yrsed* is the highest educational qualifications: 0 for the NOQUAL group, 8 for the BOLEV group, 10 for the OLEV group, 11 for the ALEV group, 14 for the HIGHER group and 15 for the DEGREE group (see definitions in Table 2.1).

The basic information about employment and trade union membership can be extracted from Table A4.3. For example, the first individual (pid: 10011) is a male born in 1968, who has not any educational qualification (yrsed=0) and took his first job in 1987. The individual worked for a firm of reproduction of sound recording (ind =2231) for one year before he moved to a firm of manufacture of grain mill (ind =1561) for another year in 1988. In 1989, he was a worker of processing of fruit and vegetable (ind =1533). Then, he lost his job for 4 years until he found a job in the public sector (the NHS) as a health and social worker (ind =8511) in 1993. In the same year, he joined a trade union which lasts to the survey year 1995.

Following the same line, we can describe the history of employment and union membership for other individuals. It is worth mentioning that workers possibly move from one union to another union, which will be counted by the variable *tucn*. It may happen as the worker moves between jobs. For example, a male worker (pid=40541) was born in 1967, who has not any educational qualification (yrsed=0) and took his first job as a general (overall) public service worker (ind =7511) in 1987. In the same

year, he joined a trade union in the public service. However, he lost his job for 7 years until he found a job in radio and television activity (ind=9220) in 1994. Then, he joined in another union (tucn=2). Another case is a male worker (pid=50591) born in 1946 with A-level qualification. He joined the first trade union at age of 20 and has changed job/union five times between 1969 and 1992 in telecommunications industry (ind=6420). In 1992, he was unemployed first time in his employment history.

Consequently, using the event history data in the Table A4.3, we calculate the numbers of employee and trade union member by gender, education and experience (see details of definition in Chapter 2) in the private and public sector. For simplicity, Table A4.4 only presents results of the private sector. For example, there are about 198 male workers without any qualification, with experience less than 5 years in 1972 (e72), 69 of which had trade union membership (tu72). The union density for this cell is about 34.8 percent (=69/198).

Using information in Table A4.4, the aggregated trade union density can be calculated. As can be seen, there are many missing values in the part of females, especially for the skilled female workers in the 1970s. Hence, we only concentrate on males in Chapter 4. Union densities of male workers by skill are presented in Figure 4.5 and 4.6, as well as in Table A4.1 and Table A4.2.

Table A4.3: The event history dataset of trade union membership, the FWLS 94/95

pid	sex	biryear	tu	tucn	syear	fyear	ind	yrsed
10011	1	68	0	0	87	87	2231	0
10011	1	68	0	0	88	88	1561	0
10011	1	68	0	0	89	89	1533	0
10011	1	68	1	1	93	95	8511	0
10101	2	72	0	0	90	90	7420	0
10101	2	72	0	0	91	91	9261	0
10101	2	72	0	0	94	95	7482	0
10541	2	66	0	0	83	84	9500	14
10541	2	66	0	0	84	84	8010	14
10541	2	66	0	0	85	95	8010	14
10631	2	29	0	0	47	59	7411	0
10631	2	29	0	0	60	64	9132	0
10631	2	29	0	0	64	65	4521	0
10631	2	29	0	0	75	85	7413	0
10681	2	69	0	0	87	88	2215	0
10941	1	72	0	0	94	95	5164	14
20381	2	46	0	0	65	67	9231	8
20381	2	46	0	0	67	68	9231	8
20381	2	46	0	0	82	92	6512	8
20381	2	46	0	0	92	95	7450	8
40211	2	61	0	0	78	80	5231	0
40211	2	61	0	0	80	81	5231	0
40211	2	61	0	0	81	82	5231	0
40211	2	61	0	0	82	84	5242	0
40211	2	61	0	0	84	87	5231	0
40281	1	51	0	0	68	82	2222	0
40281	1	51	1	1	84	95	8030	0
40541	1	67	1	1	87	87	7511	0
40541	1	67	1	2	94	94	9220	0
41421	1	49	0	0	75	79	7511	0
41421	1	49	0	0	79	82	5530	0
50591	1	46	0	0	63	63	7530	11
50591	1	46	0	0	63	65	6720	11
50591	1	46	0	0	65	66	5020	11
50591	1	46	0	0	66	66	5020	11
50591	1	46	1	1	66	69	6420	11
50591	1	46	1	2	69	80	6420	11
50591	1	46	1	3	80	80	6420	11
50591	1	46	1	4	80	85	6420	11
50591	1	46	1	5	85	92	6420	11
51891	2	30	0	0	44	48	5246	0
51891	2	30	0	0	48	51	5212	0
51891	2	30	0	0	57	59	1584	0
51891	2	30	0	0	71	79	2222	0
…	…	…	..	…	…	…	…	…

Notes: All figures in this table are from the cross-sectional and longitudinal data in the FWLS 1994/1995.

Table A4.4: Numbers of employees and trade union members by skill in the private sector, the FWLS 94/95

Gender	Edu	Exp	tu72	e72	tu73	e73	tu74	e74	…	tu94	e94
Male	**NOQUAL**	**5**	69	198	62	196	77	234	…	14	222
Male	**NOQUAL**	**10**	71	186	73	190	82	175	…	46	192
Male	**NOQUAL**	**15**	89	170	87	173	78	178	…	53	223
Male	**NOQUAL**	**20**	105	193	112	203	99	191	…	63	204
Male	**NOQUAL**	**25**	96	175	96	177	98	172	…	41	150
Male	**NOQUAL**	**30**	118	213	113	199	117	206	…	48	133
Male	**NOQUAL**	**35**	21	42	45	85	67	125	…	41	105
Male	**NOQUAL**	**40**	-	-	-	-	-	-	…	31	89
Male	**BOLEV**	**5**	27	51	20	46	17	45	…	1	25
Male	**BOLEV**	**10**	22	29	21	31	30	43	…	12	42
Male	**BOLEV**	**15**	7	20	11	22	14	24	…	7	26
Male	**BOLEV**	**20**	5	10	6	10	6	13	…	14	32
Male	**BOLEV**	**25**	13	15	12	15	9	12	…	10	24
Male	**BOLEV**	**30**	6	12	6	9	7	9	…	13	23
Male	**BOLEV**	**35**	2	2	1	3	3	6	…	10	19
Male	**BOLEV**	**40**	-	-	-	-	-	-	…	5	10
Male	**OLEV**	**5**	34	62	40	73	47	88	…	4	21
Male	**OLEV**	**10**	32	58	44	76	38	69	…	14	43
Male	**OLEV**	**15**	36	70	29	60	33	74	…	23	56
Male	**OLEV**	**20**	40	60	47	66	40	60	…	29	69
Male	**OLEV**	**25**	33	65	35	62	49	71	…	35	67
Male	**OLEV**	**30**	42	63	48	75	45	71	…	21	45
Male	**OLEV**	**35**	11	13	15	19	20	28	…	13	36
Male	**OLEV**	**40**	-	-	-	-	-	-	…	17	34
Male	**ALEV**	**5**	8	11	10	14	12	19	…	0	5
Male	**ALEV**	**10**	4	6	4	10	5	6	…	6	16
Male	**ALEV**	**15**	12	17	10	17	11	17	…	7	18
Male	**ALEV**	**20**	3	5	5	6	4	5	…	9	24
Male	**ALEV**	**25**	1	1	1	2	3	4	…	4	11
Male	**ALEV**	**30**	1	2	2	3	1	2	…	3	8
Male	**ALEV**	**35**	-	-	-	-	-	-	…	6	10
Male	**ALEV**	**40**	-	-	-	-	-	-	…	2	3
Male	**HIGHER**	**5**	22	46	24	44	25	43	…	0	5
Male	**HIGHER**	**10**	9	15	9	21	9	20	…	4	13
Male	**HIGHER**	**15**	5	8	7	12	6	8	…	8	27
Male	**HIGHER**	**20**	6	17	3	9	4	8	…	8	17
Male	**HIGHER**	**25**	4	9	8	17	9	15	…	9	25
Male	**HIGHER**	**30**	1	3	1	5	2	5	…	2	14
Male	**HIGHER**	**35**	-	-	-	-	-	-	…	4	8
Male	**HIGHER**	**40**	-	-	-	-	-	-	…	1	5
Male	**DEGREE**	**5**	22	51	19	46	25	55	…	2	21
Male	**DEGREE**	**10**	12	27	14	28	13	32	…	8	29
Male	**DEGREE**	**15**	10	17	12	18	14	19	…	11	44
Male	**DEGREE**	**20**	12	23	9	21	8	24	…	7	29
Male	**DEGREE**	**25**	6	18	10	21	10	21	…	11	27
Male	**DEGREE**	**30**	3	9	3	12	4	13	…	9	24
Male	**DEGREE**	**35**	-	-	-	-	-	-	…	8	14
Male	**DEGREE**	**40**	-	-	-	-	-	-	…	0	9
Female	**NOQUAL**	**5**	62	195	72	228	87	270	…	10	207

Female	**NOQUAL**	**10**	49	184	38	169	38	156	…	36	222
Female	**NOQUAL**	**15**	33	134	45	140	42	159	…	40	219
Female	**NOQUAL**	**20**	26	110	36	117	41	138	…	50	219
Female	**NOQUAL**	**25**	40	137	39	138	35	122	…	29	148
Female	**NOQUAL**	**30**	53	156	54	157	58	173	…	27	119
Female	**NOQUAL**	**35**	8	33	18	56	32	96	…	27	119
Female	**NOQUAL**	**40**	-	-	-	-	-	-	…	22	84
Female	**BOLEV**	**5**	14	55	15	49	19	69	…	0	24
Female	**BOLEV**	**10**	11	28	10	28	9	25	…	15	45
Female	**BOLEV**	**15**	3	19	5	19	4	17	…	9	48
Female	**BOLEV**	**20**	4	17	9	23	9	22	…	10	40
Female	**BOLEV**	**25**	7	14	7	14	10	18	…	8	31
Female	**BOLEV**	**30**	2	12	1	7	1	12	…	0	16
Female	**BOLEV**	**35**	1	1	2	8	2	8	…	2	17
Female	**BOLEV**	**40**	-	-	-	-	-	-	…	4	13
Female	**OLEV**	**5**	4	26	4	23	11	33	…	1	12
Female	**OLEV**	**10**	7	20	9	30	10	25	…	1	14
Female	**OLEV**	**15**	3	15	3	15	4	15	…	4	14
Female	**OLEV**	**20**	6	15	5	14	6	16	…	3	11
Female	**OLEV**	**25**	2	5	4	8	4	11	…	2	16
Female	**OLEV**	**30**	6	8	4	6	3	4	…	8	16
Female	**OLEV**	**35**	2	4	3	5	3	6	…	1	10
Female	**OLEV**	**40**							…	4	12
Female	**ALEV**	**5**	2	8	3	6	3	10	…	0	4
Female	**ALEV**	**10**	0	1			0	1	…	4	19
Female	**ALEV**	**15**	3	5	1	1	1	1	…	3	11
Female	**ALEV**	**20**	-	-	0	1	0	1	…	1	6
Female	**ALEV**	**25**	-	-	-	-	-	-	…	1	5
Female	**ALEV**	**30**	-	-	-	-	-	-	…	0	1
Female	**ALEV**	**35**	-	-	-	-	-	-	…	1	2
Female	**ALEV**	**40**	-	-	-	-	-	-	…	0	1
Female	**HIGHER**	**5**	6	18	6	26	6	27	…	0	9
Female	**HIGHER**	**10**	1	4	1	5	1	10	…	1	10
Female	**HIGHER**	**15**	0	7	1	8	2	8	…	3	13
Female	**HIGHER**	**20**	0	5	1	8	2	8	…	0	13
Female	**HIGHER**	**25**	4	7	3	6	2	5	…	1	9
Female	**HIGHER**	**30**	-	-	1	2	2	5	…	1	4
Female	**HIGHER**	**35**	-	-	-	-	-	-	…	2	6
Female	**HIGHER**	**40**	-	-	-	-	-	-	…	0	1
Female	**DEGREE**	**5**	9	20	9	23	10	28	…	0	9
Female	**DEGREE**	**10**	0	6	0	8	1	8	…	4	27
Female	**DEGREE**	**15**	0	3	0	1	0	2	…	3	12
Female	**DEGREE**	**20**	1	4	1	3	0	3	…	1	10
Female	**DEGREE**	**25**	-	-	-	-	1	2	…	5	9
Female	**DEGREE**	**30**	-	-	-	-	-	-	…	2	7
Female	**DEGREE**	**35**	-	-	-	-	-	-	…	0	3
Female	**DEGREE**	**40**	-	-	-	-	-	-	…	1	2

Notes: *tu* represents the total numbers of employees who are trade union members; *e* represents the total numbers of employees. All figures in this table are from the cross-sectional and longitudinal data in the FWLS 1994/1995.

CHAPTER FIVE:
REAL WAGE CYCLICALITY IN ITALY

5.1 Introduction

In previous chapters, we described and analyzed the changes of earnings inequality over the last thirty years using a supply-demand-institution framework. We find that the decline of trade union in unskilled workers accounts about half of the degree premiums increase in the private sector. This result implies that institutions are very important to the evolution of earnings inequality in the UK.

Moreover, many European countries such as Italy, Germany and Sweden have some form of centralized wage setting and had little increase in earnings inequality since the late 1970s (see Erickson and Ichino 1995 for Italy, Abraham and Houseman 1995 for Germany, and Edin and Holmlund 1995 for Sweden). The Krugman hypothesis states that the rise in wage inequality in the Anglo-Saxon countries and the rise in unemployment in continental Europe reflect a fall in the relative demand for unskilled workers under different wage setting institutions (see Krugman 1994, p28 39, Nickell and Bell 1996, p302 and Puhani 2003, p1). Thus, wage setting institutions play a key role in the changes of earnings inequality. Changes in the labour market institutions such as the decline of trade unions presumably affect the wage responses to the business cycle.

As Machin (1996, p57) notes, the usual approach to analyze earnings inequality begins by considering a standard supply-demand framework, and then generalizes further by considering labour-market institutions and the role of unemployment. In Chapter 5 and 6, we will analyze the real wage adjustment over the business cycle, i.e. wage cyclicality under different wage setting institutions in three

countries: Italy, Germany and the UK. As trade unions declined after 1979 in the UK, wages were set at the company or individual level, compared with the centralised collective agreements in Italy and Germany. In fact, highly centralised and coordinated wage setting institutions may be associated with rigid wages, which are insensitive to changes in market conditions such as unemployment.

In this chapter, we aim to analyze the real wage adjustment over the business cycle using panel micro data for Italy 1994-2001, which have recently become available from the European Community Household Panel. Italy has a regulated economy which forms an interesting contrast to the more flexible economies of the US and the UK which have been extensively studied (starting with Bils 1985 for the US; see also Devereux and Hart 2006 for the UK). The Italian labour market has been performing badly, with only about 55% of Italians in the 15-64 age range in employment during the 1990s, compared to over 70% in the UK and US (OECD, 2004). The 2001 Italian White Paper on reform of the labour market (EIRO, 2001) sees a "local" wage policy, with "more space for decentralised bargaining", as part of the cure. Put simply, it may be that nationally bargained wages cannot adjust downwards enough in response to adverse shocks to avoid job losses (see also Ochel, 2005, for a similar argument for Germany). In this study, we aim to give a factual basis to the debate, making comparisons with the well-developed research results for the UK and the US. In the next chapter, we make a further analysis of the UK and Germany.

In fact, Italy's wage-setting institutions have a dual nature. On the one hand, the Constitution makes collective agreements generally binding (OECD, 2004, p149), and the courts use minimum wages from sectoral agreements to determine whether

wages conform to constitutional requirements. Also, studies by Ammermueller et al (2007) and Devicienti et al (2006) note the importance of industry agreements, and the limited role of local bargaining. Indeed, Limosani's (2004) recent model of Italian unemployment simply assumes no regional differentiation in wages. On the other hand, the debate on bargaining reform (EIRO, 2004) reveals nearly 300 sectoral wage agreements registered with the National Statistical Institute, which indicates flexibility. Certainly, firm-specific agreements are important for large private sector firms as the work of Guiso et al (2005) shows. Moreover, it is possible that the 1993 bargaining reforms (Devicienti et al, 2006; Eurofound, 2004) made industry wage-setting more flexible by stressing local top-up components and abolishing wage indexation. On balance, however, Italy's wage-setting institutions have been characterised as distinctly coordinated and centralised (OECD, 2004, Table 3.5). An indication of this centralisation is Italy's relatively high, over 80%, collective bargaining coverage. Whether, in fact, there is effective central power is something our regressions will test.

We will distinguish between the Italy's North and South[49]. Many authors have remarked on the differences between the regions, and Ammermueller et al (2007, p9) even talk of "progressive polarisation". For example, the public-private wage differential has been estimated (Dell'Aringa et al, 2005, p31) as two to five times higher in the South than the North. Also, there is much higher unemployment in the South, which gives prima facie grounds to expect labour markets to be working worse in the South. In fact, Devicienti et al (2006) note that the top-up components in

[49] The ECHP provides information for 11 regions. We categorise the Nord Ovest (Piemonte, Valle D'Aosta and Liguria), Nord Est (Trentino-Alto Adige, Veneto and Friuli-Venezia Giulia), Lombardia and Emilia-Romagna as the North. Centro (1) (Toscana, Umbria and Marche), Lazio, Abruzzo-Molise, Campania, Sud (Puglia, Basilicata and Calabria), Sicilia and Sardegna are defined as the Centre-South. This division gives about 40% of the sample classified as the Centre-North (see Table 5.1).

national agreements are less likely to be used in southern regions. Hence we would expect less real wage procyclicality in the South.

Our approach offers two advances. First, we use data on real wage movements from a panel of individuals, the European Community Household Panel (ECHP) rather than aggregate data. Using aggregate data, most studies of real wage behaviour (e.g., Blanchard and Fischer, 1989) have concluded that real wages are at best weakly procyclical. However, aggregate data ignore the fact that, over the cycle, more unskilled workers become employed in expansion and pull the aggregate average wage downwards. The converse occurs in recession. Thus, an aggregate wage series is counter-cyclically biased. Our panel method avoids this bias which is strong, as we show below.

Second, following Devereux and Hart (2006), we make a threefold distinction between job stayers (remaining in the same job over the year), internal movers (i.e., within-company movers), and external movers (between-company). Each of these three groups is likely to have a different wage reaction to business cycle conditions. As regards the broad distinction between movers and stayers, research has found that real wages are more procyclical for those who change companies, than for those who do not (Bils 1985 and Shin 1994 for the US, Hart 2006 and Devereux and Hart 2006 for the UK). Beaudry and DiNardo's (1991) implicit contracting model can explain this result. Risk-averse employees may be shielded from productivity shocks, implying smoother wage adjustments for job stayers. In contrast, workers who are forced to change jobs have no access to insurance, and their new wage rates are likely

to be more dependent on spot market conditions, leading to higher fluctuations in wages.[50]

As for wage movements within the company, Reder's (1955) theory of promotion/demotion along a firm's internal job ladders shows that wages can change for internal movers even while job stayers' wages – set perhaps by collective agreement – are unresponsive to the cycle. In fact, for the UK, Devereux and Hart (2006) find that wages for job stayers are quite flexible, so that internal job moves play a minor role in wage cyclicality. Nickell and Quintini's (2003) also find that around 20% of job stayers experienced nominal wage cuts annually during the 1990s, pointing to high UK wage flexibility. However, the Italian results might be different, given the greater importance of collective agreements. Our threefold distinction is potentially important therefore.

The remainder of this paper is organised as follows. In section 2, we present our estimation methodology, and in Section 3, we describe the data. Section 4 examines the basic predictions of theoretical models by region and compares our results with other findings. We also test the robustness of our results by firm size and public-private sector. The final section concludes.

[50]Using the PSID and CPS, Beaudry and DiNardo (1991) find empirical evidence to support their model. Grant (2003) also finds support for Beaudry and DiNardo (1991) using the NLS. Barlevy (2001) provides an alternative hypothesis that the strong wage procyclicality of job changers is due to compensating wage differentials. Workers who voluntarily switch jobs in booms enter temporary jobs with unemployment risk and receive compensating higher wages in the new jobs.

5.2 Estimation

The standard decomposition of wage growth (Solon et al, 1997, and Devereux and Hart, 2006), distinguishing between job-stayers and internal and external movers is:

$$\begin{aligned} E(\Delta \ln W) &= (1 - P_W - P_B)\, E(\Delta \ln W_S) + P_W\, E(\Delta \ln W_W) + P_B\, E(\Delta \ln W_B) \\ &= E(\Delta \ln W_S) + P_W\, E(\Delta \ln W_W - \Delta \ln W_S) + P_B\, E(\Delta \ln W_B - \Delta \ln W_S) \end{aligned} \tag{5.1}$$

where P_W and P_B denotes the proportion of workers changing jobs within and between companies, and $E(\Delta \ln W_S)$, $E(\Delta \ln W_W)$, and $E(\Delta \ln W_B)$ is the expected wage growth of job stayers (S), internal movers (W) and external movers (B).

Differentiating equation (5.1) with respect to the change in the unemployment rate, Δu, which is the commonly used cyclical indicator, provides a decomposition of total wage cyclicality:

$$\begin{aligned} \partial E(\Delta \ln W)/\partial(\Delta u) = {} & \partial E(\Delta \ln W_S)/\partial(\Delta u) \\ & + P_W\, [\partial E(\Delta \ln W_W - \Delta \ln W_S)/\partial(\Delta u)] \\ & + P_B\, [\partial E(\Delta \ln W_B - \Delta \ln W_S)/\partial(\Delta u)] \\ & + \partial P_W/\partial(\Delta u)\, [E(\Delta \ln W_W - \Delta \ln W_S)] \\ & + \partial P_B/\partial(\Delta u)\, [E(\Delta \ln W_B - \Delta \ln W_S)] \end{aligned} \tag{5.2}$$

The first term is the wage response of job stayers; the second term defines the incremental effect of wage cyclicality on internal movers relative to stayers, and the third term defines the incremental effect of wage cyclicality on external movers relative to stayers. The last two terms represent the cyclicality of the probability of internal and external job changes. Since the last two terms are small, we concentrate on the wage responses.

Our empirical work uses the now-standard two-step estimation procedure (beginning with Solon et al 1994). The two-step procedure is designed to get round the Moulton (1986) problem of explaining earnings based on individual data with

unemployment based on aggregate data.[51] In step 1, we use all our individual panel observations to estimate the wage change equation for an individual i at time t. This equation is given by:

$$\Delta \ln w_{it} = \alpha_0 + \alpha_1 Age_{it} + \alpha_2 Ten_{it} + \sum_{t=1}^{T} s_t D_t + \sum_{t=1}^{T} w_t M_{Wit} D_t + \sum_{t=1}^{T} b_t M_{Bit} D_t + \varepsilon_{it} \qquad (5.3)$$

where w_{it} is the real hourly wage rate, Age_{it} is a cubic in age, Ten_{it} is a cubic in job tenure, D_t denotes a year dummy, and ε_{it} is a random error term. M_{Wit} denotes a dummy variable for internal movers, and M_{Bit} is a dummy variable for external movers. Here we control for changes in worker age as a proxy for experience, and for changes in tenure which might be correlated with unobservables such as motivation. Then the sequences of estimated time dummies trace out controlled real wage changes for stayers ($\hat{s}_t$), and internal ($\hat{w}_t$) and external ($\hat{b}_t$) job movers.

Two approaches are possible in step 2. The conventional approach is to use only time series variation. An alternative is to use both time and regional variation, which we also report. In the conventional approach, the three sets of dummy variable estimates $\hat{s}_t$, $\hat{w}_t$, and $\hat{b}_t$, are regressed on the change in the current year's unemployment rate (Δu_t), which picks up labour market disequilibrium, thus:

$$\begin{aligned} \hat{s}_t &= a_0 + a_1 \Delta u_t + a_2 Year_t + v_t^s \qquad (5.4a) \\ \hat{w}_t &= b_0 + b_1 \Delta u_t + b_2 Year_t + v_t^w \\ \hat{b}_t &= c_0 + c_1 \Delta u_t + c_2 Year_t + v_t^b \ . \end{aligned}$$

[51] Moulton (1986) shows that individuals in the same year/area will share some common component of variance that is not entirely attributable either to their measured characteristics (e.g., gender and age) or to the aggregate unemployment rate in the year/area. In this case, the error component in OLS regression will be positively correlated across people in the same year/area, causing the estimated standard error of the unemployment effect to be downward biased. A similar two-stage procedure is used in the wage curve literature (Nijkamp and Poot 2005, p434).

In these equations we also include a time trend (*Year*). Since the aim of the chapter is to examine cyclical variability, long-run changes both in real wages and in unemployment need to be swept out by the time trend variable. Equations (5.4a) link directly to the decomposition of wage cyclicality in equation (5.2). Using $\hat{s}_t$ in equation (5.4a), the estimated value of a_1 gives the cyclical wage response of job stayers. Using $\hat{w}_t$ and $\hat{b}_t$ we obtain estimates of b_1 and c_1, that is, the incremental wage effects of within- and between-company movers relative to stayers.

Our time series analysis covers almost the full business cycle that began in Italy in 1992. As is conventional in the estimation of these two-step models, we use weighted least squares where the weights are the numbers of individuals observed in a given year. While the time series is short, only 7 years, short time series are often found in panel data analyses (for example, Shin, 1994). We also use a region-time model with more data points (see below).

In Italy's case, with marked divergence between North and South, the appropriate indicator of market disequilibrium would be the regional rather than the national unemployment rate. Hence, the regional unemployment rate is our first choice. On the other hand, wage negotiators at central level may have in mind the national unemployment rate, and we accordingly report results for this measure as well. Moreover, it is even possible that national negotiations operate perversely, giving rise to a sort of pattern bargaining in which market conditions in the prosperous North determine wage movements in the South. In this case, Southern wage movements will be determined better by Northern than Southern unemployment conditions, and we will also test for this possibility.

An alternative approach is to use both regional and time variation. Here, we maintain the division between North and Centre-South, so as to give comparability with the time-series analysis. Hence we form two panels, that for the North's four regions having 28 region-year observations, and that for the Centre-South's seven regions having 49 observations. For the North, the step 2 equations then become:

$$\begin{aligned} \hat{s}_{jt} &= A_j + a_1 \Delta u_{jt} + a_2 Y_t + v^s_{jt} \\ \hat{w}_{jt} &= B_j + b_1 \Delta u_{jt} + b_2 Y_t + v^b_{jt} \\ \hat{b}_{jt} &= C_j + c_1 \Delta u_{jt} + c_2 Y_t + v^w_{jt} \end{aligned} \tag{5.4b}$$

where j = 1, 2,..., 4 regions. In this specification, we allow fixed effects for each region (A_j, B_j, C_j), but restrict the coefficients on ΔU and Y_t to be the same across regions within the North. In this specification, with more observations available, we introduce time dummies Y_t, to sweep out trend effects (such dummies being more flexible than the *Year* trend variable, which however gives very similar results).[52] We have a similar set of equations for the Centre-South where j = 1, 2,…,7, again restricting the coefficients on ΔU and Y_t to be the same across regions within the Centre-South. We therefore maintain our basic North vs. Centre-South distinction which gives comparability with the conventional analysis. In fact both approaches come to much the same conclusion, as we will see.

5.3 Data Description

Our main data source is the ECHP, which is a harmonised cross-national longitudinal survey focusing on household income and living conditions (Eurostat, 2007). The surveys in Italy were carried out as eight waves from 1994 to 2001. Approximately

[52] See this specification with region and time intercepts in Hart (2008, equation 12).

7,100 households were interviewed in the first wave. Households have an average attrition rate of about 9% a year. This attrition is partially compensated in the design by a yearly supplementary sample (average 5% a year), which keeps the net attrition rate to about 4% a year. Hence, for our last wave in 2001, about 5,600 households were interviewed. Compositional changes due to attrition appear slight. For example, there is a tendency for heads of household's average education to decrease. Such a decrease is to be expected as less advantaged households are more likely to leave the panel, but it is only 3%.

Our panel restrictions are as follows. First, we restrict the analysis to males as is common (see also Devereux 2001; Shin and Solon 2006). In any case, female participation in Italy is low, giving too small a sample for analysis of sub-groups. Second, we only include workers present in the panel for two adjacent years so as to be able to compute mover-stayer status. Thus our sample does not include any new entrants into work, for example from unemployment, since these have no wage or job information for the past year[53]. The average length of time for a worker in our panel is about 4 years. Our panel is therefore unbalanced, but we can also construct a smaller balanced panel, and will report results for comparison where appropriate.

We use two questions from the ECHP to distinguish between job stayers and movers: the starting year of the employee's job spell in the organization, and his movement in job status (supervisory, intermediate or non-supervisory etc.). We identify a job stayer as an employee who has no change in starting year or job status –

[53] In fact, 25% of our sample for the Centre-South region has experienced one or more unemployment spells, compared to only 10% of the Northern sample. However, a past unemployment spell can have little direct impact on wage movement due to the restriction that individuals must have two adjacent years in employment.

the large majority, 75%, of the sample in any year (Table 5.1). An internal mover is a worker who has no change in starting year, but has a change in job status. An external mover is simply identified as a worker who changes his starting year, that is, the starting year becomes the current year. This category is the smallest, about 7% (Table 5.1).

Our main dependent variable is the real hourly wage, which we compute as the ratio of annual gross labour income to annual hours of work. Gross annual earnings are composed of normal wages, 13th and 14th month salary, and extra payments for overtime, holiday pay, earnings from an additional job, and other earnings not specified separately. Hence, the corresponding annual working hours are also from the main and any additional job including overtime. This broad hourly wage measure is conventional (e.g., Solon et al 1994, and Devereux 2001), though likely to show higher procyclicality than a basic wage measure. Since we distinguish between Italy's North and Centre-South, we deflate wages using the corresponding regional price index for family consumption (ISTAT, 2005). However, we also provide a sensitivity test using the national price index since this index may be influential in negotiations over national collective agreements.

The main concern about our wage variable is likely to be the measurement of hours. In particular, workers may report contract hours rather than actual hours worked, causing reported hours to remain overly steady from year to year. Devereux (2001) calls this the "clumping" problem, giving an understatement of the cyclicality of hours, and consequently an overstatement of the cyclicality of hourly wages. We have checked our hours variable. We find, on average, only 65% of job stayers had the same reported weekly hours in two adjacent years (the proportion varied between

56% for 1996/97 and 71% for 1999/2000). Thus, there seems to be significant variation in reported hours from year to year, especially given that true hours are likely to remain constant for most stayers, which give us some confidence in our hours measure. Nevertheless, to cross-check, we will also show (Table 5.4) that results from an analysis using annual earnings data are broadly similar to those for hourly earnings.

The final important variable is the unemployment rate, changes in which act as our cyclical indicator. As noted above, our analyses distinguish between the North and Centre-South, hence we use the corresponding regional male unemployment rate derived (ISTAT, 2007) from the Labour Force Survey (LFS). These regional unemployment change measures are shown in the lower panel of Figure 5.1. The LFS is also the source for the national unemployment rate measure we use in some analyses.

Table 5.1 presents summary statistics, distinguishing by region, for the key variables. Our sample includes 6363 males who are employed in the year and can provide clear information about job movement. The North and Centre-South have rather different workforce compositions. Fewer in the North are working in the public sector (18%) than in the Centre-South (28%). Also, there is a much smaller proportion who work in very small firms, employing less than 5 workers, in the North. This difference is partly because the North has a smaller proportion of workers in agriculture (5.3%) than does the Centre-South (9.1%), since agricultural establishments tend to be small. (Again, as can be seen, the North has more manufacturing, which tends to have large establishments.) We cater for these differences below by running separate regressions by public-private sector, and by

firm-size. Finally, while part-time work is unimportant in both regions, temporary contracts can be seen to cover a higher proportion of the workforce in the Centre-South, 15%, an indication of the depressed business conditions in this region. In order to maintain sample sizes for separate regional analyses (below), we make no distinction between temporary workers and others. In fact, internal wage flexibility for temporary workers – as they are bumped up and down job ladders – should be higher than for permanent. The importance of temporary contracts the Centre-South should therefore assist wage flexibility.

As regards wage changes, we see that stayers and internal movers have similar average real wage changes in the North and Centre-South, with increases averaging 4 to 5% a year. There are fluctuations in these wage changes, as shown for stayers in the top panel of Figure 5.1. External movers in the Centre-South are an exceptional group, showing a negative real wage change on average, -8.6%. The implication here is that external movers are more likely to be involuntarily laid off in the South, and the large loss in wages for movers points to the possibility of above-equilibrium wages for stayers. Such above-equilibrium wages could be a result of the power of collective agreements which cater for the North, and prevent wages falling in the Centre-South.

Finally, the unemployment statistics show a tight labour market for the North with an unemployment rate of 4.8%, and a slack market in the Centre-South with a rate of 11.1%. Moreover, as can be seen from the next row, the North shows a tendency for unemployment to decline over the period, while for the Centre-South the tendency is for unemployment to rise.

5.4 Empirical results

5.4.1 Basic results

Results for the two regions as a whole are reported in Table 5.2. We confine attention to the unemployment change coefficients, estimated in step two of our regressions, i.e., equations (5.4a). The table suggests markedly different labour markets in the North and Centre-South. Take first panel a), which uses regional unemployment rates. We see that wages of job stayers in the North show significant flexibility, with a semi-elasticity of -9.11. This figure implies that a decrease of one standard deviation in Northern unemployment, 0.44 (Table 5.1), will increase real wages by 4.0% (=-9.11×-0.44). Internal and external movers have insignificant coefficients, implying similar procyclicality (no extra effect) for these groups. Results for the Centre-South make less sense, with an insignificant effect for stayers (point estimate -3.14) and a positive incremental effect for internal movers (8.05), suggesting that this group's wages even move with rather than against unemployment (-3.14+8.05=4.91).

Figure 5.1 shows the reason for the contrasting North and Centre-South effects. As can be seen, wage movements for the main group, stayers, are similar at the aggregate level for the two regions. But the regional unemployment changes are different. Evidently, the forces moving real wages in the North and Centre-South are similar, but these forces apparently do not include the Centre-South's labour market conditions.

Table 5.2's panel b) shows that wage movements in the Centre-South may be perverse. For stayers, we see that wage movements are much better explained by market conditions in the North, -6.76, than they are by conditions in the Centre-South

itself. There is no such effect for the North whose wage movements are determined by conditions in the North. Also, there is a large effect for external movers in the Centre-South, -16.50. This result could fit in with the view that Southern wages are above equilibrium. If Southern wages are pushed up by Northern wage agreements, an extra burden of flexibility is placed on Southern external movers. In sum, the fact that Northern unemployment affects Southern wage movements suggests that wages are set in the north, and then communicated southwards via pattern bargaining and extension of collective agreements.

Finally, Table 5.2's panel c) shows the misleading results that arise if the national unemployment rate is used to predict wage changes in the regions. The change in the national unemployment rate is simply the weighted average of the regional changes: $\Delta U = a\Delta U^S + (1\text{-}a)\Delta U^N$ where $a \approx 0.53$ is the weight of the South (which can be taken as constant over the time period), and ΔU^S, ΔU^N are the unemployment rate changes in the South and North. We see that wages in both regions respond well to national unemployment changes, with significant wage procyclicality for stayers. However, this result is misleading because in fact the southern component of national unemployment makes no contribution. It can be shown that the explanatory power of total unemployment is never significantly higher than that of the North alone. Moreover, when both southern and northern unemployment are entered together in either the North or Centre-South's wage equations, southern unemployment is always insignificant. Thus, the apparent strong influence of national unemployment conditions is really due to the underlying power of unemployment conditions in the North – as panels a) and b) make clear.

Making comparisons with the UK and the US, Table 5.2 shows that while wage cyclicality for the Centre-South appears to be almost zero, that for Northern Italy is, if anything, higher than the US and UK. Our definition is close to Devereux's (2001, p845) definition of "average hourly earnings" for the US, and he finds that a one point fall in unemployment (approximately 1 standard deviation) is associated with a 2-3% rise in real wages. As noted above, our corresponding figure for workers in the North is a 4.0% rise in real wages. Other estimates for both the US and UK use narrower definitions of earnings, with accordingly less cyclicality. Thus, for male stayers in the US, Solon et al (1994) find a semi-elasticity of -1.2 for male stayers, and Shin and Solon (2006) find a similar -1.5. Also for the US, Devereux (2001) finds -1.09 for male job stayers. For the UK, Devereux and Hart (2006) find -1.83 for male stayers. In order to test the robustness of our broad results, we now estimate wage cyclicality for sub-groups within our sample.

5.4.2 Results by firm size and sector

We now contrast small and large firms, and public and private sectors .We would expect more flexibility in small firms, which may take a more *laissez faire* approach to industry wage agreements. Also small firms (under 15 employees in the legislation) are less likely to be covered by employment protection laws (Boeri and Jimeno 2005), meaning less shielding of job stayers and accordingly more wage flexibility. Because of small firm importance, more flexibility is likely to be found in the private than the public sector. Moreover, the greater centralisation of wage bargaining in the public sector, with very little room for public bodies to add wage increases on top of national agreements (Dell 'Aringa et al, 2005) will constrain flexibility.

Panel a) of Table 5.3 gives results using corresponding regional unemployment rates as before, with panel b) switching rates. In general, we continue to find that Southern unemployment has little explanatory power. The first rows of panels a) and b) contrast the public and private sectors as a whole. In the North, we see that there is significant wage flexibility in both the public and private sectors, but flexibility is lower in the public sector, as expected. (In fact, low wage flexibility appears to be a feature of public sector labour markets, since we find it also in panel studies of the UK and both East and West Germany – see Peng and Siebert, 2007.) The South exhibits little flexibility in either sector, unless we use the North's unemployment, as shown in panel b).

The next rows consider the private sector in more detail, distinguishing between four categories of firm, from the very small to the large (defined in Table 5.1). Sample sizes become quite small for some sub-groups in this analysis, but we pursue it because very small firms are important in the South (Table 5.1), while large firms for their part deserve a separate analysis because of their possible role in pattern bargaining. Let us take the very small firms in the North first. The puzzling aspect here is that now only panel b) coefficients are significant, indicating that such firms respond more to unemployment conditions in the South. However, in some experiments with industry composition, we find that this effect largely drops away if we exclude agriculture. Hence, we believe it shows the importance of the large Southern agricultural sector on Northern farm workers.

As for other firm size groups in the North, we see high procyclicality for all groups, with semi-elasticities in the -6 to -8 range. These findings suggest that the

system of centralised wage negotiations for the larger firms adapts well to local labour market conditions in the North.

Turning to the Centre-South, we again see a pattern of wage response to Northern conditions. Only large firms react to local conditions (-7.18). The flexibility of large Southern firms suggests that such firms' special agreements indeed give them freedom as noted above (see Guiso et al 2005). But in general, the North sets the tone for Southern wage movements.

5.4.3 Sensitivity Tests

Results of tests are summarised in Table 5.4. For brevity we show only the results for the important job-stayer group. The benchmark result is given in column (a) taken from Table 5.3 (with a simplified firm size breakdown), using hourly wages and the regional CPI as wage deflator, together with the full, unbalanced sample. In the remainder of the table, we consider the consequences of varying this basic specification.

Column (b) gives the results of a traditional aggregate analysis which does not use the panel element, and is therefore subject to the composition effects mentioned earlier. As can be seen, while the signs for the various sub-groups are all negative which indicates procyclicality, the coefficients are never significant in either the North or Centre-South. The implication is that the panel approach is necessary, otherwise the composition effect is strong enough to obscure cyclical movements in individuals' real wages.

Column (c) takes annual wages as the dependent variable. (Hourly wages would probably be preferable, but the ECHP has no measure of annual weeks worked; consequently we restrict this analysis to full-timers.) This regression avoids using hourly wages which are based on an hours worked measure whose variability may be under-reported, imparting a spurious cyclicality to measured hourly pay. In fact, the results are quite similar (as also found by Ammermueller et al Tables 1a and 1b). Thus, it is not mismeasurement of working hours which is driving our results.

Column (d) takes the results from a "balanced" dataset (see, e.g., Solon et al 1994). Because individuals must then be observed each year, such samples are necessarily smaller, with only 750 observations yearly in the North and 1231 in the Centre-South. The results are close to the results for the larger, unbalanced sample for the North, and again no coefficient is significant for the Centre-South.

Finally, column (e) gives the consequences of choosing a different wage deflator, the national CPI rather than the regional CPIs. There is not much change in the coefficients for the groups in the North, but interestingly, the Centre-South's public sector coefficient now becomes significantly negative, indicating procyclicality. The implication here is that public sector negotiations take place with the national CPI in mind. However, the implication is not clear-cut, because public sector wages in the North need to be deflated by Northern (not national) prices to respond significantly to market conditions. Overall, however, it can be said that the choice of price deflator does not make much difference.[54]

[54]Results of wage deflated by the National CPI on unemployment rates calculated from the ECHP are presented in Peng and Siebert (2008), which are consistent with our findings in this chapter.

5.4.4 Regional analysis

Results are given in Table 5. For this analysis, we use 28 region-year data points for the North, and 49 for the Centre-South (equations 4b). The cyclical unemployment measure for each of the 11 regions is now that region's own change in unemployment. Looking first at the top panel contrasting the public and private sectors, we see little evidence of wage procyclicality in the public sector in either the North or Centre-South. Nor is there wage procyclicality in the Centre-South's private sector. However, in the North's private sector there continues to be significant procyclicality, with a semi-elasticity of -3.14 for job stayers. Thus the picture of more flexibility in the North than the South, and in the private than the public sectors remains using the regional analysis.

However, breaking down the private sector into small and medium/large firms we obtain somewhat different findings from before, with larger firms not having procyclical wages in either region (and in the Centre-South having the wrong sign). As can be seen, only job stayers in Northern small firms now exhibit significant procyclicality, -8.62, with very small firms also showing signs of procyclicality. To find small firms having more flexible wages than large is no surprise, but finding no flexibility in larger Northern firms contradicts the time series results in Table 3. This issue is important, because the large Northern firms at the centre of Italy's system of national agreements should be able to negotiate wage flexibility at least for themselves – as we found in the times series results. However, as noted above, wages in large firms are more likely to respond to more aggregated unemployment levels than the simple region. On the other hand, small firms are likely to respond to local unemployment conditions, which is what we find here.

5.5 Conclusions

Following the methodology of earlier studies of the USA and the UK, we are able to make a fine distinction between wage movements of job stayers, of internal job movers, and external job movers. Job stayers are most important, and we find that stayers in Northern Italy have procyclical real wages. When we cut the samples, we find that the procyclicality of Northern wage movements is stronger for the private than the public sectors, and for small firms than large. This pattern is plausible. However, wages in the Centre-South have a perverse pattern of responding only to Northern unemployment conditions, and not at all to local conditions. Wages even of the smallest firms are irresponsive to local conditions. It looks as though the Northern labour market works in an efficient way, but the Southern does not.

The argument that Italy's system of institutional wage setting can explain our contrasting results for the North and Centre-South receives qualified support. At first blush, that fact that Northern unemployment determines Southern wage movements (as well as Northern) implies that wages are negotiated in the North, with only Northern conditions in mind, and then communicated southwards by institutional means such as extended collective agreements. It is easy to fit public sector wage determination into this picture since public sector wages are not regionally differentiated, and could easily be set in the North. Also, in this setup, wages in the South should be above equilibrium. Then, the high procyclicality of external movers' wages in the South would also fit, since above-equilibrium wages in the South could give rise to a "hitting the jackpot" effect when a job is won. But the fact that the very smallest firms in the Centre-South have wage movements which only match labour market conditions in the North does not easily fit. Wages in this group, with its many

fringe and underground workers, are least likely to be closely tied by the North's collective agreements. More research is needed here.

Two results stand out, and will need to be tested in future work, as the ECHP panel lengthens. First, Italy's centralised institutional arrangements have worked well for the North. The fact that all firm size categories in the North, both large and small, and even the public sector, have flexible wages shows that benefits can be achieved from high collective bargaining coverage. But, second, this institutional system has worked badly for the poorer Southern regions of the country.

Figure 5.1: Real Wage Changes (Job-stayers) and Unemployment Changes, by Region

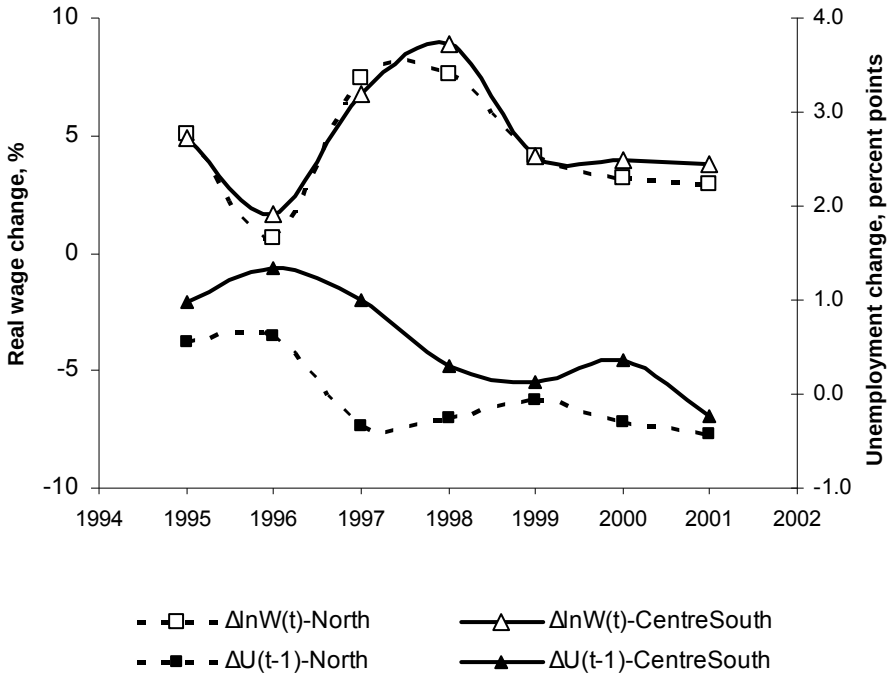


Table 5.1: Means and Standard Deviations, Male Employees in the ECHP 1994-2001 (Standard deviations in parentheses)

Variable			North	Centre -South
Workforce composition: proportions of total:	**Public sector:**		0.180	0.280
	Private sector	**Very small firm(<5)**	0.387	0.517
		Small firm(5≤ <20)	0.242	0.224
		Medium firm (20≤ <100)	0.190	0.139
		Large firm(100≤)	0.181	0.120
	Agriculture		0.053	0.091
	Manufacturing		0.323	0.190
	Temporary contracts		0.070	0.152
	Part-time workers		0.031	0.053
Worker movement: proportions of total observations:	**Job stayers**		0.755	0.764
	Internal movers		0.176	0.168
	External movers		0.069	0.067
Real wage changes*: (ΔlnW):	**Job stayers (ΔlnW_S)**		0.045 *(0.41)*	0.050 *(0.38)*
	Internal movers (ΔlnW_W)		0.057 *(0.41)*	0.043 *(0.40)*
	External movers (ΔlnW_B)		0.045 *(0.70)*	-0.086 *(0.79)*
Average unemployment rate (%) **			4.8	11.1
Average change in unemployment rate (ΔU)**			-0.030 *(0.44)*	0.552 *(0.56)*
Number of individuals			2,489	3,874
Number of observations			6947	10,789

Notes: * Wages are deflated by the corresponding regional CPI for the North and Centre-South. The change of wage calculation includes only full-timers. Other figures include part-timers.
** Unemployment rates are calculated from the Labour Force Survey.

Table 5.2: Real Hourly Wage and Unemployment Changes (coefficients on Δu_t from wage change equations 5.4a)

Region	Job stayers	Incremental effect for internal movers	Incremental effect for external movers
	a) Corresponding regional unemployment rates used to calculate ΔU_t		
North	-9.11***	-0.01	3.25
	(2.19)	***(2.89)***	***(23.8)***
Centre-South	-3.14	8.05***	0.61
	(3.69)	***(3.37)***	***(16.7)***
	b) Switched regional unemployment rates used to calculate ΔU_t		
North	-4.57	-4.89***	-6.94
	(4.73)	***(1.74)***	***(24.5)***
Centre-South	-6.76***	0.50	-16.5
	(1.93)	***(5.08)***	***(13.9)***
	c) National unemployment rates used to calculate ΔU_t		
North	-12.8***	-4.92*	-1.55
	(3.04)	***(3.21)***	***(33.4)***
Centre-South	-9.23***	8.31	-15.1
	(2.90)	***(5.79)***	***(21.3)***

Notes: Standard errors are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels for two-tail tests. Wages for the North and Centre-South are deflated by corresponding regional CPIs. In panel (b), the unemployment rates are switched by region, so that wage changes in the North (Centre-South) are regressed on Centre-South (Northern) unemployment changes.

Table 5.3: Real Hourly Wage and Unemployment Changes by Sector and Firm Size (coefficients on Δu_t from wage change equations 5.4a)

		North			Centre-South		
		Job stayers	**Incremental effect for internal movers**	**Incremental effect for external movers**	**Job stayers**	**Incremental effect for internal movers**	**Incremental effect for external movers**
		a) Corresponding regional unemployment rates used to calculate ΔU_t					
Public sector		-5.58**	-7.03***	-2.86	-2.87	1.71	14.3
		(2.92)	***(2.88)***	***(71.8)***	***(2.76)***	***(5.98)***	***(18.8)***
Private sector		-10.1***	2.37	7.08	-3.54	12.0**	-0.15
		(2.90)	***(3.67)***	***(17.7)***	***(4.50)***	***(5.13)***	***(18.9)***
Private sector	**V. small firm**	-23.0	-8.73	49.7	2.28	19.2	-12.7
		(19.8)	***(19.3)***	***(30.8)***	***(10.2)***	***(15.2)***	***(47.0)***
	Small firm	-7.41***	-3.59	7.89	-7.00	8.69***	29.2
		(2.47)	***(13.8)***	***(20.0)***	***(6.31)***	***(2.95)***	***(26.2)***
	Medium firm	-8.16**	0.27	-18.9	-0.77	25.0*	-70.1**
		(3.93)	***(12.2)***	***(31.9)***	***(6.47)***	***(15.94)***	***(37.8)***
	Large firm	-6.41*	9.16*	10.7	-7.18	-2.21	26.7
		(3.58)	***(5.60)***	***(17.9)***	***(5.22)***	***(3.8)***	***(45.6)***
		b) Switched regional unemployment rates used to calculate ΔU_t					
Public sector		-2.97	-0.9	17.4	-4.06**	0.66	7.88
		(3.94)	***(4.72)***	***(74.4)***	***(2.22)***	***(5.83)***	***(19.0)***
Private sector		-5.12	-6.92***	-4.68	-8.45***	-0.65	-19.0
		(5.52)	***(2.04)***	***(18.6)***	***(1.98)***	***(7.59)***	***(15.6)***
Private sector :	**V. small firm**	-33.5*	16.5	-2.91	-16.4***	2.92	-26.0
		(17.3)	***(19.1)***	***(41.7)***	***(5.41)***	***(17.2)***	***(46.7)***
	Small firm	3.55	-23.1***	-9.31	-6.67	4.20	14.3
		(4.32)	***(8.98)***	***(20.9)***	***(6.15)***	***(4.63)***	***(28.1)***
	Medium firm	4.08	-15.0*	1.19	-7.12*	-11.5	-47.1
		(5.46)	***(10.0)***	***(34.2)***	***(5.04)***	***(18.4)***	***(43.1)***
	Large firm	-6.99**	-1.72	14.5	-3.60	1.34	-43.3
		(3.41)	***(7.30)***	***(17.6)***	***(5.95)***	***(3.83)***	***(41.3)***

Notes: as for Table 5.2.

Table 5.4: Sensitivity Tests - Job Stayers
(coefficients on Δu_t from wage change equations 5.4a)

		Benchmark: Table 3 results for stayers (a)	Aggregate results (not using panel data) (b)	Annual rather than hourly wages (c)	Balanced dataset (d)	National rather than regional CPI (e)
			North			
Public Sector		-5.58**	-0.18	-3.81**	-7.43***	-3.91
		(2.92)	***(0.83)***	***(1.91)***	***(1.62)***	***(3.19)***
Private Sector		-10.1***	-2.02	-9.72***	-9.04**	-8.51**
		(2.90)	***(2.13)***	***(2.77)***	***(4.94)***	***(4.56)***
Private Sector	**Small firm (< 20)**	-13.6**	-3.34	-13.2**	-11.62	-11.9*
		(6.50)	***(7.65)***	***(5.96)***	***(8.50)***	***(8.16)***
	Medium + firm (20 +)	-7.35***	-1.49	-6.86***	-6.96**	-5.83**
		(2.23)	***(3.46)***	***(2.52)***	***(3.40)***	***(2.87)***
			Centre-South			
Public Sector		-2.87	-4.39	-3.24	-1.45	-5.46*
		(2.76)	***(4.25)***	***(2.76)***	***(3.97)***	***(3.50)***
Private Sector		-3.54	-4.85	-1.44	-1.45	-5.96
		(4.50)	***(3.97)***	***(4.34)***	***(4.09)***	***(4.29)***
Private Sector	**Small firm (< 20)**	-2.61	-5.58	0.64	0.02	-4.94
		(6.42)	***(5.21)***	***(5.40)***	***(5.33)***	***(5.62)***
	Medium + firm (20 +)	-3.83	-4.05	-3.04	-2.74	-6.43
		(5.23)	***(4.20)***	***(5.04)***	***(3.29)***	***(5.75)***

Notes: Basic model uses panel data with hourly wages deflated by regional CPIs, regressed on corresponding regional unemployment rates.
Standard errors are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels for two-tail tests.

Table 5.5: Regional Real Hourly Wage and Unemployment Changes Using Region-Year Data
(coefficients on Δu_{jt} from wage change equations 4b)

		North			Centre-South		
		Job stayers	Incremental effect for internal movers	Incremental effect for external movers	Job stayers	Incremental effect for internal movers	Incremental effect for external movers
Public sector		0.76	-9.89**	5.85	0.40	0.21	14.2*
		(2.28)	***(3.99)***	***(31.8)***	***(0.79)***	***(1.57)***	***(9.26)***
Private sector		-3.14*	-0.06	-6.33	2.40**	-2.85*	-0.70
		(2.30)	***(4.87)***	***(7.66)***	***(1.12)***	***(1.79)***	***(4.87)***
Private sector	small firm (0-5)	-2.97	-20.9	-26.9	0.02	-1.33	6.84
		(10.5)	***(22.3)***	***(31.4)***	***(2.69)***	***(4.79)***	***(8.66)***
	small firm (5-20)	-8.62**	-3.13	9.22	0.68	-1.93	-2.77
		(4.12)	***(12.1)***	***(13.7)***	***(1.51)***	***(2.51)***	***(8.78)***
	Large firm (20-100)	-0.67	2.24	-2.63	4.30***	-3.45	-1.42
		(3.82)	***(6.37)***	***(18.9)***	***(1.42)***	***(4.18)***	***(8.58)***
	Large firm (100-500)	1.51	0.53	-2.10	4.12**	-0.98	-6.19
		(2.62)	***(3.31)***	***(15.4)***	***(1.96)***	***(3.05)***	***(10.0)***

Notes: Standard errors are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels for two-tail tests. There are 4×7 region-years in the North and 7×7 region-years in the Centre-South. Corresponding regional unemployment rates are used to calculate ΔU_t for each of the 11 regions. Wages are deflated by corresponding regional CPIs.

CHAPTER SIX:
REAL WAGE CYCLICALITY IN GERMANY AND THE UK: NEW RESULTS USING PANEL DATA

6.1 Introduction

This chapter analyses real wage adjustment over the business cycle using panel micro data for Germany 1984-2002 and the British Household Panel Survey 1991-2004. We follow Chapter 5 which analyses real wage adjustment in Italy. Germany, like Italy, has a regulated economy which forms an instructive contrast with the more flexible economies of the US and the UK, which have been shown to have wider wage differentials as well as significant real wage flexibility, using micro panel data. Our aim is to analyze the wage flexibility picture in this chapter, using microeconomic panel data from the German Socio-Economic Panel (GSOEP). We will apply the same variable definitions and analytical methods to the UK's British Household Panel Survey (BHPS), thus allowing a close comparison between Germany and the UK, and with Italy in the previous chapter. Our study will have the further interest, for the UK economy, of providing results from the BHPS which can be compared to Devereux and Hart's (2006) analysis using the New Earnings Survey.

In practice, it is difficult unambiguously to classify a country's wage-setting institutions. Most discussions accept that collective agreements in the UK and the US are only important in certain sectors, and are neither centralised and/or coordinated. But Germany is more difficult. Franz and Pfeiffer (2006, Table 3) find that 57% of (private sector) employers they questioned believed labour union contracts were very important in preventing wage cuts for unskilled workers. However, this figure leaves a substantial minority, and the more skilled workers, for whom union contracts are not important. At

the same time, Germany's system of pattern bargaining can be taken as highly coordinated (see e.g., Kenworthy, 2001, Figure 1), and also "governable" in Traxler's (2003) terms due to the legal enforceability of collective agreements. Ochel (2005, 105) argues that pattern bargaining, with wage agreements following the metalworking industry located in prosperous regions, may result in wages which are "excessive" for the economically weaker regions. On the other hand, he notes the possibility that Germany's coordinated wage setting results in wages being more responsive to macroeconomic shocks, since coordination assists in aligning the bargaining parties' expectations. In other words, the parties' gains to changing wages are higher if all change, so that there is a "strategic complementarity" (Ball and Romer, 1991) in wage adjustments. In this chapter we directly test whether such coordination makes real wages responsive to macroeconomic shocks, making a crucial distinction between West and East Germany.

Our methodology here is similar to Chapter 5, and relies on panel data for individuals. Data used in this chapter allow fine distinctions to be made between country regions, between public and private sector, and by firm size. It is worth testing all of these distinctions, which have implications for the way institutions affect wage flexibility hence earnings inequality. Thus, lower real wage procylicality among large firms - which are more affected by collective bargaining – would suggest this factor causes stickiness and less earnings inequality. Similarly, lower procyclicality in the public than the private sector would point to the extra authority of the state in setting public sector wages (Traxler, 1999), as well as softer public sector budget constraints.

The alternative approach is to use country data, which is the method followed by current studies from the international wage flexibility project (Dickens et al, 2006; also

Holden and Wulfsberg, 2007). This approach suggests widespread real wage rigidity since wage changes clump near expected inflation rates. Downward nominal wage rigidity also appears common. However, the aggregate method cannot test for differences within countries, which is our contribution.

Beaudry and DiNardo (1991) argue on the effect of implicit contracts on the movement of wages over the business cycle using micro data. Their model shows that in a rigid labour market, in which workers cannot move costlessly, they would accept a fixed wage decided by the market condition in their first employment year. It implies in a segmented and rigid labour market, such as the Centre-South of Italy in the previous chapter, we will see, also maybe the East of Germany in this chapter, wages are set by collective bargaining following a "standard rate" principle and hence show more homogeneity. However, Devereux and Hart (2007) find evidence that this kind of implicit contract is not very important in the UK, maybe because workers in the UK can move costlessly and wages here are set at individual or company level according to contemporaneous market conditions. Thus, the UK would show a different "The Spot Market Matters" model from "The Institutions Matters" model in the continental European countries such as Italy and Germany. This chapter aims to explore this difference by comparing the real wage cyclicality in these three countries, allowing deep analysis and comparison on distinctions by country regions, sector and firm size using micro data.

A further advantage of our methodology is that we can again follow Devereux and Hart's (2006) distinction between job stayers (remaining in the same job over the year), internal movers (i.e., within-company movers), and external movers (between-

company). While job stayers are the most important numerically, bumping workers within the company up and down a job ladder as in Reder's (1955) theory of internal job ladders, can provide a valuable further form of flexibility even if wages for stayers are rigid. Furthermore, as regards external movers, if this group experiences large real wage changes with the cycle, the implication is that incumbents are receiving rents. Again, such a finding might provide an insight into the working of labour market institutions in the particular case.

The remainder of this paper is organised as follows. In section 2, we present our estimation methods, and in Section 3, we describe the data. Section 4 examines the basic predictions of theoretical models by region and compares our results with other findings. The final section concludes.

6.2 Estimation methods

As in Chapter 5, our empirical work uses the-standard two-step estimation procedure (beginning with Solon, 1997), to get round the Moulton (1986) problem that, though we have thousands of individuals, each year provides only one business cycle (unemployment) observation. To circumvent this problem, in step 1 we estimate a wage change equation using individual data. This equation is the same as equation (5.3):

$$\Delta \ln w_{it} = \alpha_0 + \alpha_1 Age_{it} + \alpha_2 Ten_{it} + \sum_{t=1}^{T} s_t D_t + \sum_{t=1}^{T} w_t M_{Wit} D_t + \sum_{t=1}^{T} b_t M_{Bit} D_t + \varepsilon_{it} \qquad (6.1)$$

Definitions of all variables are also the same as in equation (5.3). In step 2, we then derive estimates of the wage cyclicality of stayers, for example, by regressing s_t on the unemployment change variable (Δu_t), and a linear time trend. In this step, we only have time series variation, reducing the number of observations – in our case 19 years for

West Germany (1984-2002), 11 years for the East Germany (1992-2002) and 13 years for the UK (1991/2-2003/4). Our data cover more than one full business cycle in Germany and the UK. Following Chapter 5, we use weighted least square regression, where the weights are the numbers of individuals observed in a given year. This equation is the same as equation (5.4a):

$$\begin{aligned} \hat{s}_t &= a_0 + a_1 \Delta u_t + a_2 Year_t + v_t^s \\ \hat{w}_t &= b_0 + b_1 \Delta u_t + b_2 Year_t + v_t^w \\ \hat{b}_t &= c_0 + c_1 \Delta u_t + c_2 Year_t + v_t^b . \end{aligned} \tag{6.2}$$

Specification of the variables in equations (6.1) and (6.2) requires care in several respects, which we will cover in turn. First, there is the definition of the wage variable. Here we take quite a broad definition[55], including overtime, bonuses, and profit-sharing (and also pay from second jobs in the case of the GSOEP) because this definition allows the best comparison between the GSOEP and the BHPS, and to our results for Italy in Chapter 5. This wage measure is also close to the measures used in Solon et al (1994) and Devereux (2001) for the United States. Use of the broad definition will reduce the measured extent of rigidity: basic wages could be rigid while there could be flexibility in other components, especially bonuses and overtime. Thus, our results may show higher flexibility than results using the basic wage such as Devereux and Hart (2006) for the UK (see below). Still, flexibility imparted by variation in overtime and bonuses is genuine flexibility and should be considered.

A further issue is the definition of the wage deflator. Both the GSOEP and the BHPS provide data on consumer prices. We find it appropriate to deflate wages in

[55] Specifically, labour earnings is the sum of income from primary job, secondary job, 13th and 14th month pay, Christmas bonus pay, holiday bonus pay, miscellaneous bonus pay, and profit-sharing income. We exclude the self-employed, because of difficulties with the reliability of their self-reported pay figures.

Germany (West or East) by price indices for the appropriate region. In the case of the UK, we use a single price index.

Next, there is the definition of the hours variable. Since we work with annual earnings for Germany, we require a measure of annual hours. Annual hours worked is calculated by adding together the estimated annual hours of full-time, part-time, and short-time work.[56] For the UK, the hourly wage is computed as the latest gross pay divided by the number of hours in the pay period. The working hours of the last pay period is the product of the number of weeks in the last pay period times weekly working hours including normal and overtime.

Errors in reporting of hours can give rise to spurious cyclicality of wages. In particular, workers may report contract hours rather than actual hours worked, causing reported hours to remain overly steady from year to year. Such understatement of the cyclicality of hours will give an overstatement of the cyclicality of hourly wages. We have checked our hours variable carefully. We find, even with 10 percent tolerance of the change in hours, on average, only 65% of job stayers had the same reported weekly hours in two adjacent years in the Germany. Tests on the BHPS also show many changes year-on-year in working hours. Only about 77% of job stayers have the same reported normal weekly hours in adjacent year. Thus, there seems to be significant variation in reported hours from year to year in both Germany and the UK, especially given that true hours are likely to remain constant for most stayers. Furthermore, hours show some significant procyclicality in a regression with the unemployment rate. Thus, we take it that the bias from misreporting of hours is not large for our data.

[56] Annual hours of work in each of these three states is calculated by multiplying the average number of hours worked per week by the number of months worked in each of these three states for the previous year and by 4.33 (the average number of weeks per month).

Next, there is the issue of whether to use a regionally differentiated unemployment variable, or a country-wide variable. If labour mobility between regions is low, then regional differentiation is indicated. We experimented with both types, including a South versus North-Central split for the UK, as well as the obvious East-West split for Germany. We found that regional differentiation for Germany gave the most sensible results, together with a single unemployment variable for the UK, and accordingly report this specification.

There is also the question of forming the stayer and the within- and between-company mover groups. For both datasets, we use tenure with the company: if the tenure is one year or less, the respondent is a between-company mover, otherwise, a job stayer or within-company mover. (We remove new entrants to the labour market from the category of external movers.). The BHPS asks a direct question: "What was the date you started working in your present position, by that I mean the beginning of your current spell of the job you are doing now for your present employer?" which provides clear information about the starting year of the job spell. We identify a job stayer as an employee who answers yes to the direct question in the case of the BHPS and a similar question for the GSOEP[57]. If there is a missing value for this question, we identify a stayer as an individual who has no change in residential area, working sector and industry. A within-company mover is then a worker whose tenure is more than one year but is not a job stayer.[58]

[57] The GSOEP asks a direct question: "Did you change your job or start a new one? If not, are you working in your original position?"(DWI 2002), which provides clear information about the job spell.

[58] The GSOEP provides good data on 17 residential areas, public/private sector and one digit (9) and two digit (33) industries of current jobs. We choose one digit industries to define the job stayer here, because using two digit industries affects little. When we limit the sample only to those defined as job stayers from the direct question, our basic conclusions do not change. For the BHPS, we use 19 residential areas,

Finally, there is the question of what to do about structural breaks over time. For East Germany, we drop the 1991 observation, so as to avoid the special wage turbulence associated with re-unification. For West Germany, there is the possibility that over the long time period we consider, the underlying bargaining structure changes, particularly since the late 1990s (see Doellgast and Greer, 2007). In fact, our sample period for Germany ends in 2002, and hence will not be much affected by such recent changes.

6.3 Data Description

The GSOEP is a wide-ranging representative longitudinal study of private households in Germany. The same private households, persons and families have been surveyed yearly since 1984 (the GSOEP West). In June 1990, the survey was extended to the territory of the former German Democratic Republic (the GSOEP East). In 1984, 5,624 households containing a total of 15,729 individual respondents participated in the GSOEP West. After the joining of the GSOEP East in 1990, an immigrant sample was added as well to account for the changes that took place in Germany society in 1994/95. Further new samples were added in 1998, 2000 and 2002. Thus, with a high degree of stability over time, there were 12,055 households containing a total 29,982 individual respondents participating in 2002.

For this research, we formed an unbalanced panel of 20,574 male workers with clear employment information, in which 16,474 workers are from West Germany for the period 1984-2002 and 4,100 from East Germany for the period 1992-2002 (see Table

public/private sector and four digit (9999) industries of current job to define job stayers. However, the BHPS updated the industry categorisation from the SIC80 to the SIC92 in the 2002/2003 survey. Thus, only in that year, we use one digit (5) industries. Our results for the UK are not sensitive to the choice of industry variables rather than the direct question.

6.1).[59] In concentrating on males, we are following the literature (e.g., Devereux, 2001; Shin and Solon, 2006). In any case, the female participation rate in Germany is only about 65 percent, compared with about 80 percent for the males, so that our female sample would be much less than males, giving difficulties when we analyse sub-groups.

For the United Kingdom, we use the first thirteen waves of the BHPS, which was designed as an annual survey of each adult (16+) member of a nationally representative sample of more than 5,000 households in the UK, making a total of approximately 10,000 individual interviews yearly. The same individuals are re-interviewed in successive waves. A development in 1999/2000 was the recruitment of two additional samples from Scotland and Wales to increase the relatively small sample sizes for these regions. In 2001/2002, an additional sample from Northern Ireland was added. Thus, the sample should remain broadly representative of the whole population of the UK as it changed through the 1990s and beyond. From this dataset, we formed an unbalanced panel of 13,758 male workers with clear employment information.

We use changes of the unemployment rate as our cyclical indicator. As noted above, our analyses distinguish between the West and East for Germany, as the national unemployment rates are used for the UK. Hence, we use the corresponding regional/national male unemployment rate derived (FSO 2007 and ONS 2007b) from the Labour Force Survey (LFS) in Germany and the UK.[60]

[59] Though the GSOEP East actually started in 1990, there is no employment information for workers in 1990 and 1991. Thus, our data for the East Germany is actually for the period 1992-2002.
[60] Results on unemployment rates calculated from the GSOEP and BHPS are presented in Peng and Siebert (2007), which are consistent with our findings in this chapter.

Table 6.1 presents summary statistics for (the former) West and East Germany and the UK, for the key variables. The three columns seem quite similar in the first and second panels, apart from the fact that the workplaces are much smaller in the UK (68% small/medium companies) and East Germany (66.3%) than West Germany (only 47%).[61] There is a somewhat higher proportion working in private sector in the West Germany, but few temps and part timers in either country, as is to be expected in an all-male sample. It seems that the proportion of job stayers is a little higher in the West Germany, while the external movers' proportion is a little higher in the East. The internal movers' proportion is distinctly lower in the UK than Germany, either west or east. Perhaps the bigger firm size of German companies provides more space and resources for internal promotion/demotion than in the UK.

As regards wage levels, we see that wages in the West are much higher than in the East. There is a stable wage gap by category of about 30 percent between the East and West. Also, for both German regions (and for the UK), public sector wages are equivalent to wages of large companies in the private sector, which are about 20 percent higher than small/medium companies in the private sector.

In Germany, centralised collective agreements have been used to push East German wages up from 7% of West German levels at the time of unification in 1989, to about 72 % in 2002 (Ochel 2005). As Ochel (2005, p167) argues, the initial collective wage negotiations in Germany were "proxy negotiations" that were carried out by West Germany employers' associations and trade unions with the aim of equalisation of wages

[61] The GSOEP and the BHPS can only provide categorized information by employer size. We define a small company as a workplace with less than 20 (25) employees, a medium company as one with from 20 (25) to 200 employees, and a big company as one with 200 to 2000 (1000) employees. A large company has 2000 (1000) or more employees in Germany (the UK).

across Germany. High welfare payments subsequently have permitted the high wages to continue. This uplifting of wages in the East seems to have had the same speed in the public and large-firm private sectors, but been somewhat slower in the small firm category (a 40% gap can be detected here between East and West).

Evidence on the uplifting of East German wages is also shown in the wage change data at the bottom of the table, where we see that job stayers and internal movers in the East Germany have faster wage growth than those in the West. However, external movers do not. In fact, external movers in both East and West Germany suffer negative wage changes on average – in contrast to the UK – pointing to involuntary moves, and rents for incumbents[62].

6.4 Empirical results

The GSOEP results for the unemployment change coefficients from equation (6.2) are reported in Table 6.2, for the East and West separately. We differentiate between the public sector and the private sector. Also, within the private sector we consider different size company categories to test whether the opt-out from collective agreements (Ochel, 2005, p95) permitted to small firms makes their wage movements any more procyclical. Furthermore, small companies (under 5 or 10 employees in the legislation) are less likely to be covered by employment protection laws (Ebbinghaus and Eichhorst 2006, p19), meaning less shielding of job stayers and accordingly more wage flexibility.

The table shows markedly different labour markets in the West and East. In the West, real wages of job stayers in the private sector exhibit significant and highly

[62] Our wage change statistics for the UK are similar to those in Devereux and Hart (2006), in particular the large positive wage changes for between-company movers.

procyclical movements (-1.32). However, private sector wages in the East are rigid except for large firms with more than 2000 employees (-1.32). It appears as though the pattern bargaining in the West delivers wage flexibility in that area's private sector, but not in the East. Interestingly, there is no evidence of greater flexibility among small firms in the West, which suggests that there is not so much benefit to being "untrammelled" by collective agreements. Put in another way, for the big firms which lead the collective bargaining, the benefits of coordination are real. However, these benefits do not extend to the East, where wages set are above equilibrium except for the very large firms (2000+). Public sector wage behaviour is more similar in the two regions, being completely inflexible.

The results for the BHPS are presented in Table 6.3. The top panel gives results for the country as a whole, while the bottom reports on the South-North split. Taking the whole country first, we see that the pattern of real wage cyclicality is similar to that in the West Germany, with the private sector flexible, and the public sector not. Here we differ from Devereux and Hart (2006) who find significant, though lower, flexibility for the UK public sector based on New Earnings Survey data. It is also worth noting how in the public sector the incremental wage effect for external movers is high and significant (-5.18). This result implies that moving into and out of public sector over the cycle has strong wage consequences, as would be expected if rents were available to incumbent workers in the sector.

In the bottom panel we give some results from experiments with dividing the UK into two regions: the South, and the North. Here we pool the public and private sectors

for simplicity.[63] As can be seen, there is not much difference in the estimates for the two regions, in both of which stayers' real wages are significantly procyclical. The chi-square test for equality of coefficients is easily passed. Thus, there in no extra wage inflexibility in the UK's North such as might occur if wage-setting mechanisms imposed wage movements derived from the prosperous South. The picture of regional labour segmentation in Germany, and Italy (see Chapter 5) is quite different.

Comparing Tables 6.2 and 6.3 we see that wage flexibility in the private sector of the UK appears to be much larger than that in West Germany. Both small (<20) and large (>2000) firms in the West Germany show the right sign but insignificant wage procyclicality. Only the large-size firm category in the UK shows insignificant cyclical effect. Hence, the overall wage procyclicality in the private sector in the UK is almost double the size of that in West Germany. Further, it must be remembered that we are using a similar wage definition for both datasets, and are comparing like with like. The finding of considerable UK (private sector) wage flexibility is a point against the view that coordination of bargaining is necessary for firms in an industry to be willing to alter their wages, since there has not been much coordination of private sector bargaining in the UK for some time. For example, the famous engineering agreement came to an end in 1989, when the Engineering Employers withdrew from national bargaining.

Making comparisons with other research using panel data, our findings in Tables 6.2 and 6.3 indicate that real wage cyclicality - for West Germany at least - is comparable with that in the US and UK. Thus, for male stayers in the US, Solon et al (1994) find an elasticity of -1.2 for male stayers, and Shin and Solon (2006) find a similar -1.5. Also for

[63] If we only concentrate on the private sector, wages are more different between the south and the north-central. The south (stayer:-2.78***) shows higher wage procyclicality in the private sector than the north-central (-2.17***). But, the chi-square test for equality of coefficients is still insignificant (7.22, p>0.1246).

the US, Devereux (2001) finds -1.09 for male job stayers (using a narrow wage definition). For the UK, Devereux and Hart (2006) find -1.93 for male private sector stayers, which is a little lower than our findings for the BHPS, perhaps due to their using a more narrowly defined wage variable. For Italy, we find considerable wage cyclicality for male stayers in Northern Italy (-6.41~-8.16) but inflexibility in the Centre-South region. Thus, the problem of inflexible real wages affects specifically lagging regions such as East Germany and Southern Italy, and of course the public sector everywhere.

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6.5 Conclusions

This paper compares the cyclical behaviour of male real wages in Germany and the UK using the GSOEP 1984-2002 and the BHPS 1991-2004. Following the methodology in particular of Devereux and Hart (2006) we distinguish between job stayers (remaining in the same job), and within- and between-company job movers. Stayers are the large majority in both countries. Using changes in the unemployment rate as the cyclical measure, we find real wages of stayers in the private sector in West Germany – but not East Germany - to be procyclical, and quite sensitive to unemployment, comparable to the US and the UK. We find cyclicality in the public sector in neither country. Furthermore, for the UK we find that real wages in the North are just as procyclical as in the-South. There is nothing like the marked and continuing regional labour market segmentation that is to be found between West and East Germany, or North and South Italy.

The results suggest that real wages are not sticky in the private sectors both of the UK and West Germany. It is in the public sector of both countries, and in East Germany, that stickiness occurs. However, we might argue that both these cases of sticky wages are

special. For the public sector case, there might be little reason to expect labour demand movements to be in step with the aggregate unemployment rate, and for East German case there is the unique shock of unification. We are then left with a comparison of the private sectors of the UK and West Germany. Wages in the UK show much larger procyclicality than in West Germany, both of which appear to be flexible, whatever the underlying differences in wage-setting institutions – be it the pattern bargaining coordination of West Germany, or the company bargaining and individualism of the UK. The policy conclusion seems to be that when regions within a country are reasonably prosperous, the two types of wage-setting institution give the same result. However, when a region is lagging, as in the case of East Germany or Italy's South, pattern bargaining delays recovery.

Table 6.1: Means and Standard Deviations, Males in the GSOEP and the BHPS (Standard deviations in parentheses)

	Variable		West Germany (1984-2002)	East Germany (1992-2002)	UK (1991-2004)
Proportions of total observations:	**Private sector**		0.805	0.772	0.783
	Permanent contracts*		0.933	0.903	0.925
	Workers in small /medium company (employees<200)		0.470	0.663	0.680
	Full-time workers		0.872	0.872	0.921
Worker movement: proportions of total observations:	**Job stayers**		0.740	0.710	0.789
	Internal movers		0.146	0.135	0.079
	External movers		0.114	0.155	0.132
Mean real wage, 1995 prices (lnW):**	**Overall**		3.22 *(0.45)*	2.82 *(0.44)*	1.93 *(0.49)*
	Public sector		3.31 *(0.38)*	2.97 *(0.36)*	2.08 *(0.44)*
	Private sector:	**Big/large company (≥200)**	3.33 *(0.39)*	2.99 *(0.38)*	2.05 *(0.46)*
		Small/medium company (<200)	3.11 *(0.47)*	2.71 *(0.44)*	1.82 *(0.49)*
Real wage changes (ΔlnW)*:**	**Job stayers (ΔlnW_S)**		0.011 *(0.25)*	0.017 *(0.26)*	0.026 *(0.39)*
	Internal movers (ΔlnW_W)		0.008 *(0.27)*	0.011 *(0.28)*	0.066 *(0.38)*
	External movers (ΔlnW_B)		-0.017 *(0.36)*	-0.026 *(0.34)*	0.067 *(0.52)*
Number of individuals			16,474	4,100	13,758
Average number of observations each year			5,687	2,096	5,789
Total number of observations			108,056	23,052	75,262

Notes: * The consistent contract variables in the GSOEP only appear in 1985, 1988 and 1995-2002
** Log form wages are only for full-time workers.
*** Wage changes are only for full-time workers, excluding outlying cases.

Table 6.2: Real wage and unemployment changes, by sector and firmsize, Males in the GSOEP (coefficients on Δu_t from wage change equation 6.2)

		West (1984-2002)			East (1992-2002)		
		Job stayers	Incremental effects: internal movers	Incremental effects: external movers	Job stayers	Incremental effects: internal movers	Incremental effects: external movers
Public Sector		-0.51	-1.75	-3.59	0.52	-1.18	-7.67
		(0.50)	*(6.44)*	*(6.24)*	*(0.76)*	*(3.45)*	*(8.15)*
Private Sector		-1.32**	-1.88	-3.14	-0.41	-0.17	1.69
		(0.62)	*(1.77)*	*(2.78)*	*(0.40)*	*(1.70)*	*(2.17)*
Private sector:	**Small firm (~20)**	-1.33	-2.89	0.79	-0.12	0.32	0.85
		(1.07)	*(3.05)*	*(3.09)*	*(1.03)*	*(5.62)*	*(2.78)*
	Medium firm (20~200)	-1.29***	-2.69	-5.08*	-0.03	-1.82	4.45
		(0.58)	*(2.92)*	*(3.27)*	*(0.51)*	*(2.25)*	*(3.85)*
	Big firm (200~2000)	-2.15***	-0.24	-2.05	-0.40	-0.24	6.05
		(0.74)	*(1.67)*	*(3.13)*	*(1.58)*	*(3.21)*	*(4.58)*
	Large firm (2000~)	-0.43	-1.75	-6.99	-1.32*	6.97	-9.55
		(0.58)	*(2.28)*	*(8.51)*	*(0.78)*	*(4.33)*	*(6.52)*

Notes: Standard errors are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels for two-tail tests. There are 55,233 individual observations in the first stage (46,848 for the west and 8,385 for the east), and 17/10 region-wide weighted observations for the west/east in the second stage. Unemployment rates are from the Labour Force Survey (LFS)-Germany. Wage is deflated by regional CPI, also provided by the Federal Statistics Office (FSO).

Table 6.3: Real wage and unemployment changes by sector and firm size, Males in the BHPS 1991-2004
(coefficients on Δu_t from wage change equation 6.2)

		Males (1991-2004)		
		Job stayers	**Incremental effect for internal movers**	**Incremental effect for external movers**
Whole Economy				
Public Sector		0.86	-1.14	-5.18***
		(0.93)	*(4.20)*	*(2.49)*
Private Sector		-2.57***	1.26	1.51
		(0.58)	*(0.87)*	*(1.44)*
Private sector:	**Small firm (~25)**	-3.13***	6.77***	4.81**
		(0.86)	*(2.56)*	*(2.46)*
	Medium firm (25~200)	-1.94***	0.04	0.44
		(0.61)	*(2.03)*	*(1.33)*
	Big firm (200~1000)	-3.29***	-3.57	-1.65
		(0.88)	*(3.05)*	*(2.43)*
	Large firm (1000~)	-0.49	-1.40	-1.12
		(1.86)	*(3.42)*	*(5.34)*
North-South Split				
South		-1.70***	0.23	-1.46
		(0.38)	*(1.91)*	*(1.46)*
North-Central		-1.77***	1.00	1.15
		(0.60)	*(0.72)*	*(1.11)*
Chi-square test for equality of coefficients for South and North-Central				3.38 (p>0.7592)

Notes: Standard errors are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels for two-tail tests. There are 25,667 individual observations in the first stage, and 12 region-wide weighted observations for the second stage. Unemployment rates are from the Labour Force Survey (LFS)-UK. Wage is deflated by national CPI, also provided by the Office for National Statistics (ONS).

CHAPTER SEVEN: CONCLUSIONS

What are institutions? Why are they important for earnings inequality? According to Hodgson (2006), this term "institutions" has a long history of usage in the social sciences, dating back at least to *Giambattista Vico* in his *Scienza Nuova* of 1725. Institutions are important to a society, since they can provide some kinds of "public goods" to the whole society or certain collective sub-groups within the society (such as trade union members), just as organizations of government and public service. Even though it is widely accepted that institutions are an indispensable part of a society, according to Hodgson (2006), there is no consensus in the definition of this concept.

In North's (1990, p3) simple words, institutions are "rules of the game … or …humanly devised constraints". Institutions are identified with the making and enforcing of rules to govern collective human behaviors. Hence, we can regard institutions as rules of collective behaviour in a society or "a regularity of the conduct of individuals" (Hayek 1967, p67). In my thesis, institutions are the rules of collective behaviour in labour markets. Workers get paid from their jobs according to their productivity as well as the institutional environment they are under.

As far as the different labour market performance between the UK and continental European countries is concerned, it is convenient to simply accept the "Krugman hypothesis", that the high earnings inequality in the UK as well as the high unemployment rates in continental Europe are due to different institutions such as centralised collective bargaining, or employment protection laws. However, many years ago, Addison and Siebert (1979) said:

> "Many labour economists of this persuasion have been curiously reluctant to believe that the genesis of labour market institutions may lie at least partly in economics. The task is, then to look for a broader framework - a structure that lies behind actual market forces - that provides explanations of why the latter take the form they do." (Addison and Siebert, 1979, p5-6)

On the one hand, institutions should arise from Nash equilibriums of games in a society (see the theoretic model in Koeniger et al 2004). Otherwise, institutions as game rules would be rejected by game players, including individuals and organizations in the society. On the other hand, institutions determine strategy sets and utility functions in games. Players' behaviors arise from the given set of institutional rules, just as Hayek (1973, p11) emphasized that "man is as much a rule-following animal as a purpose-seeking one." Different institutions in the UK and in continental European countries may arise from long term social equilibriums as well as short and medium term shocks in a dynamic society. Thus, we can see "more pressures for reform, but also more opposition to change" in the whole Europe (Boeri 2005, p8).

We should not ignore other short or medium term impacts from new technologies and globalization. Garicano and Hansberg's (2006) model suggests that a reduction in the cost of processing information leads to an increase in the knowledge-content of all jobs, an organisation decentralization and an increase in wage inequality within skill categories, while a reduction in the cost of

communication should reduce the knowledge content of production jobs, and increase centralization and skill hierarchies within the organization. This in turn should decrease wage inequality among less skilled workers but, increase inequality among skilled workers and between skilled and less skilled workers. Their theory shows that technological and organisational evolution may work together to change wage structures.

At the same time, the rise of China and India is an important phenomenon in the international labor market. Freeman (1995) argued that the lack of compelling evidence that trade underlies the problems of the less skilled in the past does not rule out the possibility that trade will dominate labour market outcomes in the future. Even though we can generally reject international trade as the explanation of the past decline in the demand for unskilled workers (since the 1970s), there is a good chance that, in the future, pressures for factor price equalization will grow. Just as Freeman (1995) mentioned, maybe wages were not set in Beijing yesterday or today, but tomorrow they will be.

With these ideas in mind, let me summarise my findings, and consider implications for future research. My study has aimed to describe and analyze earnings inequality in the UK, incorporating institutional measures and changes. Institutional reforms since the Thatcher-era in labour market are widely regarded as a major contributor to the UK's better economic performance as well as her higher earnings inequality (see Blanchflower and Freeman 1993, and Devereux and Hart 2006). The conventional argument is that flexible labour market institutions in the UK allow

wages to adjust to changes of market conditions and achieve new equilibriums as required.

In continental European countries, however, centralized wage setting institutions prevent wages from falling in response to economic shocks and the imposition of new marketing conditions "flows". Hence, in the face of SBTC, the rigidity of labour markets maintains the wage of unskilled workers above equilibrium. There is an excess-demand for skilled workers as well as a higher unemployment rate for unskilled workers. Thus, it is not surprising to see evidence of a negative association between rigid institutions and wage inequality in cross-country analysis (e.g. Koeniger et al 2004, Table3, p27, see also the survey in Siebert 2006, Figure 1, p14).

It is sometimes argued that wage flexibility can also perhaps be achieved by centralised and coordinated bargaining, as in Germany and Italy because of strategic complementarity (see Ball and Romer 1991, Guiso et al 2005 and Peng and Siebert 2007, 2008). However, why then is wage bargaining at the individual or company level preferred in the UK? On the one hand, it may be supposed that coordination of wage bargaining is not, in fact, necessary for labour market flexibility. On the other hand, US-style labour market institutions may not seem to be the best way to improve labour market performance, especially considering the cost of higher earnings inequality. Thus, the efficiency of such institutional reforms is further questioned in this section.

In Chapter 2, I track the growth of earnings inequality in the UK from 1972 to 2002. Earnings inequality has increased substantially over the last three decades, during which overall hourly wage inequality (90th-10th percentile differential) has increased by about 25 percent for males. Along with the increase of skill (mainly education) inequality and skill premiums, residual wage inequality of males has also increased by about 14 percent during the same period. This result implies that changes in skill endowments and market valuation cannot capture all the wage changes in the British labour market. A significant residual space is left for further analysis.

Consequently, Chapter 3 tests whether relative supply shifts, given stable or steadily growing relative demand can explain the changes of relative wage (that is, Katz and Murphy hypothesis, alternatively, Machin hypothesis). From co-variation of relative wages and relative labour supply, we reject the hypothesis that relative labour demand is stable over time. However, steadily growing relative demand combined with relative supply shifts can help explain overall changes in the relative wage over the last thirty years. The market mechanism appears to perform well in the long term.

At the same time, we also find a positive association between relative wages and supply in the 1980s and the 2000s which implies an acceleration of relative demand for skilled workers. These findings are obviously beyond the steadily growing relative demand model. Moreover, this supply and demand analysis cannot explain why there is a steadily growing relative demand, and what factors accelerate the relative demand for skills. Along with technology and industrial shifts, institutions including trade union, the combined system of taxes and welfare benefits and minimum wages could be important forces behind these changes. Much cross-country

research (for example Gottschalk and Joyce 1998, Card et al 2003 and Koeniger et al 2007) treat the UK as an intermediate case between the rigid labour market of continental European countries and the flexible labour market of the United States. Thus, Chapter 4 analyzes changes of skill premiums in the UK, incorporating these various institutional forces.

A fairly consensual position is that wage changes reflect both market factors and the institutional environment. Chapter 4 disentangle the impact of labour market institutions from traditional supply-demand framework. Controlling for explanatory variables such as industrial structure, technology and market conditions, the links between institutions and skill premiums are analyzed in this chapter. We find the institutional factors such as trade unions and unemployment benefits are significantly associated with changes in skill premiums. For instance, the decline of trade unions in the private sector explains about one third of the rise in degree premium since the 1970s. On the other hand, increases in unemployment benefit over the period 1979-1998 appear to reduce the degree premium in the private sector by about 9.31 percent. Therefore, we can conclude that institutional changes, especially the decline of trade unions after the 1970s, are important contributors to the increasing skill premiums and earnings inequality in the UK.

In Chapter 5 and Chapter 6, we provide clearer empirical facts on wage flexibility in three countries: Italy, Germany and the UK. We analyze the effect of different wage-setting institutions on the extent of wage adjustment over the business cycle. With worse economic performance than the US and the UK, policy-makers of many continental European countries have especially emphasized wage flexibility in

recent years. If wages respond to market conditions, adverse shocks from business cycles can result in wage adjustments rather than unemployment. Broadly speaking, private sector wages in the UK are set at the company or individual level, compared with the centralised collective agreements in Italy and Germany. These two chapters find an overall procyclical wage in the UK, in contrast to procyclical wages only in the prosperous regions of Italy (the north) and Germany (the west). Wage rigidity in the lagging regions in Italy (the centre-south) and Germany (the east) appears to be associated with the centralised and coordinated wage setting institutions in both countries.

For Italy, we find that stayers in the Northern region have procyclical real wages, (which is strongest for the private sector and for small firms) but, wages in the Centre-Southern Italy have a perverse pattern. They seem to respond only to Northern unemployment conditions, and not at all to local conditions. Wages even of the smallest firms appear irresponsive to local conditions. Thus, it looks as though the Northern labour market works in an efficient way, but the Southern does not.

Similarly, real wages of stayers in the private sector in West Germany – but not East Germany appear to be procyclical, and quite sensitive to unemployment, comparable to the US and the UK. But in Germany, as in Italy, wages in the public sector do not change over the business cycle.

It is interesting to note that the private sectors of the UK, West Germany and Northern Italy all appear to be similarly flexible, whatever the underlying differences in wage-setting institutions – be it the centralised bargaining in Northern Italy, the

coordinated pattern bargaining of West Germany, or the company bargaining and individualism of the UK. Admittedly, the overall wage cyclicality in the UK is still higher than in these two regions, but the policy conclusion seems to be that when regions within a country are reasonably prosperous, the different types of wage-setting institution give the same result. However, when a region is lagging, as in the case of East Germany or Italy's South, centralised bargaining or coordinated pattern bargaining delays recovery. Thus, the advantages of company bargaining are not only better responsiveness of wage, but also the freedom to decide wages at a micro economic level. Flexible wage setting institutions allow wages to adjust to changes in the local market conditions, while rigid wage setting institutions only provide channels for some regions or firms.

Now, we can go back to our arguments at the beginning of this chapter. Since institutions can regularize the conduct of individuals, different institutions means different Nash equilibriums of wages and employment in the labour markets, which are also above or below the equilibrium results in a competitive market (see Koeniger et al, 2004). We see the dramatic trade union decline since the 1970s with higher earnings inequality in the UK, but not in Germany and Italy.

In a democratic country such as the UK, institutional evolution may only reflect preferences of the median voters. But, if the rich game player (such as trade unions in the North of Italy) can take advantage of rules of the game by imposing bargaining results that are good for them (the "insiders") upon the poorer players, there must be "government failures". And this inefficient institutional arrangement will bring inefficiency to the labour market and hence to the whole economy. Thus, in

an international comparison, there are “efficient” or “inefficient” distinctions and smart institutional choices.

More research is needed here. Three results stand out, and will need to be tested in future work. First, as we argued at the beginning of this chapter, institutions are actually endogenous to the whole economic and social system. Acemoglu et al (2001) would rather regard institutional factors as consequences of labour market changes or an important intermediate than as an exogenous dominant reason. The changes in the skill premiums (earnings inequality) may induce institutional changes such as deunionization. We may need a model allowing channels from earnings inequality to institutions and corresponding empirical specifications.

Secondly, Italy’s centralised institutional arrangements, as well as German coordinated wage setting, worked well for prosperous areas in both countries. The fact that all firm size categories in the north of Italy have flexible wages shows that benefits can be achieved from high collective bargaining coverage. The flexible wage in the private sector in the west of Germany also shows good aspects of pattern bargaining. However, this institutional system has worked badly for the poorer Southern Italy and East Germany, and more research is needed here.

Finally, labour market reforms in the UK appear to have been successful in promoting economic performance. But, is rising earnings inequality necessary for a flexible labour market and better economic performance? Recent research shows that the National Minimum Wage contributes to decreased earnings inequality, without a negative employment impact for unskilled workers (see Metcalf, 2004). It seems there

is “the third way” in institutional choice. Further research is needed to find the origin of success or failure in labour market institutions and earnings inequality.

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