UK Workplace Injuries in the context of Occupational Change, 1986 - 2004

Rhys Davies and Paul Jones*[1]

July 2006

PRELIMINARY AND NOT FOR QUOTATION

Abstract

This paper details changes in rates of workplace injury in the UK from 1986 to 2004, and provides an assessment of factors within the broader economic environment which contribute towards changes in the incidence of workplace injuries over time. Analysis is based upon administrative records collected by the Health and Safety Executive (HSE) and on Labour Force Survey (LFS) data. The dominant factor affecting the likelihood of injury at the individual level is found to be occupation. With this in mind we show that the downward trend in injury rates during this time has partially been driven by changes in the occupational composition of employment. However, the findings also reveal notable improvements in workplace safety over the period which cannot be explained by changing occupational composition alone.

Keywords: Workplace Injuries, Health and Safety, Occupational Change.

Word Count: 9,350 words

Correspondence*: Paul Jones, Warwick Institute for Employment Research, University of Warwick, Coventry CV4 7AL, UK. E-mail: p.s.jones@warwick.ac.uk

---

[1] This paper owes its origin to work funded by the Health and Safety Executive (HSE) under the 'Trends and Context to Workplace Injuries' project. In this respect we thank our sponsors and acknowledge their input, not least of all in allowing access to the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) data. We would also like to acknowledge the contribution of Graham Stevens, Alberto Pompermaier, Ingrid Summersgill, Andrea Blackburn, and Vicky Warbrick of the HSE, and Peter Elias of the Institute for Employment Research, all of whom have provided valuable comments on the contents of the analysis.

1 Introduction

At the turn of the decade the UK government set out national targets for health and safety. This 10-year strategy forward to 2010 introduced a number of over-arching objectives. These include: reducing working days lost due to injury and ill health by 30 per cent, reducing the incidence rate of cases of work-related ill-health by 20 per cent and reducing the occurrence of fatal and major accidents by 10 per cent. The plan set out by the government includes measures to motivate employers, engage small firms, improve health and safety in the public sector and to instigate changes to the National Curriculum to secure greater coverage of risk concepts in education[2]. The establishment of such targets reflects a desire to demonstrate that the regulatory regime can have a positive impact on 'bottom line' measures of health and safety. However, are there other factors within the broader economic environment that can influence rates of workplace injury which cannot be easily influenced by the regulatory regime?

Health and safety policy, and changes in the incidence of workplace injuries, is set against the context of the changing world of work. Not least of all changing patterns of industrial employment over recent years have profound implications for the demand for different types of occupations. The decline of employment in primary and manufacturing industries (whose share of employment have decreased from 5 to 2 percent and 23 to 13 percent of employment, respectively, since 1982) has resulted in a clear shift in employment away from more traditional, blue collar manual occupations towards more what on the whole are safer occupations. For example, there has been a decline of employment within skilled trades occupations and amongst transport and machine operatives over the same period (from 17 to 11 percent and 12 to 8 respectively). In contrast, the growth in service sector employment has lead to the expansion of jobs in a number of non manual occupations, including increases in the share of employment amongst managers and senior officials, professional and associate professional and clerical and administration occupations.[3]

---

[2] The government's strategy is laid out in 'Revitalising Health and Safety Strategy Statement' (DETR, 2000). Our paper does not set out to test the success or otherwise of the targets, but instead provide a more general analysis of factors influencing injuries at work.

[3] Figures taken from Cambridge Econometrics/Institute for Employment Research Estimates.

This paper investigates trends in workplace injuries since 1986 against this background of occupational change. The paper details changes in rates of workplace injury in the UK from 1986 to 2004, based on rates of injuries constructed from reports of accidents made to the Health and Safety Executive (HSE) under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR). To our knowledge, other than Stevens (1992) ours is the first paper in recent years to utilise this datasets to analyse trends in workplace injuries.

The paper also provides an assessment of factors within the broader economic environment which contribute towards changes in the incidence of work related accidents between 1993 and 2004 based on an analysis of the Labour Force Survey (LFS), which offers a rich source of micro data relating workplace injuries to personal and workplace characteristics. An earlier study of workplace injuries using this dataset was undertaken by McKnight et al (2001) whereas other studies in the UK have tended to use the Workplace Industrial Relations Survey (WIRS) which although based on establishments tends to be potentially more restricted in terms of sample coverage; see Nichols (1990, 1994, 1997) and Litwin (2000) for previous work[4].

As well as documenting changes in rates of workplace injuries over time and examining factor affecting the likelihood of injury, the paper seeks to establish to what extent changes in injury rates over time have been driven by occupational change and how far improvements in health and safety have been concentrated within particular occupations or industries. To this end, we implement an Oaxaca decomposition (see Oaxaca, 1973) of the aggregate rate of injuries to separate out the effects of the changing occupational composition from changes in rates of injuries due to other residual factors. The effect of changing employment is documented as are any detected improvements in workplace health and safety over time.

---

[4] For an overview of previous work on factors affecting workplace injuries see Nichols (1997) and Hillage et al (1998).

2 Sources of Workplace Injury Data

There are two main comprehensive and regularly updated sources of information relating to the occurrence of accidents at work available in the UK. These sources of data, along with the timeframe of their availability, are as follows:

- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR): available from April 1986 onwards;
- UK Labour Force Survey (LFS); available from 1993 onwards, winter quarters only.

The first of these data sources, RIDDOR, is collected by the UK's Health and Safety Executive (HSE). Under current UK legislation, employers are responsible for reporting workplace accidents to the HSE where employees or self employed subcontractors are killed or sustain a major injury or injuries that result in an absence from normal work of more than three days. In addition the self-employed are also required to report injuries that occurred whilst working on their own premises. It is noted, however, that whilst all injuries are required to be reported to the HSE the data inevitably contains an element of under-reporting of non-fatal accidents, particularly those which are considered to be minor in nature. The extent of this under-reporting is quantified and modelled as part of the exercise to construct rates of injuries from RIDDOR, as described in the next section of the paper.

The major advantage of the RIDDOR data is that (under-reporting of accidents not withstanding) it presents a comprehensive record of UK workplace injuries over the longest available period for the UK – from April 1986 to March 2004. Quarterly rates of injury are constructed using the RIDDOR data, based on individual records of workplace injuries. These rates incorporate relevant information on the individual's gender, sector of employment and the severity of the injury (fatal, major or resulting in over-3 days absence from work) on the whole period, as well as information on occupation is also available for the last two years of the data, 2002-03. The resulting time series data is used to investigate trends in rates of injury over time as well as the effects of the business cycle on workplace injuries.

The second major source of data on workplace injuries utilised in this study is the Labour Force Survey (LFS), a quarterly household survey covering approximately

60,000 households in the UK. Since 1993, a set of questions relating to workplace injuries has been included in the LFS. During the winter quarters of the LFS, survey respondents are asked whether they have been injured in a work related accident during the past 12 months, whether this injury was in their current job, whether this injury was due to road traffic accident, and how soon after the accident they were able to return to work. Information collected from these questions is used to compute injury rates from ‘reportable’ workplace injuries (i.e. non-road accidents resulting in over 3 days absence) which relate to the occurrence of injuries during the previous year.

Whilst the LFS data may suffer from errors on individual recall with respect to whether or not they had an accident at work[5] the data does not from problems of under-reporting *per se* and is therefore viewed (in line with HSE practices) as a ‘full count’ of work related injuries which may or may not be otherwise reported under RIDDOR. In addition to this the main advantage of LFS based information on workplace injuries is that it provides a rich source of micro level data with a wide range of information on personal, employment and workplace characteristics available at the individual level along with the information on workplace injuries. Therefore, as well as providing extra detail on the cross sectional aspects of injuries (particularly with respect to occupation), this data readily allows the application of multivariate techniques with respect factors associated with increased likelihood of a workplace injury.

3 RIDDOR Reported Workplace Injuries, 1986 - 2004

This section details the construction of the injury rate series and describes the trends in injuries at the aggregate level as well as looking at cross sectional differences in rate of accidents by gender and by sector.

An **unadjusted** injury rate series is constructed each quarter from April 1986 to March 2004 using a count of the number of accidents the RIDDOR as the numerator and the total number of employees in work at each point in time as the denominator (expressed per 100,000 employees)[6]. This is done for major and over 3 day injury

---

[5] This is particularly the case as approximately a quarter of LFS responses are done by proxy, usually on behalf of the partner or spouse.

[6] The number of employees by gender and by sector was supplied by the Office for National Statistics based on a quarterly count from the Labour Force Survey from spring 1992 onwards and an annual

rate series based on RIDDOR 1996 definitions[7] and calculated for all employees, as well as for male and female employees separately. Injury rate series were also calculated by sector of employment. Note that the self employed are deliberately excluded from the analysis of RIDDOR data due to the high levels of under-reporting amongst this group (see Stevens, 1992).

In addition to this series a **full time equivalent** (FTE) rate of injuries is also calculated over the same period. The full time equivalent rate of injuries similarly uses the RIDDOR count as the numerator, but an adjustment is made to the denominator to take into account full time equivalence, in terms of number of hours worked per week, thereby controlling for exposure to accident risk. Since many female employees work part time rather than full time, an unadjusted accident rate based on the raw count of the number of employees may understate the rate of occurrence of injuries for women. The employment denominator is therefore adjusted to a full time equivalent level in each instance based on a full time employee working 40 hours per week[8]. The unadjusted and full time equivalent rate of injuries, relating to non-fatal injuries, are shown for all UK employees in Figure 1, where the series are presented using a 4 quarter moving average to smooth seasonal variation.

A second adjustment is also made to the injury rate series in order to compensate for the effect of under-reporting of accidents within RIDDOR. This is a recognised problem with the RIDDOR data (see Stevens, 1992)[9]. However, as described above, the alternative source of data on workplace injuries from the LFS can be regarded as a 'full count' of work related injuries which may not have been otherwise reported under RIDDOR. The LFS can therefore be used as a benchmark against which the level of under-reporting within RIDDOR can be estimated. The rate of reporting of

---

count prior to this time. Prior to 1992 quarterly estimates of employment are calculated based on an interpolation of the annual data.

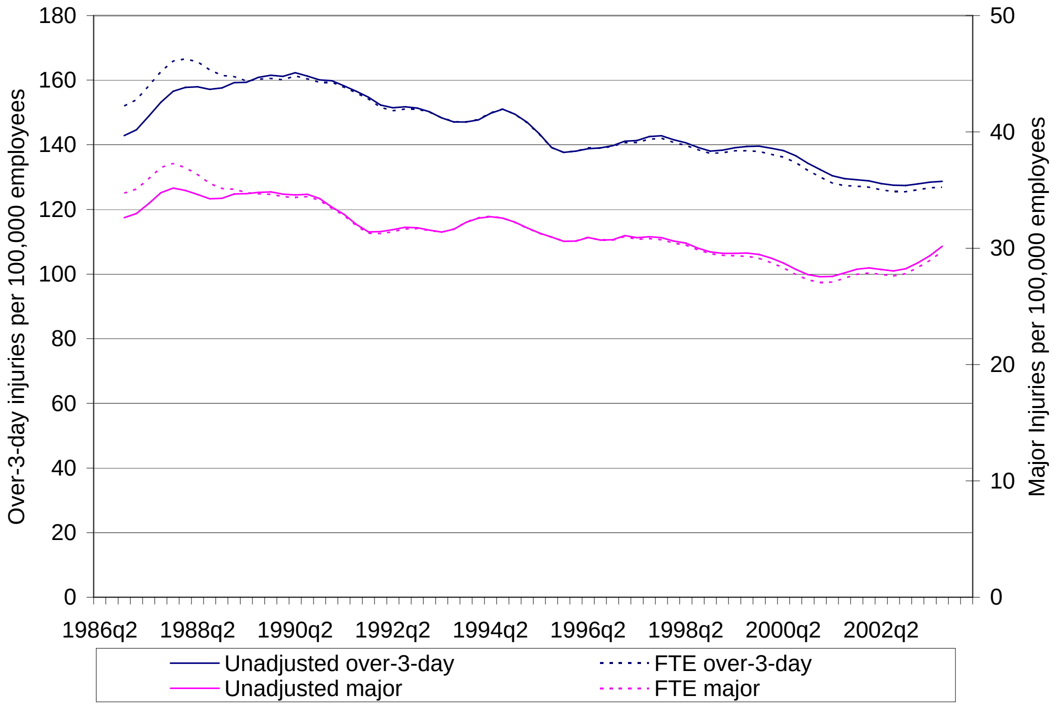
[7] Note that accident rates are constructed based on 1996 RIDDOR definitions. There is a degree of discontinuity in injury data due to the introduction of new reporting regulations in April 1996. Rates prior to this date are adjusted to the new definitions. The adjustment is made on the basis of the coefficient of log injury rate against a step-shift dummy (by type of accident) from the time series models described in section 3. The net effect of the changes was to expand the categories of major accidents (the magnitude of this increase is approximately 50 per cent) and slightly decrease the count of over-3-day injuries (the magnitude of this decrease is approximately 4 per cent).

[8] The figure of 40 hours per week is of course arbitrary. However, this corresponds to a well known and recognisable benchmark figure for full time working which has been utilised in previous work. The term "full time equivalent" employment is therefore synonymous with "40-hour equivalent" employment in this instance.

[9] Comparing the number of accidents reported to RIDDOR with estimates of aggregate number of 'reportable' workplace accidents in the LFS reveals that on average only approximately 40 per cent of all accidents are reported via RIDDOR (see Table 1).

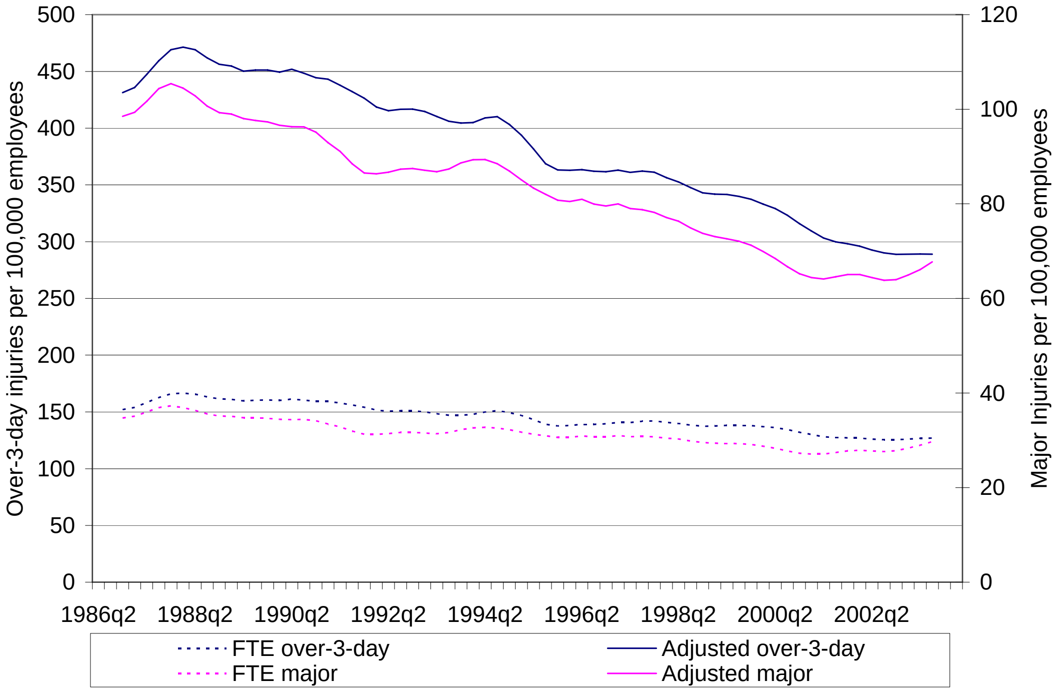
non-fatal injuries RIDDOR is estimated using the ratio of number of major plus over-3-day injuries reported to RIDDOR divided by the aggregate number of reportable injuries derived from the LFS. The LFS does not distinguish the severity of the accident and so we therefore make an implicit assumption that employers underreport major and over-3-day injuries to the same extent.

Figure 1 Trends in rates of workplace injuries, 1986 - 2004



Calculations show that the observed rates of reporting are volatile and vary significantly over time as well as by gender and sector. We therefore use a model of under-reporting in order to derive predicted (fitted) rather than actual rate of reporting each quarter. This is done as follows. Raw rates of under-reporting are calculated comparing FTE RIDDOR and LFS rates of injury, as described above, for each quarter by gender and sector. These raw rates of under-reporting are then regressed against gender and sector dummies as well as a sector specific trend in order to generate 'smoothed' fitted values of under-reporting. These values are available from 1993 onwards, when the LFS is first available. Prior to time the model is used to extrapolate rates of under-reporting backwards based on the time trends established in the model. The regression model is described in Appendix 1. Finally, the (fitted) rates of under reporting are then applied to the injury rate series so that the series is suitably inflated to produce an **adjusted** rate of injuries series. This is shown at the aggregate UK level, along with the FTE series, in Figure 2.

Figure 2 Trends in rates of workplace injuries adjusted for under-reporting



The series relating to aggregate levels of injuries for the UK reveal a general downward trend in the rates of both over-3-day and major injury among males. In contrast, the rate of over-3-day injuries amongst women was trended upwards prior 1994 but has since fallen. Major injuries show a notable downward trend prior to 2000. Since 2000 there appears to have been an increase in the incidence of major injuries, particularly among women, which bucks the general downward trend over time. In each case the obvious result of correcting for under-reporting is the upward shift in the position of these injury rate time series. This is particularly the case among female employees who are more likely to be employed in areas of the service sector where reporting rates are generally lower. In addition, adjusting for improved rates of reporting over time accentuates the effect of the downward trend in injury rates.

Finally, we consider the rates of injury in cross section by sector and by gender. Table 1 shows the average rate of workplace injury by gender and sector from both RIDDOR and LFS sources. The analysis of the LFS data is based on twelve merged annual LFS datasets between winter 1993/94 and winter 2004/05. For consistency, in this instance the RIDDOR figures relate to the average rates of major and over three day accidents based on annual rates over the same period. It can be seen that the workplace injury rate among males is almost twice that observed for females. In terms of absolute numbers, males account for more than two-thirds of LFS reportable accidents and three-quarters of accidents reported to RIDDOR. In terms of sector of employment, again we see a great deal of variation in rates of workplace injuries, with the Construction (F), Agriculture (AB) and Transport, Storage & Communication (I) sectors having the highest rates of accidents, whereas the accident rates in the services sector (JK and OPQ) as well as in Education (M) are much lower.

Table 1 Workplace injury rates summarised by gender and sector

	Accident Rate per 100,000 employees per annum			**Percentage of all accidents**		
	RIDDOR		**LFS**[10]	**RIDDOR**		**LFS**
	Major	**Over-3-day**	**All**	**Major**	**Over-3-day**	**All**
Gender						
Male	130	712	1,720	74	74	68
Female	62	347	890	26	26	32
Sector						
AB: Agriculture, Fishing	241	588	2,110	2	1	2
CDE: Mining, Manufacturing, Utilities	134	479	1,830	30	33	24
F: Construction	250	742	2,170	14	7	12
GH: Retail, Hotels, Restaurants	86	436	1,230	15	14	18
I: Transport, Storage and Communication	122	965	1,960	9	13	10
JK: Financial Intermediation, Real Estate and Business	33	122	500	5	3	6
L: Public Admin and Defence	111	869	1,550	8	12	7
M: Education	72	248	780	6	3	5
N: Health and Social Work	66	559	1,480	7	10	12
OPQ: Other Community, Social, Personal	88	383	1,210	4	3	5
Average Annual Rate/Total	**112**	**617**	**1430**	**100**	**100**	**100**
Average Number of Accidents Per Annum	**23,422**	**127300**	**264200**			

Note: RIDDOR rates relate to FTE rates *not* adjusted to correct for under-reporting.

---

[10] Note that whilst the RIDDOR data suffers from under-reporting, the LFS may be problematic with respect to recall bias on the part of the survey's respondents since questions in the survey collect information on accidents in the preceding 12 month period. Reported accidents are therefore likely to underestimate the actual number of accidents due to both recall error. In addition, information is only with respect to whether or not the respondent has had an accident. We are therefore not able to record multiple instances of accidents per person, although these events are likely to be rare.

4 A Multivariate model of risk of Workplace Injury

The previous section has demonstrated the steady decline of rates of workplace injury over the past two decades (see Figures 1 and 2). The remainder of this paper focuses on seeking explanations as to what is behind this phenomenon. In order to do this we first of all turn our attention to the micro data provided by the LFS to examine the extent to which various characteristics of individuals, their jobs and workplace contribute towards the relative risk of workplace injury.

A cross sectional analysis is undertaken for merged cohorts of the LFS winter quarter between 1992/3 and 2003/4 (inclusive). The multivariate modelling exercise examines the factors related to of risk of injury with two main modelling components:

- Analysis of Variance (ANOVA)
- Logistic regression

The risk of injury is modelled based on a binary dependent variable which corresponds to whether or not the survey respondent has had a workplace injury *in their current job* during the course of the preceding 12 months which resulted in more than three days absence from work. The ANOVA is used to establish the main factors affecting the risk of workplace injury in terms of the contribution of each factor to the explained variance of the model. The set of explanatory variables is selected which relate to various personal (PERS), job (JOB) and establishment (ESTAB) characteristics relating to the individual. Similarly the logistic regression contains the same set of explanatory variables, where the basic structure of the model is presented in the regression equation below. Note that p_i is the risk of injury to person *i* and e_i is the residual for individual *i*.[11]

$$Log\left(\frac{p_i}{1-p_i}\right)=\alpha+\sum_{j=1}^{N(PERS)}\beta_j PERS_j+\sum_{j=1}^{N(JOB)}\mu_j JOB_j+\sum_{j=1}^{N(ESTAB)}\delta_j ESTAB_j+e_i$$

A difficulty in implementing the multivariate analysis described above for the period 1992/3 and 2003/4 is that the classification of occupations changes during this time. From the winter quarter 2001/2 onwards, the 2000 vintage of the Standard

---

[11] The procedure models the log of the odds ratio (the probability of an injury divided by the probability of not having an injury) using a maximum likelihood estimation procedure.

Occupational Classification (SOC2000) replaces the 1990 Standard Occupational Classification (SOC90). There is no direct one to one map between the constituent groups of SOC90 and SOC2000. To overcome this problem, we utilised information from the Winter 1996/7 quarter of the LFS which contained dual coded occupational information (SOC2000 and SOC90). This dual coded data set was used to estimate the level of correspondence between the two classifications and to derive a *composite classification* of occupations. Appendix 2 shows the results of the mapping exercise and the 49 composite occupational groups derived from the 77 minor groups of SOC90 (2 digit level) and the 81 minor groups of SOC2000 (3 digit level).

Table 2 summarises the results of the ANOVA exercise. The factors are ranked in the table by their contribution to the partial (explained) sum of squares. In short, the ANOVA procedure identifies the separate and independent influence of each factor, where a larger sum of squares is associated with a higher covariance of that factor and risk of injury. As well as showing the partial sum of squares, the table also tests the ability of each factor to offer any explanatory power, based on an F statistic. Factors which provide significant explanatory power are marked by an asterisk.

The results show that all of the following factors are able to partially explain the risk of workplace injury: occupation, union membership, job tenure, shift working, hours worked, proxy response in the LFS, qualifications, size of establishment, sector of employment based on SIC, public sector employment, ethnicity and gender. However, we can see that in terms of relative importance, occupation (defined using the 49 composite categories) is by far and away the most important factor associated with an individual's risk of workplace injury. Occupation contributes to almost 40 per cent of the overall explanatory power of the model and clearly dominates all other factors in terms of covariance with risk of injury. Moreover, it is emphasised that sector of employment, although significant, contributed very little to the explanatory power of the model compared with occupation.

Table 2 ANOVA model of LFS reportable injuries

Source	Sum of Squares	Degrees Freedom	F Statistic	Prob > F	Sign.
Model	**89.30**	**155**	**43.8**	**0.000**	
Occupation	33.97	49	52.7	0.000	*
Union membership	3.38	3	85.7	0.000	*
Job tenure	3.30	16	15.7	0.000	*
Shift working	1.88	2	71.6	0.000	*
Hours worked	1.64	13	9.6	0.000	*
Proxy response	1.49	1	113.4	0.000	*
Highest qualification	1.31	7	14.2	0.000	*
Size of establishment	1.07	8	10.2	0.000	*
Sector	0.53	10	4.0	0.000	*
Public sector	0.39	3	10.0	0.000	*
UK Region	0.34	18	1.4	0.104	n.s.
Ethnicity	0.28	8	2.6	0.007	*
Gender	0.12	1	9.4	0.002	*
Full time / part time	0.09	3	2.4	0.067	n.s.
Travel to work time	0.09	3	2.4	0.071	n.s.
Temporary job	0.07	3	1.9	0.135	n.s.
Age group	0.06	5	1.0	0.427	n.s.
Self employment	0.02	2	0.7	0.480	n.s.
Residual	**7323.30**	**556,688**			
Total	**7412.61**	**556,843**			

Note: “*”: significant at the 5 percent error level. “n.s.”: not significant.

The importance of occupation is similarly emphasised in Table 3 which shows the results of the logistic regression. The regression coefficients show the relative risk of injury (summarised by the so called *odds ratio*) compared to the relevant reference or base category. Examining the odds ratios, we can see that the strongest effects on risk of injury in the model come through occupation. Rates of relative risk by occupation vary from a factor of 0.25 (i.e. a risk of injury of only 25% of that of the reference category) to 3.3 (i.e. a risk of injury of only 330% of that of the reference category). In particular, we notice that there is a clear split between manual and non-manual occupations, with highest rates of relative risk restricted to manual employment. The highest relative risks of injury are observed for:

- Construction labourers
- Metal, wood and construction trades
- Vehicle trades
- Agriculture and animal care occupations
- Stores/warehouse keepers

Whereas the lowest relative risks of injury are observed for

- Legal professionals
- ICT professionals
- Public service administrative
- Corporate and public service managers
- Business and financial professionals

Other factors are also shown to affect relative risk of injury. In terms of the influence of personal characteristics, the result reveals that males are approximately 9 per cent more likely to have a reportable workplace injury compared to females. In terms of ethnic background, those of Indian, Pakistani and Bangladeshi origin appear less likely to report having had a workplace injury in the previous 12 months. We also note that proxy respondents in the LFS survey are 24 per cent less likely than direct respondents to report the occurrence of a workplace injury.

In terms of employment characteristics, we estimate that the self-employed are 28 per cent less likely to report having had a reportable workplace injury compared to employees[12]. After controlling for other factors, public sector employees are 23 cent more likely than those in the private sector to report having had a reportable workplace injury. Similarly, union members are 49 cent more likely than non-union members (ref) to report having had a reportable workplace injury. In terms of size of establishment, those working in smaller establishments are least likely to report having had a reportable workplace injury. Those working shifts were estimated to have a significantly higher risk of workplace injury compared to those who did not work shifts.

The effect of job tenure and hours worked deserve more attention since we must be careful to correct the relative risks for exposure to injury risk. For example, an employee with six months job tenure has only *a* half the potential exposure to risk of someone who has been in their job for a year or more. Similarly, somebody who works 20 hours per week as opposed to 40 hours has only half the potential exposure to risk. In each of these cases it is therefore necessary to rescale the

---

[12] Further analysis (results not shown) revealed that this relationship was also observed for the broader definitions of workplace injuries and can therefore not be attributed simply to the self-employed returning to work faster after the occurrence of a workplace accident. Similar conclusions were reached with respect to higher rates of injuries amongst the self employed.

relative risks by normalising the exposure to risk. In the case of job tenure, to a year for all job tenure of less than twelve months; and in the case of hours worked relative risk coefficients are been rescaled to an exposure of 42.5 hours based on the mid point of the base category (40-45 hours per week).

It is noted that once the relative risk of injury for job tenure and hours worked are adjusted for exposure to risk the figure reveals a very pronounced effect of job tenure on risk of injury, with the risk of injury declining rapidly after the early months of employment. In particular the increased risks associated with tenure are particularly apparent during the first four months within a new job. Similarly, after adjustment for exposure to risk we find that those working shorter hours in fact have higher relative risk of injury *on a per hour worked basis* compared to those working longer hours.

Table 3 Logistic regression model of LFS reportable injuries[13]

Explanatory Variable	Odds Ratio	Std. Err.	z	P>|z|
Gender				
Male	1.083	0.038	2.26	0.02
Female	ref.			
Ethnicity				
White	ref.			
Caribbean	0.889	0.118	-0.88	0.38
African	0.932	0.171	-0.38	0.70
Indian	0.644	0.084	-3.38	0.00
Pakistani	0.634	0.129	-2.24	0.03
Bangladeshi	0.223	0.158	-2.11	0.03
Chinese	0.860	0.275	-0.47	0.64
Other	0.883	0.115	-0.96	0.34
Age				
Age 16 to 19	1.006	0.074	0.08	0.94
Age 20 to 24	1.074	0.061	1.25	0.21
Age 25 to 34	1.056	0.046	1.24	0.22
Age 35 to 44	1.066	0.044	1.55	0.12
Age 45 to 54	1.025	0.043	0.58	0.56
Age 55 plus	ref.			
Highest Qualification				
Degree or equivalent	ref.			
HE Below Degree	1.693	0.139	6.39	0.00
A-Levels	1.963	0.142	9.32	0.00
GCSE A-C	2.039	0.151	9.65	0.00
Other qualification	2.055	0.155	9.52	0.00
No qualification	1.745	0.139	6.98	0.00
Region of Residence				
Tyne and Wear	0.978	0.100	-0.22	0.83
Rest of North	ref.			
South Yorkshire	1.174	0.106	1.77	0.08
West Yorkshire	1.151	0.093	1.73	0.08
Rest of Yorkshire	0.961	0.086	-0.44	0.66
East Midlands	1.007	0.073	0.10	0.92
East Anglia	1.067	0.087	0.80	0.42
Inner London	1.055	0.102	0.55	0.58
Outer London	1.126	0.087	1.53	0.13
Rest of South East	1.002	0.065	0.03	0.98
South West	1.011	0.072	0.16	0.87
West Midlands MC	1.085	0.087	1.01	0.31
Rest of West Midlands	1.012	0.079	0.15	0.88
Greater Manchester	0.975	0.081	-0.31	0.76
Merseyside	1.187	0.114	1.79	0.07
Rest of North West	1.103	0.089	1.22	0.22
Wales	1.057	0.082	0.72	0.47
Strathclyde	0.897	0.077	-1.27	0.20
Rest of Scotland	0.986	0.075	-0.18	0.86

---

[13] The regression is based on a combined sample of 556,844 individuals. The pseudo R-squared statistic on the analysis is 0.0845 (Chi squared = 6732.55, which is significant at the 0.1 per cent error level).

Explanatory Variable	Odds Ratio	Std. Err.	z	P>|z|
Survey Responder				
Personal response	ref.			
Proxy response	0.760	0.020	-10.48	0.00
Sector				
Private	ref.			
Public	1.230	0.055	4.64	0.00
Union Membership				
Not known	1.127	0.060	2.25	0.02
Union member	1.494	0.046	13.13	0.00
Not a union member	ref.			
Shiftworking				
Not known	1.114	0.036	3.30	0.00
No shiftwork	ref.			
Shiftwork	1.269	0.040	7.49	0.00
Employment Status				
Employee	ref.			
Self-employed	0.725	0.041	-5.65	0.00
Establishment Size				
1-10 employees	ref.			
11-19 employees	1.179	0.066	2.96	0.00
20-24 employees	1.309	0.091	3.89	0.00
25-49 employees	1.424	0.070	7.22	0.00
50+ employees	1.407	0.174	2.77	0.01
DK < 25 employees	1.064	0.132	0.49	0.62
DK > 25 employees	1.396	0.058	8.03	0.00
Tenure				
1 month or less	0.413	0.051	-7.11	0.00
2 months	0.543	0.077	-4.34	0.00
3 months	0.697	0.082	-3.05	0.00
4 months	1.064	0.107	0.62	0.54
5 months	0.921	0.104	-0.73	0.47
6 months	0.953	0.112	-0.41	0.68
7 months	0.828	0.107	-1.46	0.14
8 months	1.321	0.145	2.54	0.01
9 months	1.344	0.149	2.66	0.01
10 months	1.248	0.145	1.91	0.06
11 months	1.277	0.152	2.06	0.04
1 to 2 years	1.366	0.074	5.76	0.00
2 to 5 years	1.419	0.066	7.49	0.00
5 to 10 years	1.368	0.063	6.82	0.00
10 to 20 years	1.177	0.052	3.71	0.00
20+ years	ref.			
Hours Worked				
0-5 hours	0.174	0.046	-6.67	0.00
5-10 hours	0.297	0.037	-9.76	0.00
10-15 hours	0.403	0.039	-9.28	0.00
15-20 hours	0.550	0.041	-7.99	0.00
20-25 hours	0.592	0.040	-7.66	0.00
25-30 hours	0.892	0.062	-1.65	0.10
30-35 hours	0.995	0.060	-0.08	0.94

Explanatory Variable	Odds Ratio	Std. Err.	z	P>|z|
35-40 hours	0.913	0.033	-2.53	0.01
40-45 hours	ref.			
45-50 hours	1.061	0.042	1.51	0.13
50-55 hours	1.088	0.052	1.79	0.07
55-60 hours	1.244	0.077	3.53	0.00
60+ hours	1.258	0.060	4.76	0.00
Travel to Work Time				
30 mins to work	ref.			
30-59 mins to work	0.994	0.033	-0.18	0.86
60+ mins to work	0.978	0.055	-0.39	0.70
Industry				
AB: Agriculture, Fishing	1.274	0.145	2.13	0.03
CDE: Mining, Manufacturing, Utilities	ref.			
F: Construction	1.198	0.067	3.24	0.00
GH: Retail, Hotels, Restaurants	1.133	0.056	2.52	0.01
I: Transport, Storage and Communication	0.959	0.056	-0.72	0.47
JK: Financial Intermediation, Real Estate and Business	0.818	0.052	-3.19	0.00
L: Public Admin and Defence	1.022	0.083	0.27	0.79
M: Education	0.888	0.082	-1.28	0.20
N: Health and Social Work	1.039	0.077	0.52	0.60
OPQ: Other Community, Social, Personal	1.258	0.086	3.37	0.00
Occupation				
1: Corporate and Public Service Managers	0.253	0.038	-9.18	0.00
2: Production and Quality Managers	0.507	0.086	-4.00	0.00
3: Retail, Distribution and Service Managers	0.682	0.090	-2.89	0.00
4: Senior Protective Service Officers	0.818	0.232	-0.71	0.48
5: Farmers and Farm Managers	2.130	0.302	5.33	0.00
6: Natural Scientists	0.341	0.110	-3.33	0.00
7: Engineers	0.509	0.090	-3.81	0.00
8: Health Professionals	0.307	0.090	-4.01	0.00
9: Teaching Professionals	0.500	0.070	-4.95	0.00
10: Legal Professionals	0.174	0.103	-2.96	0.00
11: Business and Financial Professionals	0.267	0.078	-4.50	0.00
12: Architects, Draughtsmen and Surveyors	0.315	0.093	-3.93	0.00
13: Librarians	0.599	0.278	-1.10	0.27
14: Public Service Professionals	0.755	0.152	-1.40	0.16
15: Scientific Technicians	0.807	0.140	-1.24	0.22
16: ICT Professionals	0.239	0.066	-5.16	0.00
17: Ship, Aircraft Officers and Controllers	1.330	0.350	1.08	0.28
18: Health Associate Professionals	0.921	0.125	-0.60	0.55
19: Legal Associate Professionals	0.402	0.238	-1.54	0.12
20: Business, Finance and Public Service Assoc. Prof.	0.392	0.069	-5.32	0.00
21: Welfare and Social Care Occupations	1.914	0.234	5.30	0.00
22: Artistic and Sports Professionals	1.116	0.175	0.70	0.48
23: Public Service Administrative	0.250	0.053	-6.55	0.00
24: Clerks, Cashiers	0.383	0.062	-5.92	0.00
25: General Administrative Occupations	0.370	0.055	-6.74	0.00
26: Stores/Warehouse Keepers (M)	2.388	0.313	6.64	0.00

Explanatory Variable	**Odds Ratio**	**Std. Err.**	**z**	**P>|z|**
27: Secretaries & Receptionists	0.281	0.048	-7.45	0.00
28: Metal, Wood and Construction Trades *(M)*	2.877	0.369	8.23	0.00
29: Metal Machining Trades *(M)*	1.996	0.270	5.11	0.00
30: Electrical Trades *(M)*	1.624	0.223	3.53	0.00
31: Vehicle Trades *(M)*	2.790	0.396	7.22	0.00
32: Routine Operatives *(M)*	1.758	0.226	4.38	0.00
33: Printing Trades *(M)*	1.399	0.267	1.76	0.08
34: Food Preparation and Service *(M)*	1.474	0.193	2.96	0.00
35: Armed Forces and Security Occupations	1.737	0.234	4.10	0.00
36: Travel Assistants and Personal Services *(M)*	1.029	0.201	0.15	0.88
37: Child carers *(M)*	*ref.*			
38: Hairdressers, Beauticians *(M)*	0.596	0.166	-1.85	0.06
39: Domestic Staff *(M)*	1.374	0.242	1.80	0.07
40: Sales Agents	0.625	0.103	-2.86	0.00
41: Sales Assistants	1.179	0.154	1.27	0.21
42: Process and Plant Operatives *(M)*	2.255	0.304	6.02	0.00
43: Construction and Plant Operatives *(M)*	2.095	0.287	5.40	0.00
44: Road Transport Operatives *(M)*	2.377	0.306	6.72	0.00
45: Mobile Machine Drivers *(M)*	2.173	0.320	5.27	0.00
46: Agriculture and Animal Care Occupations (*M)*	2.733	0.483	5.69	0.00
47: Construction Labourers *(M)*	3.314	0.509	7.80	0.00
48: Elementary Administration Occupations *(M)*	2.023	0.306	4.66	0.00
49: Cleaning, Elementary Sales Occupations	2.062	0.249	6.00	0.00

Note: (M) = Manual Occupation

5 The Effect of Changing Occupational Composition

The analysis so far has revealed that occupation is a major factor in driving the change in accident rates over time. The multivariate analysis of individual occurrences of injury based on LFS data reveals that occupation is the dominant underlying factor, compared with other relevant factors, in determining the probability of an individual having a workplace. It is therefore interesting to extend the analysis to consider the effect of occupational change over the period 1986 - 2004, and to examine what extent to which the gradual decline of workplace injuries during the period may be attributed to changes in the occupational composition of employment.

The changes in occupational composition over this time period may be analysed using estimates of employment from the LFS. This is combined with data on injury rates **by occupation** from the two main sources:

- RIDDOR, for 2002/3
- LFS, 1993 - 2004

The advantage of the first source of information is that the RIDDOR data is able to separate out the severity of injury, in terms of major and over 3 day injuries. However, in this case injury rate data by occupation is available only for 2002/3.[14] The advantage of the LFS data, in contrast, is that injury rate data is available by occupation for a number of years back to 1993. This means that we are able to track both the effect of changes in occupational composition and the changes in rates of injury within occupation. Analysis of the effect of changing occupational composition is undertaken separately using both sources of data, as outlined below.

Occupational Change using RIDDOR Injury Rate Data

The analysis is undertaken as follows. The rate of major and over-3-day injuries adjusted for under-reporting is available from RIDDOR by occupation for 2002/3. Applying these rates to the composition of employment by occupation in 2003, we obtain an overall quarterly rate of major injury of 67 per 100,000 employees and a rate of over-3-day injury of 289 per 100,000 employees. These rates should be already familiar from Figure 2. The same rates of injury by occupation are then applied to the occupational composition of each year back to 1986, based on the 49 occupation categories used previously[15]. The resulting series is the expected rate of injury which we would anticipate based on changes in occupational composition over time. The resulting injury rate series is shown in the upper panel of Figure 3 for major injuries (upper panel) and over-3-day injuries (lower panel) and is compared with the actual rate of injuries.

The results show that the changing occupational structure over the period does help to partially explain falling rates of injury over time. During 1986, it can be seen that the rate of major injuries is 45 per cent higher than that observed in 2003. Similarly,

---

[14] RIDDOR injury rate data is available by occupation for 2003/4 but this was provisional at the time of writing and was therefore not utilised.

[15] Before and including 1990 the composite classification of occupations is extended to include the Key Occupations for Statistical Purposes (KOS) classification system. In order to derive a consistent occupational series for 1986 onwards, we therefore map KOS codes onto the 49 occupation categories. Details of this mapping are available from the authors on request.

the rate of over-3-day injuries is 49 per cent higher than that observed in 2003. Based on our knowledge of changing occupational composition over this period, we would have expected the rates of both major and over-3-day injuries to have been 23 per cent higher in 1986 compared to those observed in 2003. Therefore, the decrease in that actual rate of workplace injury observed over this period can be apportioned approximately equally between occupational factors and to other residual effects. With regards to the residual decrease in injury rates, a number of otherwise unidentified factors may be at play. Firstly, there is the possibility of secular decreases in the rate of injury within occupations over time as a result of real improvements in health and safety over time. Secondly, while occupation is the dominant influence upon an individual's risk of suffering a workplace injury, there may be a range of other factors such as those relating to gender composition of employment and changes in the pattern of work.

Occupational Change using LFS Injury Rate Data

Whereas the analysis of the RIDDOR data is particularly useful in that we are able to analyse workplace injuries by severity of injury, the analysis is restricted by the fact that a detailed breakdown of rates of injury by occupation is not available each year. This information is, however, available in the LFS over the shorter period of 1993 - 2004. In particular, we are able to obtain from the LFS the rate of injury by occupation and the composition of employment by occupation on an annual basis, based on the winter quarters. The availability of this data allows us to analyse changes in the overall rate of injuries each year into two composite effects:
(1) the effect of changing occupational composition; and
(2) the effect of changes in injury rates within occupation.
This is done using the **Oaxaca decomposition** (see Oaxaca 1973) where the overall change in rate of injuries each year between these two composite effects, which are additive and sum to the overall change. A technical exposition of the technique is provided in Appendix 2.

Figure 3 The effect of changing occupational composition

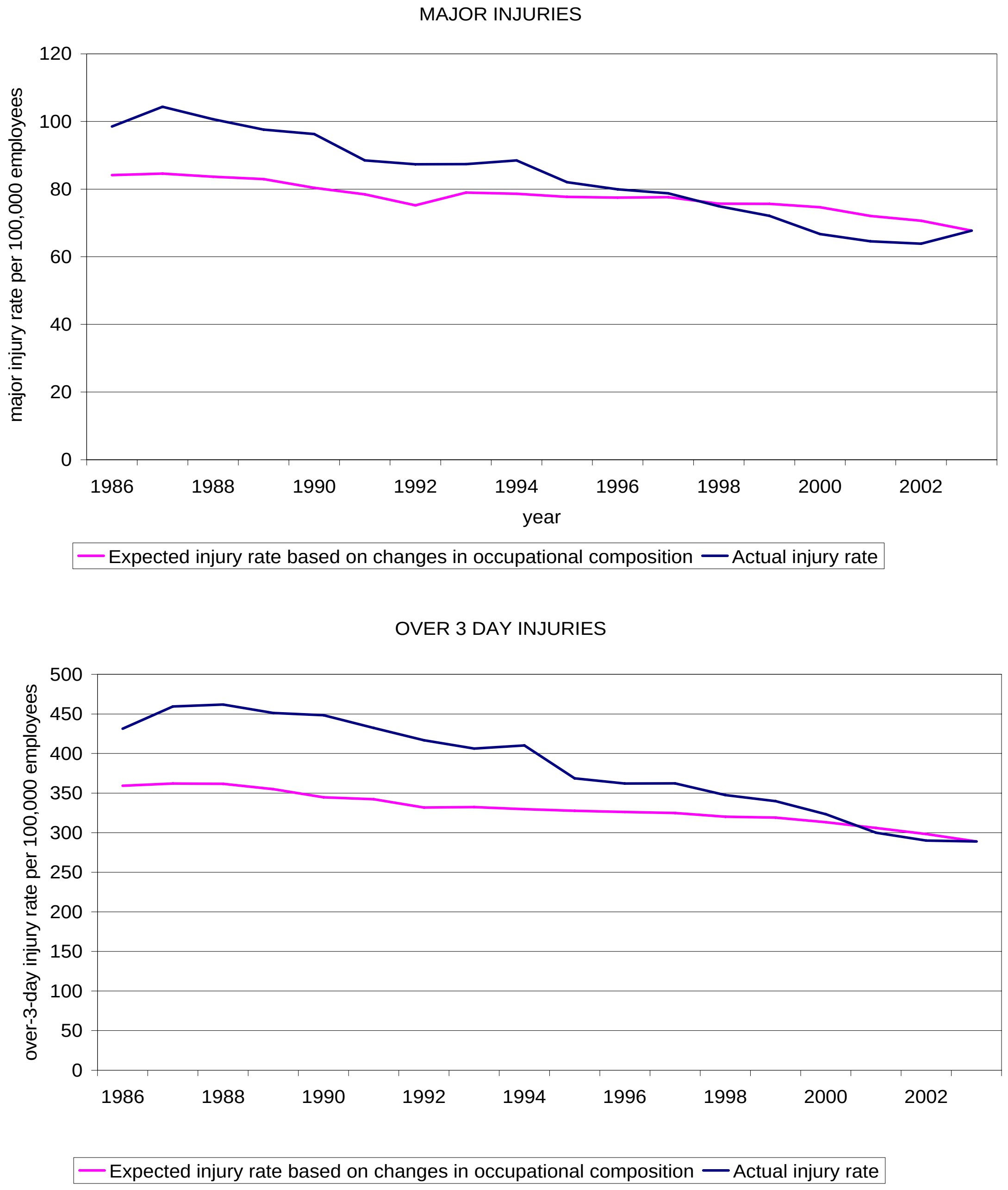
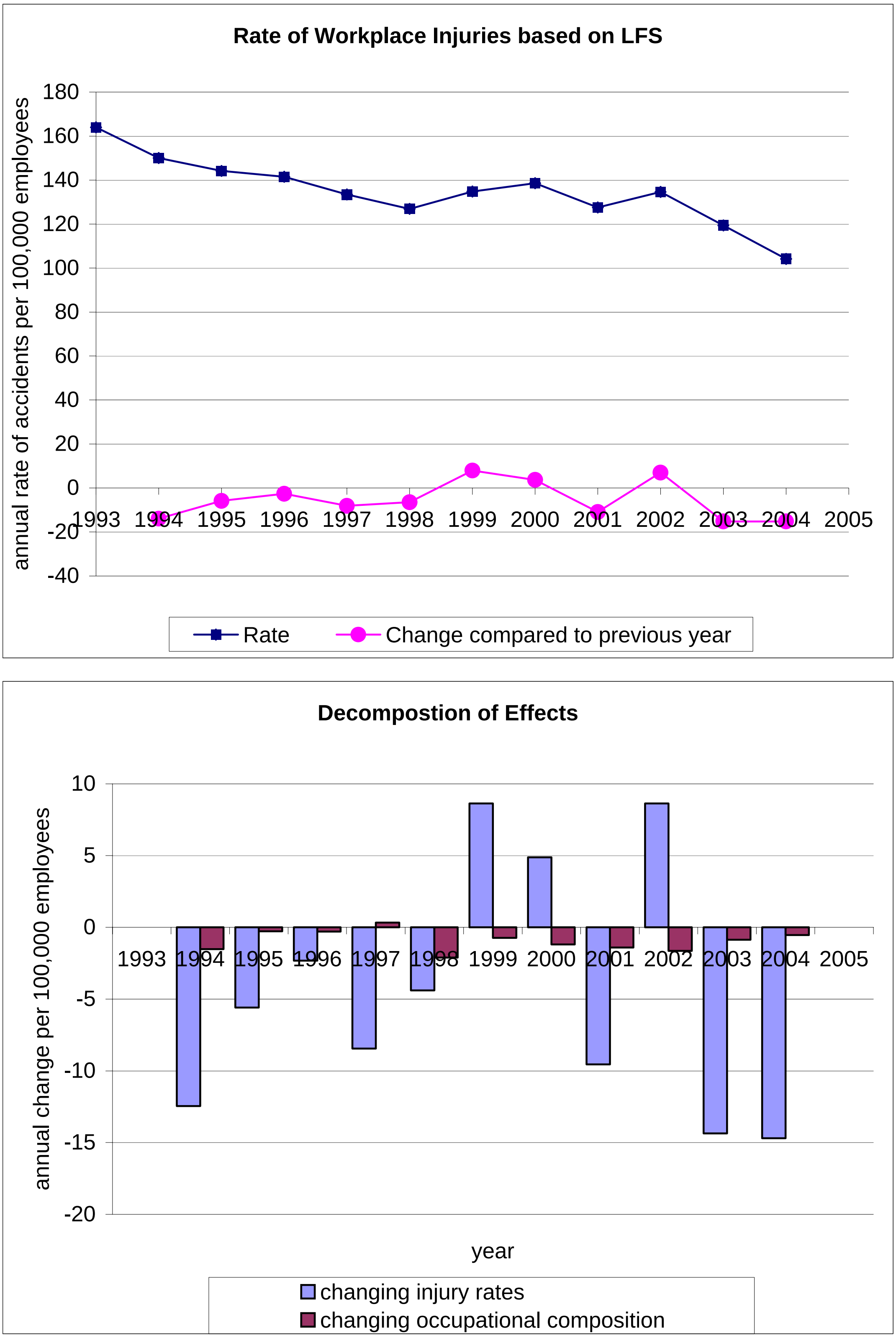


Figure 4 analyses the change in rates of injury each year using the Oaxaca decomposition. The results show that the effect of occupational change has been to steadily decrease the overall rate of workplace injuries each year (with the exception of 1997), reflecting a slow shift toward employment in relatively safer occupations. However, the relative magnitude of these effects are very much dominated by the effect of changing rates of injury within occupation, which although volatile tend to be negative and in sum significantly reduce the average rate of workplace injury over the whole period. It is notable that changes in injury rates within occupation tend to be quite volatile from year to year. The reason for this is not well understood but may partially reflect sampling variability within the survey.

Figure 4 Oaxaca decomposition of changes in LFS accident rates



6 Trends within Occupation and Industry

The analysis so far has indicated that significant improvements have taken place in terms of reductions in rates of workplace injuries, due in part to the changing composition of employment, but also due to strong downward trends in injury rates within occupation. This section extends the analysis by considering where the improvements have occurred, in terms of occupation groups and sectors, and considers whether changes have impacted equally across all areas of employment or have been relatively concentrated in a few occupations or industries.

By occupation

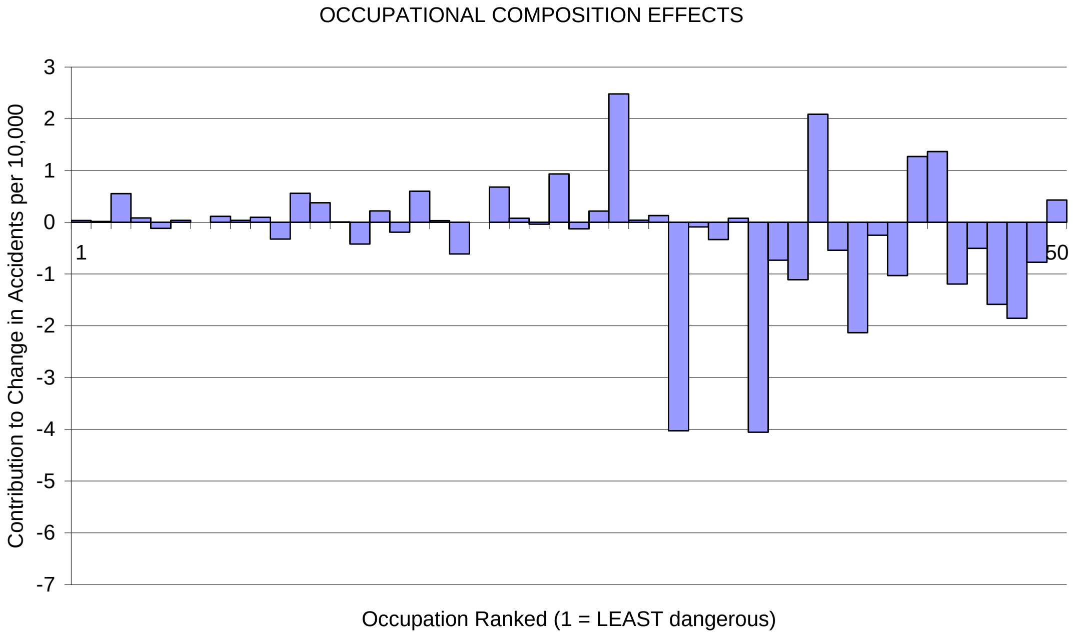
The Oaxaca decomposition applied in the previous section decomposed changes in aggregate rates of injury for the UK each year between the effect of changing levels of employment and the effect of changes in injury rates within occupation. However, it is noted that these changes are summed across the 49 (composite) occupational groups. It is therefore not apparent in which occupation major changes in employment or rates of injury have taken place.

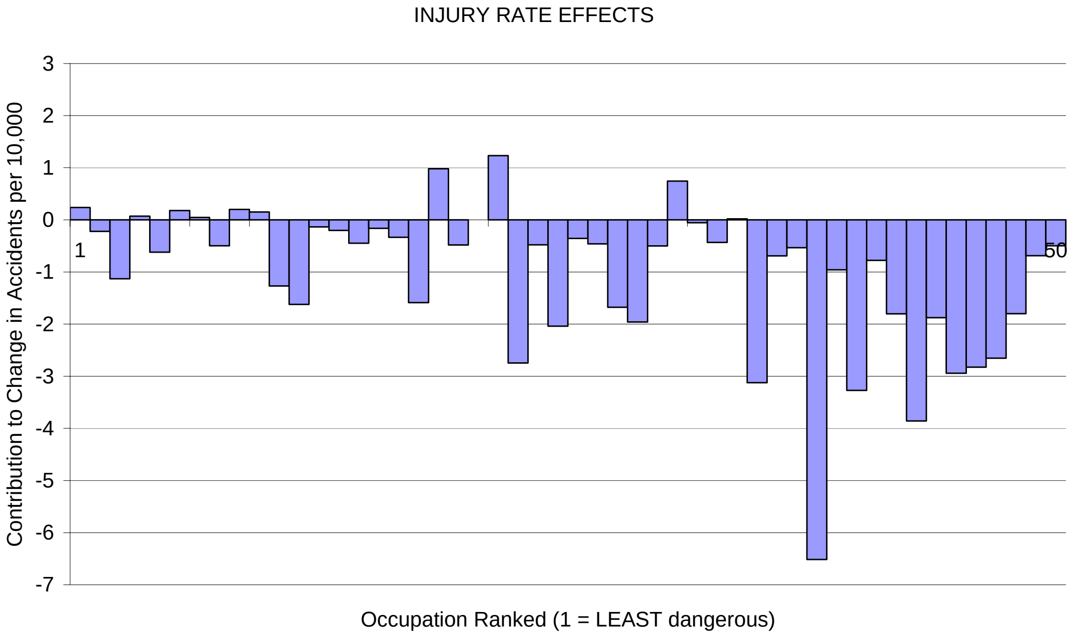
We therefore now consider changes revealed by the Oaxaca decomposition *by occupation* summed over the period 1993 – 2004. Taking the period as a whole, for each occupation we are able to quantify the effect of: *(1*) changes in employment levels within occupation; and *(2)* changes in injury rates within the occupation. Figure 5 shows the magnitude of these effects, quantified in terms of the contribution to the change in aggregate rate of injuries between 1993 and 2004 . The upper panel of the graph quantifies the effect of changes in employment, effectively weighted by rate of injury within occupation. The lower panel quantifies the effect of changes in rates of injuries within occupation, effectively weighted level of employment within occupation. Occupations are ranked from the least dangerous to the most dangerous for ease of presentation.

It can be seen from the upper panel of the graph that the changes in employment during this period have resulted in a shift, in terms of percentage of workforce employed, away from the most dangerous occupations towards the safer ones. The effect of this is on rates of workplace injury is asymmetric. Whilst expanding employment in the safer occupations (the lower end of the scale) has little impact in terms of increasing rates of injuries, the relative decreases in employment in the more dangerous occupation (top end of the scale) is instrumental in significantly reducing overall rates of injury. We can therefore see that almost all of the occupational effects described in the previous section come from reductions in employment in a relatively small number of dangerous occupations.

The lower panel of the graph shows the effect of changes in rates of injury within occupation. Whilst the graph shows that significant decreases in rates of injury across all occupations, it is noticeable that the largest decreases, in terms of the effect on the aggregate rate of injuries, have come predominantly from the most dangerous occupations. In the main part this is likely to be because rates of injuries in these occupations started from a higher base, and therefore have decreased most in absolute although not necessarily in proportional terms.

Figure 5 Decomposing employment and injury rate effects by occupation





By Industry

Although we know from the previous analysis that it is occupation rather than industry which is the main factor influencing rates of workplace injuries, it is interesting to examine to what extent the downward trend in injury rates over the period has been either concentrated within or shared across industries. In order to examine this we control for changing occupational structure within sectors (if any) so that any changes observed are residual rather than due to occupational factors.

The change in rates of workplace injuries within sector above and beyond that generated by occupational change is termed **improvement** for the purposes of this paper. This is measured, using LFS data since 1993, as illustrated in Table 4 which takes the case of the manufacturing and utilities sector (CDE)[16].

The LFS reportable rate of injuries for the sector is observed in 1993 and 2004. Note that this is (in principle) the RIDDOR rate corrected for under-reporting of accidents. The implied rate of reporting is shown in brackets in the second row of the table. The LFS reportable rate of injuries is then compared to the LFS rate we would we expect to see based purely on occupational composition. This is calculated by multiplying up proportions employed by occupation by rates of injury by occupation and summing up within the sector. Note that the rates of injury by occupation are taken as at average rate for the whole period so as to only control for changes in employment. The difference between the *actual* and *expected* LFS rate based on occupational composition is termed the industry differential (note for example that 2178 / 1772 = 122.9%). This exists because some industries are inherently more dangerous than others, even within occupation groups[17]. Improvement is then measured by comparing the industry differential between the two periods, where a decrease represents a net improvement in health and safety above and beyond any occupational effects. In this case the differential has decreased from 22.9% to *minus* 12.2%, a quantifiable improvement of 35.1 percent.

Table 4 Measuring improvements in workplace health and safety

Analysis for Sector CDE	**Accident Rate**	
	1993	**2004**
LFS reportable rate	2178	1426
RIDDOR Unadjusted	1098	918
(Implied rate of reporting)	*(50%)*	*(64%)*
Expected LFS rate based on occupational composition	1772	1624
Industry Differential	**22.9%**	**-12.2%**
Improvement	**35.1%**	

Figure 6 summarises the improvement in workplace health and safety by industry, using the method described above. It is first of all apparent that all sectors, with the

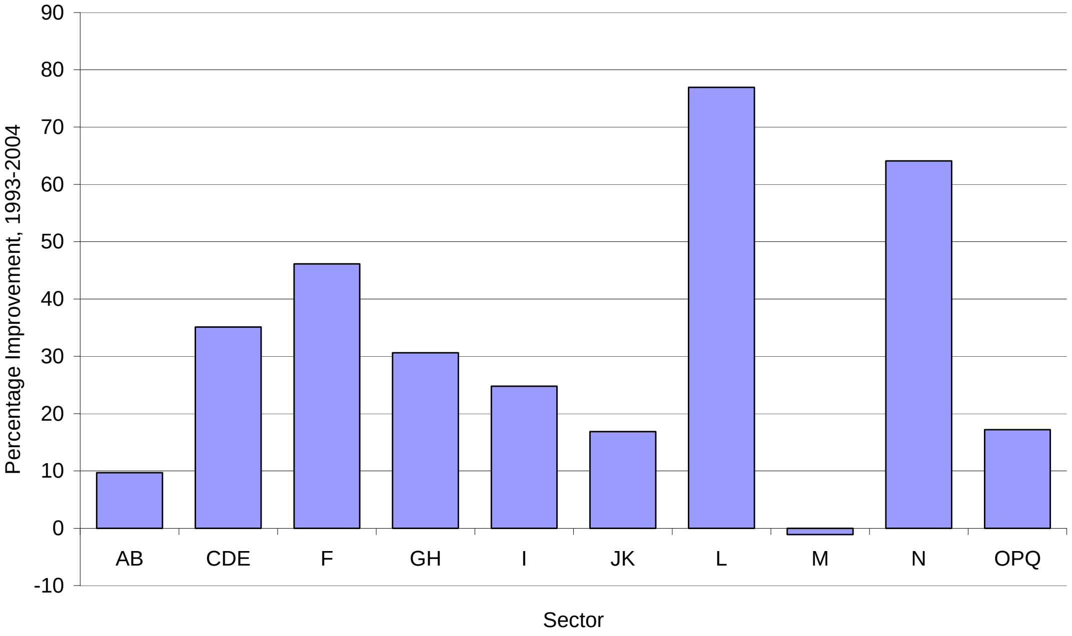
---

[16] Recall that the LFS data contains information on rates of injury by occupation in each period whereas the RIDDOR data does not.

[17] It is easy to see that for managers and professional groups some industries may be inherently more hazardous than others. Contrast for example the construction and health sectors.

notable exception of the education sector (M), have experienced substantial improvements in terms of reduced rates of workplace injuries. This suggests that in general all sectors have shared the benefits of better health and safety, rather than improvements being narrowly concentrated. In particular, however, we see the largest improvements in the Construction (F), Public Admin and Defence sector (L) and Health and Social Work (N) sectors.

Figure 6 Improvements in workplace health and safety by sector



7 Conclusions

This paper provides analysis of the most recently available administrative and survey data relating to the occurrence of workplace injuries. We find that injury rates exhibit a strong downward trend between 1986 and 2004, with some evidence of a slight reversal of this trend in the past three years.

The dominant factor affecting the likelihood of injury at the individual level is found to be occupation. With this in mind we show that the downward trend in injury rates during this time can, in part, be attributed to changing occupational structure which has accompanied the changes in industrial composition of employment during this period, with a shift in employment away from primary industries, utilities and manufacturing towards the service sectors, with resulting changes in occupational composition away from tradition high risk work environments to less risky manual occupations. Further, if these changes were to continue into the future we would anticipate corresponding decreases in the number and rate of workplace injuries.

Although changing occupational structure provides a backdrop to decreases in rates of workplace injury throughout this period, we also find that there have been substantial decreases in rates of workplaces injuries within most occupations and shared across industrial sectors. These changes demonstrate notable improvements in workplace safety over the period which cannot be explained by the changing structure of employment alone. Whether these changes are real improvements, in the sense of better safety regimes in the workplace, led by the efforts of the Health and Safety Executive (HSE) or are due to other subtle compositional changes in working is an important question and an area for future research.

References

DETR (2000) *Revitalising Health and Safety Strategy Statement*, June 2000.

Hillage, J., Bates, P. and Rick, J. (1998) Economic Influences on Occupational Health and Safety. The Institute for Employment Studies, University of Sussex.

Litwin, A (2000) Trade Unions and Industrial Injury in Great Britain, London School of Economics, Centre for Economic Performance Working Paper Series.

McKnight, A., Elias,P. and Wilson, L. (2001) Workplace Injuries and Workforce Trends. Health and Safety Executive, Contract Research Report 281/2001.

Nichols, T. (1990) Industrial Safety in Britain and the 1974 Health and Safety at Work Act: The Case of Manufacturing. International Journal of Sociology and Law, 18(3), pp314- 342.

Nichols, T. (1994) 'Research Note: Problems in Monitoring the Safety Performance of British Manufacturing at the End of the Twentieth Century', Sociological Review, 42(1): pp.104-110.

Nichols, T. (1997) *The Sociology of Industrial Injury*, Mansell: London.

Oaxaca, R. (1973) Male-Female Wage Differentials In Urban Labour Markets. International Economic Review 14 (1973), pp. 693–709

Stevens, G. (1992) Workplace Injury: A View from the HSE's trailer to the 1990 Labour Force Survey. Employment Gazette, 100 (12), pp621-638.

Appendix 1 Modelling Changes to Reporting Levels within RIDDOR

The reporting rate is constructed based on the ratio of the number of accidents reported through RIDDOR, combining major and over-3-day injuries, compared to those reported in the LFS, which is taken as the benchmark for “full reporting”. Rates of reporting are calculated by sector and gender on an annual basis from 1993 to 2004, using the winter LFS which contains questions relating to accidents at work. The aim of the modelling exercise was two to (a) smooth the reporting rate series, since at the disaggregated level of sector and gender actual rates of reporting were found to be erratic over time and (b) to extrapolate rates of reporting by sector and by gender backwards to 1986 so that RIDDOR full time equivalent rates of injuries could be adjusted upwards to their full reporting rate.

The model uses an ordinary least squares regression analysis of reporting rate by sector and gender each year, taking into account systematic differences in reporting rates by gender and by sector and incorporating sector specific trends. The outcome of this exercise is to produce an under-reporting coefficient, by gender and by sector, for each year. These coefficients were then used to adjust the accident rate series to correct for under-reporting, i.e. reflate the accident rates back to LFS reported levels. The design of the regression model imposes linear trends on reporting rates so that for the intervening period rates of reporting increase or decrease in a linear fashion (for each category). These coefficients capture the sector-specific trends in reporting rates of reporting. The results of the modelling exercise are shown in Table A1.

Table A1 Rate of Reporting of Accidents by Sector and Gender

Variable	Coef	Std. Err.	t	P>[t]
Male	(dropped)			
Female	-0.084	0.017	-4.99	0
Sector AB	(dropped)			
Sector CDE	23.878	24.011	0.99	0.321
Sector F	14.587	24.848	0.59	0.558
Sector GH	14.192	24.011	0.59	0.555
Sector I	-5.880	24.011	-0.24	0.807
Sector JK	-33.357	24.011	-1.39	0.166
Sector L	3.669	24.011	0.15	0.879
Sector M	45.654	24.011	1.9	0.059
Sector N	-14.574	24.011	-0.61	0.545
Sector OPQ	7.941	24.011	0.33	0.741
Trend AB	0.012	0.009	1.4	0.164
Trend CDE	0.000	0.008	0.01	0.991
Trend F	0.005	0.009	0.52	0.604
Trend GH	0.005	0.008	0.58	0.565
Trend I	0.015	0.008	1.78	0.076
Trend JK	0.029	0.008	3.41	0.001
Trend L	0.010	0.008	1.22	0.223
Trend M	-0.011	0.008	-1.29	0.198
Trend N	0.019	0.008	2.3	0.023
Trend OPQ	0.008	0.008	0.95	0.345
Constant	-23.532	17.165	-1.37	0.172
Sample Observations	217.000		**F Statistic**	10.640
Adjusted R-squared	0.472		**Prob > F**	0.000

Appendix 2 Deriving a Consistent Classification of Occupations

We utilise a special file prepared by the Office for National Statistics from the Winter 1996/7 quarter of the Labour Force Survey which contained dual coded occupational information (SOC2000 and SOC90). This dual coded data set was used to estimate the level of correspondence between the 2 classifications and to derive a 'composite' classification of occupations at minor group level. The results of the mapping exercise are shown in Table A2. The cross classification exercise lead to the construction of 49 composite occupational groups derived from the 77 minor groups of SOC90 (2 digit level) and the 81 minor groups of SOC2000 (3 digit level). For many minor groups, the map between SOC90 and SOC2000 was unambiguous and a straightforward one to one 'best fit' map could be identified. Such a 'best fit' map was identified as occurring when the most populated SOC2000 minor group relating to a particular SOC90 minor group provided the same map as the most populated SOC90 minor group relating to a particular SOC2000 minor group. In other occupational areas, changes made between SOC90 and SOC2000 resulted in more complex mappings, with multiple SOC90 and SOC2000 groups being mapped to each other to form a 'composite' occupational group.

To investigate the accuracy of this mapping exercise, we utilize the dual coded data from the Winter 96/7 LFS. Within this file, we allocate individuals to the derived composite classification on the basis of both their SOC90 and SOC2000 codes. By cross tabulating these two derivations of the 'composite' categories, we are able to determine the percentage of individuals who are allocated to the same category on the basis of each derivation. Overall, it is estimated that approximately 76 per cent of individuals are allocated on a consistent basis.

In addition to mapping SOC1990 to SOC2000, in order to analyse changes in occupational structure going back to 1986 we undertook a separate exercise to map occupations before 1991 into the SOC structure. The coding of occupations before 1991 is based on the Key Occupations for Statistical Purposes (KOS) coding structure developed during the 1970s. An exercise was therefore undertaken to map KOS codes into the 1990 SOC structure, which were then in turn mapped into the composite structure of 49 occupations. The 1991 annual LFS has details of occupations at an individual level using both KOS and SOC90 coding. Utilising this dataset we performed a similar exercise to the one described above to derive a 'best fit' map of KOS into SOC90 on a category by category basis. We are therefore able to analyse the occupational composition of employment on a consistent basis for the full period covered by the RIDDOR data. Details of the mapping can be found in Table A3.

Table A2 Derivation of composite categories

Composite Category	SOC90 Minor Groups					SOC2000 Minor Groups			
1: Corporate and Public Service Managers	10	12	13			111	113	115	118
2: Production and Quality Managers	11					112	114		
3: Retail, Distribution and Service Managers	14	17	19			116	122	123	
4: Senior Protective Service Officers	15					117			
5: Farmers and Farm Managers	16	59				121	511	549	
6: Natural Scientists	20					211	232		
7: Engineers	21					212			
8: Health Professionals	22					221			
9: Teaching Professionals	23					231			
10: Legal Professionals	24					241			
11: Business and Financial Professionals	25					242			
12: Architects, Draughtsmen and Surveyors	26	31				243	312		
13: Librarians	27					245			
14: Public Service Professionals	29					244			
15: Scientific Technicians	30					311			
16: ICT Professionals	32					213	313		
17: Ship, Aircraft Officers and Controllers	33					351			
18: Health Associate Professionals	34					321	322		
19: Legal Associate Professionals	35					352			
20: Business, Finance and Public Service Associate Professionals	36	39				353	356		
21: Welfare and Social Care Occupations	37	64				323	611		
22: Artistic and Sports Professionals	38					341	342	343	344
23: Public Service Administrative	40					411			
24: Clerks, Cashiers	41					412			
25: General Administrative Occupations	42	43	49			413	415	721	
26: Stores/Warehouse Keepers	44	93				914			
27: Secretaries & Receptionists	45	46				414	421		
28: Metal, Wood and Construction Trades	50	53	57			521	531	532	
29: Metal Machining Trades	51					522			
30: Electrical Trades	52					524			
31: Vehicle Trades	54					523			
32: Routine Operatives	55	85	86	91	99	541	813	913	
33: Printing Trades	56					542			
34: Food Preparation and Service	58	62				543	922		
35: Armed Forces and Security Occupations	60	61				331	355	924	
36: Travel Assistants and Personal Services	63	69				621	629		
37: Child carers	65					612			
38: Hairdressers, Beauticians	66					622			
39: Domestic Staff	67					623			
40: Sales Agents	70	71	73			354	712		
41: Sales Assistants	72	79				711			
42: Process and Plant Operatives	80	81	82	83		811			
43: Construction and Plant Operatives	84	89				812	814		
44: Road Transport Operatives	87					821			
45: Mobile Machine	88					822			
46: Agriculture and Animal Care Occupations	90					613	911		
47: Construction Labourers	92					912			
48: Elementary Administration Occupations	94					921			
49: Cleaning, Elementary Sales Occupations	95					923	925		

Appendix 3 Applying the Oaxaca Decomposition to Workplace Injuries

The overall rate of injuries in year *t*, denoted I(*t*), is defined as the percentage of individuals who have had a workplace injury in the previous year resulting in 3 or more days of absence from work. This rate can be expressed as the weighted sum of the individual rates of injuries by (in this case) the 49 occupational groups, so that:

$$I(t) = \sum_{i=1}^{49} \alpha(i,t) \bullet \theta(i,t) \qquad \textbf{(1)}$$

Where $\alpha(i,t)$ is the injury rate in occupation *i* at time *t,* and $\theta(i,t)$ is the proportion of individuals working in occupation *i* at time *t.*

Having expressed the overall rate of injuries in terms of occupation, we can then analyse changes in the overall rate of accidents in terms of changes in occupational composition. This is done using the Oaxaca decomposition, see Oaxaca (1973). This technique decomposes the change in *I(t)* in terms of two separate and additive effects: (*1*) the change in *I(t)* resulting from changes in the composition of employment by occupation; and *(2)* the change in *I(t)* resulting from the change in the rate of injuries *within* occupation. In this case, the latter can be thought of a residual change not associated with occupation, but due to other unspecified factors. The decomposition is outlined below:

Differencing the overall rate of injuries between periods *t* and *t-1*, we obtain:

$$I(t) - I(t-1) = \sum_{i=1}^{49} \alpha(i,t) \bullet \theta(i,t) - \sum_{i=1}^{49} \alpha(i,t-1) \bullet \theta(i,t-1) \qquad \textbf{(2)}$$

By identity this can be re-written as follows:

$$I(t) - I(t-1) = \sum_{i=1}^{49} \overline{\alpha}(i) \bullet \underbrace{\left[\theta(i,t) - \theta(i,t-1)\right]}_{\text{Changing Occupational Composition}} + \sum_{i=1}^{49} \overline{\theta}(i) \bullet \underbrace{\left[\alpha(i,t) - \alpha(i,t-1)\right]}_{\text{Changing rates of injury within occupation}} \qquad \textbf{(3)}$$

Where $\overline{\alpha}(i)$ is the average injury rate in occupation *i* based on periods *t* and *t-1*, and $\overline{\theta}(i)$ is the average proportion of all individuals employed in the sector. i.e.

$\overline{\alpha}(i) = \frac{\alpha(i,t) + \alpha(i,t-1)}{2}$, and $\overline{\theta}(i) = \frac{\theta(i,t) + \theta(i,t-1)}{2}$

In terms of interpretation, the first term on the right hand side of equation (3) represents the change in the percentage of individuals suffering workplace injuries which can be attributed to the change in the composition of employment between the two years, based on average rates of injuries. The second term represents the change in the percentage of individuals suffering workplace injuries which can be attributed to the change in the rate of injuries within occupation between the two years, based on average rates of occupational composition. The two terms sum to the overall change in the rate of injuries.