



# City Research Online

## City St George's, University of London

**Citation:** Forth, J. & O'Mahony, M. (2003). The Impact of the National Minimum Wage on Labour Productivity and Unit Labour Costs: A Report to the Low Pay Commission. London, UK: National Institute Of Economic And Social Research.

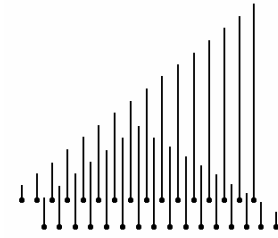
This is the published version of the paper.

This version of the publication may differ from the final published version. To cite this item please consult the publisher's version.

**Permanent repository link:** <https://openaccess.city.ac.uk/id/eprint/20943/>

**Copyright and Reuse:** Copyright and Moral Rights remain with the author(s) and/or copyright holders. Copies of full items can be used for personal research or study, educational, or not-for-profit purposes without prior permission or charge, unless otherwise indicated, provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way. For full details of reuse please refer to [City Research Online policy](#).

**NATIONAL INSTITUTE OF ECONOMIC AND SOCIAL RESEARCH**



---

**THE IMPACT OF THE NATIONAL MINIMUM WAGE ON  
LABOUR PRODUCTIVITY AND UNIT LABOUR COSTS**

---

**JOHN FORTH & MARY O'MAHONY**

**Final Draft (January 2003)**



## **The Impact of the National Minimum Wage on Labour Productivity and Unit Labour Costs**

### **1. Background**

The National Minimum Wage (NMW) came into force in April 1999 at an initial rate of £3.60 per hour for adults and £3.00 for those under 21 and for new employees in receipt of accredited training.<sup>1</sup> Its introduction dramatically reduced the prevalence of low pay in the UK. In April 1998, some 1.4 million jobs were estimated to provide gross hourly earnings below NMW rates. This figure had fallen to around 0.5 million by April 1999 and just 0.25 million by April 2000 (Table 1).

*\* Table 1 Number of jobs paid below National Minimum Wage rates\**

Those workers earning less than the NMW prior to its introduction were entitled to a pay rise that averaged around 20 per cent of gross hourly earnings.<sup>2</sup> The cumulative result was to increase the national wage bill by an estimated 0.25-0.35 per cent over the period April 1998 to April 1999 (Low Pay Commission, 2001a: 52). The various upratings of the NMW since its introduction have led to further increases in the wage bill, with the most notable changes coming as a result of the increase in the adult rate to £4.10 and the increase in the development rate to £3.50 in March 2001 (Table 2). The March 2001 uprating is estimated to have further increased the national wage bill by between 0.1 and 0.2 percentage points (Low Pay Commission, 2001a: 92).

*\* Table 2 Changes in National Minimum Wage rates \**

The impact of the introduction of the NMW in April 1999 varied considerably across different sectors of the economy (Figure 1). The four broad industry sectors with the largest numbers of jobs affected were: Wholesale and Retail (350,000 jobs); Hotels and Restaurants (300,000 jobs); Business Services (170,000 jobs); and Health and Social Work (160,000 jobs). In the first two of these four sectors – Wholesale and Retail and Hotels and Restaurants – affected jobs also represented a high percentage of all jobs in the sector: 9 per cent in Wholesale and Retail and 23 per cent in Hotels and Restaurants. In Other Services, the percentage was also relatively high, with 12 per cent of all jobs affected. Across the whole economy, the percentage of jobs affected was 6 per cent.

*\* Figure 1 Numbers and Proportions of Jobs Paid Below  
National Minimum Wage Rates in April 1998 by Industry \**

The introduction of the NMW would naturally have led to an increase in unit labour costs had all else remained unchanged. And Figure 1 indicates that, in some industries, this increase in unit labour costs could clearly have been substantial.

---

<sup>1</sup> Workers aged under 18 and the self-employed constitute the primary exemptions from the NMW. For further information on the detail of the NMW regulations, see Department of Trade and Industry (2001a).

<sup>2</sup> Average pay rise estimated by authors from New Earnings Survey data. The consequent rise in incomes would, of course, be lower as some of the additional earnings would replace means-tested benefit payments.

However, in practice, the impact would depend on whether the NMW also had some effect on the level of output, which is determined by levels of employment and labour productivity.

Under standard assumptions of a perfectly competitive labour market, an increase in wages resulting from the introduction of a minimum wage should make it unprofitable for firms to continue to employ workers previously earning less than the NMW, unless these workers are able to raise their productivity to compensate for the increase in costs. An examination of employment trends, whether at a sectoral level (Low Pay Commission, 2001a: 38-40) or through micro-data on low-wage workers (Stewart, 2002), suggests little by way of negative employment effects from the introduction of the minimum wage. This in turn suggests that firms affected by the minimum wage may have responded by raising levels of labour productivity. Indeed, some evidence has emerged from recent quantitative and qualitative research of employers having attempted to increase productivity, for example through increased use of technology, increased training or changes in work organization (e.g. Bullock et al, 2001: Table 21; Low Pay Commission, 2001a: 57; Gilman, 2002: 59).

However, Dolado et al (1996) provide a reminder that labour market imperfections, such as monopsony, are equally able to explain the rather muted employment effects of the NMW. There is also evidence of product market imperfections, with some employers being able to pass on higher costs to consumers in the way of increased prices (Bullock et al., 2001: Table 21).

These theoretical and empirical observations therefore imply that the overall effects of the NMW on unit labour costs and labour productivity cannot be pre-determined. To provide some evidence on this matter, this study compiles aggregate measures of unit labour costs and labour productivity in low-paying industries in the UK and examines trends in these measures before and after the introduction of the NMW. In summary, we find little evidence to suggest that the introduction of the NMW in 1999 provided a general boost to labour productivity growth in low-paying sectors, or that it led to a general increase in unit labour costs. There is a suggestion that it may have had some effect in a small number of sectors, but other causes cannot be discounted.

## **2. Labour productivity and unit labour costs**

Before proceeding further, it will be useful to introduce the standard framework within which our measurement and analysis takes place. The concepts that underlay the analysis are summarised here. Further details are provided in Section 5.

**Labour productivity** measures the amount of output produced, on average, over a given period for each unit of labour input. In this paper, the output of a particular sector of the economy is measured in terms of the value added to material inputs. We therefore measure labour productivity in terms of value added per unit of labour input, with hours worked forming our preferred measure of labour inputs. In all of our analysis, nominal values (e.g. value added) are deflated to real values to permit comparison across industries and time periods.

Since the level of output is also a function of capital inputs and the production technology (often termed ‘total factor productivity’ or TFP), the growth in labour

productivity may be decomposed into: changes in the quality of labour inputs; changes in the quantity and quality of capital inputs; and changes in TFP. In practice, however, changes in the quality of labour and capital are difficult to isolate and are often subsumed within changes in TFP. The resulting decomposition of labour productivity growth into changes in the capital-labour ratio (termed ‘capital deepening’) and changes in TFP (which includes changes in the quality of labour and capital) is achieved in this paper through the method of ‘growth accounting’ (see, for example, Jorgenson et al, 1987).

**Unit labour costs** measure the labour cost of producing each unit of output. In this paper, the labour costs incurred in a particular industry over a given period are calculated by dividing total employment costs per hour worked by the level of labour productivity. There is no natural means of further decomposing changes in unit labour costs, except through the decomposition of changes in labour productivity described above.

### **3. Theory of minimum wage effects on labour productivity and unit labour costs**

#### **3.1. *The standard neo-classical model***

The standard neo-classical model of the labour market holds that an individual’s wage should equal the marginal product of their labour, as wages constitute the individual’s reward for their personal contribution to the output of the firm. The introduction of a minimum wage leads to an increase in wages of those previously paid below minimum. So it is expected that, after the introduction of a statutory minimum, the wage of workers previously paid below that minimum will exceed their marginal product, all other things equal. The profit-maximising firm will naturally seek to address this situation in one way or another.

The standard expectation is that the firm will dismiss any workers whose marginal product is below the statutory minimum, substituting capital for labour. Under this scenario, as long as the ratio of substitution reflects the relative output elasticities of capital and labour, the level of output would remain constant. However, unit labour costs would fall, whilst labour productivity would rise, since the same level of output would be produced with fewer labour inputs. At the sectoral level, one would expect to see a decrease in the quantity of labour input, alongside capital deepening.

There are, of course, a number of alternatives. One is that employers respond by improving the *quality* of their capital. This might occur through the introduction of new technology, particularly investment in information and communication technologies, which is shown to have brought about considerable improvements in output growth in the United States and elsewhere in recent decades (Forth, Mason and O’Mahony, 2002). Here, the direction of changes in labour productivity and unit labour costs would mirror those resulting from capital deepening.

A further alternative is that changes occur to labour inputs, with workers raising their marginal product to account for the wage increase.

An increase in workers' marginal product may occur as a result of effort intensification (i.e. an increase in the *quantity* of labour input per head or per hour), which may itself have a number of different causes. On the one hand, intensification could be induced by the employer, for example through an increase in the monitoring and regulation of effort, which may take the form of reduced work breaks or closer supervision. On the other hand, employees may voluntarily increase the quantity of labour supplied in response to the additional motivation provided by higher wages, as assumed in efficiency wage theory (Rebitzer and Taylor, 1995). If the provision of higher wages serves to reduce labour turnover, this would also increase the quantity of labour input per head or per hour over a given period as less time would be spent in the hiring and induction of new workers.

A further cause of an increase in workers' marginal product may be an increase in the *quality* of labour input per head or per hour. This may arise from workers previously paid below the minimum wage increasing their skills through investment in education (Cubitt and Heap, 1999). Under this scenario, the overall level of employment may remain unchanged but output would rise in line with labour costs. One would therefore expect labour productivity to increase whilst unit labour costs remained unchanged.

### **3.2. *Labour market imperfections***

Moving away from the standard neo-classical model of the labour market, emphasis has recently been placed upon the scope for minimum wage effects to be cushioned by imperfections in the labour market. Labour economists have emphasised that employers often have some degree of monopsony power in the labour market, which may allow them to absorb wage increases at the cost of lower profits (Dolado, 1996; Manning, 2001). From a different perspective, readers of industrial relations have emphasised the indeterminacy of much of the wage-setting process, which must not only set a price for labour but which must also reflect expectations of fairness and provide a managerial tool for motivation (Rubery, 1997).

Under these scenarios, where the impact of a minimum wage falls primarily on labour costs and profits and has little effect on the organization of production, one would expect little resulting impact on productivity, although unit labour costs would be expected to rise.

### **3.3. *Product market imperfections***

A similar 'cushion' may also be present in the product market if employers are able to raise the price of goods or services without experiencing a fall in demand. The NMW might provide some scope for price increases in the markets for consumer goods and services as it can be expected to increase the disposable income of many lower-paid workers. However, in the absence of across-the-board price increases, the scope for individual employers to raise prices may be limited if demand is highly price-sensitive. Fixed-price contracts are also commonplace in the market for many low-skill services such as security or cleaning. Indeed, the Low Pay Commission has observed no obvious NMW effects in sectoral price indices (Low Pay Commission, 2000: 29 and Fig A2.9).

### 3.4. *Avoidance*

It is also apparent that much of the standard theoretical consideration of minimum wage effects is based upon the assumption of a single minimum which has universal coverage and which is also universally observed. Yet there are numerous routes through which employers may either ameliorate, or wholly avoid, the effect of a minimum wage.

One such is to increase the proportion of younger employees, specifically 18-21 year olds, who qualify for a lower minimum, or 16-17 year olds who are not covered. Another form of labour substitution is to shift from providing contracts of employment to acquiring services under contracts with individual suppliers: self-employment is not covered by the NMW. There are indications that some age-related substitution has taken place in the hairdressing sector, and that some home-workers have been encouraged to redesignate themselves as self-employed, but the overall incidence of either type of restructuring is considered to be minimal (Low Pay Commission, 2000: 32).

Employers may also seek to build performance-related bonuses into basic pay. Or they may seek to make compensatory changes in other terms and conditions. Such compensatory changes might include reductions in overtime premia, the abolition of paid meal breaks or new arrangements to ensure that tips are paid direct to the employer for distribution through the payroll. In these instances, the NMW may raise basic wages whilst having little effect on total remuneration (and thus total costs). Again, there is some evidence of this having taken place, but to only a minor degree (Low Pay Commission, 1999).

Finally, it is also possible that employers may seek to avoid compliance with the minimum wage. The Inland Revenue has identified substantial numbers of employers that are not complying with the NMW (3,200 between April 1999 and February 2001), but these represent only a small proportion of all employers (around 0.2 per cent) (Low Pay Commission, 2001b). There is no reliable indicator of the extent to which non-compliance varies by industry sector. Anecdotal evidence of non-compliance has emerged to some degree in all sectors, as one might expect. But there is no suggestion that non-compliance represents a substantial problem within any one sector.

From this brief discussion, it is again clear that the impact of the NMW on labour productivity and unit labour costs cannot easily be pre-determined. There is a great deal of complexity in the combination of employee and employer circumstances that lead someone to be paid low wages. And there are a number of reasons why simple models may fail to explain the outcomes of a NMW.

In practice, the effects of the introduction of the NMW may be a mixture of all of the factors mentioned in the preceding discussion, such that no one element is clearly discernible. Yet the Low Pay Commission anticipated that one means whereby firms might accommodate the introduction of the NMW, and its affect on labour costs, would be through improvements in productive efficiency (Low Pay Commission,

1998: 107-10). In the next section, we consider the evidence emerging from existing studies.

#### **4. Evidence of minimum wage effects on labour productivity**

A variety of quantitative and qualitative evidence has been collected in order to gauge the responses made by firms to the introduction of the NMW. This evidence supports the assertion made at the end of the previous section, namely that there have been a wide range of different responses. Some of these will have a bearing on measures of labour productivity and unit labour costs, whilst others will not.

A survey conducted by the Low Pay Commission in September-October 1999, some 6 months after the introduction of the NMW, suggested that: around one third of firms affected by the NMW had made significant efforts to tighten control over labour costs; one quarter had made significant changes to the organization of work; and around one tenth had significantly increased their use of technology (Low Pay Commission, 2000: Fig 3.8). A similar pattern of responses emerged from a second survey conducted one year later (Low Pay Commission, 2001a: 122). On its visits to individual employers, the Commission also identified examples of firms taking action to improve their productivity (Low Pay Commission, 2000: 28).

Below, we consider the evidence at a sectoral level (where available) in order to identify those sectors where we may be most likely to observe additional growth in labour productivity or TFP as a result of the NMW.

Retail is the sector with the largest number of employees affected by the NMW. In a Low Pay Commission survey of members of the Retail Trade Alliance in 1999, almost two-thirds reported wage bill rises of 5 per cent or more, but in only 15 per cent of cases was this impact greater than 10 per cent (Low Pay Commission, 2000: Table A5.3). Nevertheless, small retailers in particular tend to suffer from price sensitivity and from strong competition from the larger retailers. In the Low Pay Commission survey, most retail employers that had been affected by the NMW (90 per cent) had responded by cutting profits (Low Pay Commission, 2000: Table A5.7). However, substantial proportions had also responded by reducing staffing (61 per cent), reducing working hours (60 per cent), changing the way work was organized (64 per cent) or tightening control of labour costs (69 per cent) (Tables A5.6 and A5.7). Some had also increased their use of technology (39 per cent). Even so, in most of these cases, many employers reported that changes were 'slight' rather than 'significant'.

Hospitality had the second largest number of workers affected by the NMW, after Retail. But it is a diverse sector. A Low Pay Commission survey of members of the British Hospitality Association indicated that there had been no impact for around one quarter of employers. Some 10 per cent had seen wage bill rises of more than 10 percentage points. The Low Pay Commission survey suggested that slightly fewer Hospitality employers had cut profits than in Retail, but the proportion doing so was still around three quarters (Low Pay Commission, 2000: Table A5.7). Similarly, fewer employers were making productivity related changes. Some 39 per cent had reduced staffing, 40 per cent had reduced working hours, 49 per cent had changed the way work was organized, and 61 had tightened control of labour costs. Only 26 per cent

had increased their use of technology. And again, many said that the changes they had made were 'slight'.

Cleaning and Security were not included in the Low Pay Commission surveys, but they were covered by a separate survey of small businesses (Bullock et al, 2001). Employers in these industries are expected to have had transitional difficulties in passing on wage costs to customers, because of the prevalence of fixed-term contracts. Yet Bullock's survey (2001) suggested that price rises were among the dominant responses in these sectors, alongside reductions in profits and increased cost control. There is little suggestion that there may have been an increase in the substitution of capital for labour or of an increase in the provision of training.

Finally, in textile industries, the major impact of the NMW is considered to have been felt in clothing and footwear rather than in textile manufacture (Hayes and Gray, 2001: 87; Low Pay Commission, 2000: Fig 4.8). But pay rises have been accommodated in industry agreements, and thus introduced in a phased manner. Undy's research (1999) suggests only a minor impact outside small unorganized firms, since pre-existing incentive systems meant that most employees in larger firms already earned above the NMW. But there is evidence of work intensification (Hayes and Gray, 2001: Table 7). However, the general view is that the impact of the NMW is of secondary importance to other trends affecting employment and output in the sector, such as the rise of international competition from developing countries.

Consequently, from the available evidence, it appears that one may be most likely to witness an impact on productivity or unit labour costs in sectors such as Retail, where considerable proportions of employers have been undertaking productivity-related initiatives, or in Cleaning and Security where the NMW has had a substantial impact on the wage bill but other options (such as price rises) may be limited. However, the evidence for any of these sectors is rather limited in quantity.

## **5. The methodology of our study**

In this study, we compile sectoral measures of the levels of labour productivity and unit labour costs (primarily at SIC(92) Group level) on an annual basis over the period 1995-2000. We use these measures to describe changes in the levels of labour productivity and unit labour costs in low-paying sectors over this period, the latter part of which saw the introduction of a NMW. The trends that we observe in low-paying sectors are compared with the trends in higher-paying sectors. We also decompose changes in labour productivity in order to separately identify changes in the ratio of capital to labour and changes in TFP.

To accompany this descriptive analysis, we also conduct statistical analysis of labour productivity growth, using the variation in the impact of the NMW on sectoral wage bills to more robustly assess whether any element of labour productivity growth can be linked to the introduction of the NMW. This method is analogous to that used by Card and Krueger to study the employment effects of changes to the minimum wage in the United States (Card, 1992a; Card and Krueger, 1994). In their studies, they take advantage of the variation in the impact of the minimum wage across states (Card, 1992b), whereas we take advantage of the variation in the impact across industry sectors.

At the outset, however, we must acknowledge that the impact of the NMW on labour productivity is expected to be small, since only a minority of employers affected by the NMW (and thus a small minority of all employers) are thought to have adopted changes in work organization as a result of its introduction. Moreover, if it is possible to observe a change in labour productivity growth in low-paying sectors around the time of the introduction of the NMW, we can expect that it will be difficult to make a robust, causal association with the NMW. There are many changes in a firm's internal and external environments, besides regulatory changes, that may affect overall levels of labour productivity and unit labour costs.

### ***5.1. Deriving sectoral estimates of labour productivity and unit labour costs***

The principal data source for our analysis is the Annual Business Inquiry (ABI) which provides sectoral data on economic outputs and inputs for UK businesses over the period 1995-2000.<sup>3</sup> The ABI covers SIC(92) Divisions 10-93 inclusive, with the exception of Divisions 65-67 (Financial Services) and 75 (Public Administration). Other exceptions comprise public sector activities in Divisions 80 (Education) and 95 (Health and Social Work).

The exclusion of Agriculture (Division 1) is particularly notable, given the low rates of pay that exist within that industry. However, the continued operation of the Agricultural Wages Boards means that the impact of the introduction of the NMW was not as great as in other low-paying sectors (Low Pay Commission, 1998, Fig 7.1). It should also be noted that the ABI covers only those UK businesses registered for VAT and PAYE. The ABI does not therefore cover small, non-registered companies, which may have over-representation of low pay. Such businesses are likely to be numerous, but account for only a small proportion of all employment in the UK. Further details on the ABI are provided by Jones (2000).

In addition to its lack of coverage of certain sectors, problems also arise with the calculation of labour productivity and labour cost measures in some industries. National Statistics advise against the compilation of value-added measures for Division 70 (Real Estate), since these measures will exclude capital expenditure (Daffin and Lau, 2002). They also advise against compiling estimates for Divisions 80 and 85 in view of the ABI's partial coverage of activity in these sectors as mentioned earlier. Consequently, we have excluded these sectors from our database. The principal implication is that we are unable to comment on the Residential Care sector (SIC(92) Class 85.31). Nonetheless, a detailed investigation of this sector has been undertaken elsewhere using firm-level data (Machin, Manning and Rahman, 2002). That study finds no robust evidence that the introduction of the NMW raised levels of productivity in the sector.<sup>4</sup>

We have chosen to analyse the ABI primarily at SIC(92) Group level. However, we have disaggregated Division 93 to Class level in order to separately Class 93.02 (Hairdressing and Other Beauty Treatments). Our final dataset contains information

---

<sup>3</sup> We use the latest available version of the ABI data, released by National Statistics on 12<sup>th</sup> June 2002. This version incorporates final estimates for the year 2000 and some revisions to earlier estimates for other years.

<sup>4</sup> No comment is made about changes in unit labour costs.

for 183 industries in total although, because of missing values on some data items, only 167 of these contain complete information on all relevant data items across all five years.

The industry-level data provided in the official release of the ABI has been augmented with a number of other data items. The first of these is an estimate of year-average employment within each industry, provided directly to us by National Statistics. These data are preferable to the point-in-time employment estimates provided in the official release of the ABI. They constitute the measure of labour inputs used by Daffin and Lau (2002) in their calculations of labour productivity using the ABI.

To these estimates of year-average employment, we have added annual estimates of hours worked per head within each industry, derived from the Quarterly Labour Survey, in order to provide estimates of total hours worked.<sup>5</sup> Hours worked represent a better measure of the quantity of labour inputs than persons employed, particularly in industries with substantial degrees of part-time working. The Quarterly Labour Force Survey has also been used to obtain information on changing skill levels within each industry over time (skills being proxied by the level of educational qualifications). This provides us with a crude indicator of changes in labour quality.

In Table 3 we present some estimates of nominal gross value-added per job, summed across the 167 industry sectors for which we have complete information on labour productivity and its components and on unit labour costs over the period 1995-2000. These compare well with the estimates provided by National Statistics for the period 1998-2000 (Daffin and Lau, 2002). The levels of labour productivity obtained from our database are inevitably slightly smaller than the official estimates since we exclude 16 industry sectors with missing values on any of our variables. But the trends across time, shown by index numbers, are very similar.

*\* Table 3 Gross value-added per job at current prices, £ thousand \**

## **5.2. Decomposing the growth in labour productivity (growth accounting)**

Taking a simple production function, the level of output (real value added,  $V$ ) from industry  $j$  at time  $t$  can be expressed as a function of aggregate capital inputs ( $K$ ), aggregate labour inputs ( $L$ ) and the production technology ( $A$ ):

$$V_t^j = f(K_t^j, L_t^j) * A_t^j \quad (1)$$

where the values of capital and labour inputs ( $K$  and  $L$  respectively) are determined by both quantity and quality considerations. The production technology ( $A$ ) refers to the rate at which units of capital and labour are converted into output and is often termed 'total factor productivity' (TFP).

The growth in output in industry  $j$  over the period  $(t,t-1)$  will therefore be determined by changes in labour inputs, changes in capital inputs and changes in TFP. Growth in

---

<sup>5</sup> The Labour Force Survey is preferred to the New Earnings Survey as a source of data on hours worked for the reasons stated by Williams (2002).

output may be measured at a sectoral level from official data sources, as may changes in the quantities of labour and capital inputs (see Section 5.1 above). Changes in the quality of capital and labour are more difficult to measure. In addition, it is not possible to directly estimate changes in TFP. This problem is addressed by the traditional growth accounting method, which has its theoretical underpinnings in the neoclassical growth model.

Under the assumption that all markets function perfectly, the method of growth accounting method permits changes in TFP to be estimated as a residual having subtracted changes in inputs from output growth. The most commonly employed index formula is based on the assumption of a Translog production function and obtained via the Törnqvist discrete approximation to the Divisia index (see, for example, Jorgenson et al, 1987). If we let  $i$  denote industries and  $dX^i(t)$  denote the proportionate change in variable  $X^i$  between period  $t$  and  $t-1$ , i.e.  $dX^i(t) = \text{Ln}(X_t^i / X_{t-1}^i)$ , and impose constant returns to scale then the Törnqvist index is given by

$$dV^j(t) = a^j(t,t-1)*dL^j(t) + (1 - a^j(t,t-1))*dK^j(t) + dA^j(t) \quad (2)$$

where  $a(t,t-1)$  is the share of labour in value-added, averaged over the two time periods. Under neo-classical assumptions, the shares  $a(t,t-1)$  and  $(1 - a(t,t-1))$  equal the output elasticity of labour and capital respectively and since we are assuming constant returns to scale, sum to one. The rate of change in  $A^j(t)$  is a catch-all for technological or organizational improvements, such as process innovations and changes in work organization, that increase the level of output for a given amount of input. Changes in the quality of factor inputs, e.g. a greater use of new technology equipment or highly skilled labour, may be incorporated within this framework by weighting each of a number of types of capital or labour by their value added shares (see e.g. Jorgenson et al. 1987 for details).<sup>6</sup> If this adjustment for quality is not carried out directly then the TFP term also includes the impact of input quality changes.

This method of accounting for growth in output can be easily extended to permit a focus on changes in labour productivity. Having identified the impact of changes in the *quantity* of labour input (say hours worked), we can subtract this from the changes in output in (2), and using the fact that the input weights sum to one, derive a labour productivity equation of the form:

$$d(V^j / L^j)(t) = (1 - a^j(t,t-1))*d(K^j / L^j)(t) + dA^j(t) \quad (3)$$

Thus changes in labour productivity depend on changes in the capital labour ratio (capital deepening) and TFP.

An alternative approach is to start with gross output (gross value added plus purchases) and include purchases as intermediate inputs in the above formulae. Although this approach is considered in theory to be the most appropriate measure as it allows for substitution between material and other inputs, in practice reliable

---

<sup>6</sup> It is not appropriate to make such a labour quality adjustment in our circumstances since the underlying assumption, that the price of labour equates to its marginal product, is unlikely to hold both immediately before and immediately after the introduction of the NMW.

materials deflators are not available. However some experiments with this measure were carried out in the context of regression analysis (see below).

### 5.3. *Unit labour costs:*

As we have provided a formal exposition of our measure of labour productivity, it appropriate to do the same for our measure of unit labour costs.

Unit labour costs measure the labour cost of producing each unit of output. Unit labour costs in industry  $j$  at time  $t$  ( $UCL_t^j$ ) are calculated by dividing total employment costs per unit of labour input ( $C_t^j / L_t^j$ ) by the level of labour productivity ( $V_t^j / L_t^j$ ):

$$UCL_t^j = (C_t^j / L_t^j) / (V_t^j / L_t^j) \quad (4)$$

Equation (4) serves to illustrate that unit labour costs are determined both by changes in compensation per head/per hour and changes in labour productivity. However, since the amount of labour input appears in both the numerator and denominator, trends in unit labour costs may equally be measured by trends in labour's share of value added:

$$UCL_t^j = (C_t^j / V_t^j) \quad (5)$$

### 5.4. *Panel regressions*

An alternative to the index number approach is to employ regression analysis both to estimate the input weights and/or to facilitate testing for impacts of the minimum wage. This can be carried out using either the labour productivity equation above or by estimating TFP using the Törnqvist index and then regressing the results on the variables of interest. In standard panel regression analysis two basic models are used in production function estimation. The first regresses the (log) levels of output on explanatory variables including industry dummy variables (industry fixed effects) to account for industry heterogeneity in output levels. The second takes the first difference of all variables so that these industry fixed effects fall out of the equation. The latter saves on degrees of freedom and is most useful when the cross section dimension is large relative to the time dimension. The data set employed in the regressions below is based on 181 industries and six years so the first difference model is preferred. In fact the fixed effects model led to unstable results due to the need to estimate such a large number of industry parameters.

Assuming a Cobb-Douglas production function, we estimate the following two equations,:

$$d(V^j/L^j)(t) = C + \alpha * d(K^j/L^j)(t) + \sum_j \beta_j Z_j + \gamma \text{NMW} + \varepsilon(t) \quad (6)$$

$$dA^j(t) = C + \sum_j \beta_j Z_j + \gamma \text{NMW} + \varepsilon(t) \quad (7)$$

where  $Z_j$  is a vector of  $j$  control variables and NMW is a variable measuring the impact of the national minimum wage, discussed in the next section. Candidates for control variables include proportions of the work force with various skill levels,

investment in new technology and time trends to capture cyclical effects. The impact of these variables is discussed in the context of the panel regression results below.

### **5.5. Identifying low-paying sectors**

A critical part of our study is the identification of sectors most affected by the introduction of the NMW. Figure 1 shows that SIC(92) Section G (Wholesale and Retail) has the largest number of employees paid below the NMW prior to its introduction. However, Figure 1 also shows that the proportion of low paid employees is higher in other industries, most notably Section H (Hotels and Restaurants).

Either of these indicators – the number or proportion of employees affected – could be used to measure the impact of the introduction of the NMW. However, a more direct indicator of the ‘bite’ of the NMW would be provided by a measure of the proportionate change in sectoral employment costs arising directly from the introduction of the NMW. Ideally, such a measure would cover total employment costs, comprising the sum of wage payments and National Insurance contributions minus any compensatory effect arising from the withdrawal of non-pecuniary rewards. For reasons of simplification however, we follow the Low Pay Commission (2001a) in focusing solely on the impact of the NMW on the wage bill.

Estimates of the impact of the introduction of the NMW on sectoral wage bills are presented for a small number of low-paid sectors in the Low Pay Commission’s third report (Low Pay Commission, 2001a: Figure 3.27). These estimates are obtained from the 1998 New Earnings Survey by uprating the gross wages of all low-paid employees to the level of the NMW, assuming full compliance with the new minimum. A comparison of mean wages in each sector before and after the NMW adjustment provides an estimate of the impact on each sector’s wage bill.

We have adopted the same methodology to estimate the impact of the introduction of the NMW on the wage bill within each of our 183 industries. In doing so, we have not taken into account any possible ‘spill-over’ effect on the wages of higher paid workers which might occur through attempts to restore differentials. The available evidence suggests that any such spill-over effects have been minimal (Low Pay Commission, 2002: 21-24). The method also ignores the cost of anticipatory wage rises by employers that took place before the April 1998 (the date of fieldwork for the 1998 New Earnings Survey). However, since the Low Pay Commission did not publish their recommendations for the rates at which the NMW should be introduced until June 1998, the degree of such pre-emptive action by employers is considered to be small.

Figure 2 shows the estimated impact of the introduction of the NMW on the wage bill in seven industry sectors that are commonly highlighted by the Low Pay Commission. Four of these seven sectors – Textiles, Clothing and Footwear, Retail, and Hospitality – represent collections of SIC(92) Groups, whilst the remaining three sectors – Cleaning, Security and Hairdressing – are defined at Group level in line with our database. There is a degree of variation in the impact of the NMW within the agglomerated sectors. Within Hospitality, for example, the impact is estimated to be around 2.6 per cent in Restaurants (SIC(92) Group 55.3) compared with 1.2 per cent in Hotels (Group 55.1). Yet, whilst much of our descriptive analysis does focus on the

seven sectors shown in Figure 2, any Group-level variation within the four agglomerated sectors will be picked up in our panel regressions.

*\* Figure 2 Impact on the Sectoral Wage Bill of the Introduction of the NMW, Low Pay Commission Sectors \**

Of course, these seven sectors and their Group-level components are not the only sectors in the economy in which the NMW is estimated to have had a noticeable impact on the wage bill. Figure 3 shows the estimated impact in a number of other low-paying sectors. These include Other Computer-Related Activities (Group 72.6), Sporting Activities (Group 92.6) and Other Recreational Activities (Group 92.7). An examination of the impact of the NMW on the wage bill in each of the 183 Group-level industries in our database shows that the six sectors shown in Figure 3 each sit well above the 75<sup>th</sup> percentile, represented by an increase in the sectoral wage bill of 0.32%.

*\* Figure 3 Impact on the Sectoral Wage Bill of the Introduction of the NMW, Other Low-Paying Sectors \**

## **6. Results**

Our investigation of the impact of the NMW on labour productivity and unit labour costs begins with a descriptive analysis of trends in productivity and unit labour costs over the period 1995-2000. To provide a framework for the discussion of this descriptive analysis, we first focus on seven sectors that are commonly highlighted by the Low Pay Commission (see Figure 2). In doing so, we attempt to identify any obvious deviations from trend that might suggest an impact from the NMW. However, it will be difficult to judge whether anything that we observe among these seven sectors is unique to them alone, and so we continue by investigating whether the trends seen in low-paying sectors as a whole are divergent from those seen in higher paying sectors. We do so by grouping the 167 industries with complete data into four quartiles according to the magnitude of the impact of the NMW on their sectoral wage bill. In this way, we obtain a more comprehensive indication of whether trends in labour productivity and unit labour costs across a range of sectors appear to be related to the bite of the NMW.

We follow our descriptive analysis with statistical analysis of the relationship between labour productivity growth / unit labour costs and the bite of the NMW. This first takes the form of an analysis of the strength of any correlation between labour productivity growth / unit labour costs and the bite of the NMW. In the case of labour productivity growth, these correlations are also accompanied by panel regressions of the form described in Section 5.4 above.

Our discussion of labour productivity growth is presented in Section 6.1 below. Our discussion of unit labour costs follows in Section 6.2.

### **6.1. Labour Productivity Growth**

Figure 4 shows the level of labour productivity (measured in terms of real value added per hour worked) in each of the seven sectors commonly highlighted by the Low Pay Commission. The graph shows that the level of labour productivity increased in all seven sectors over the period 1995-2000, with the exception of Clothing and Footwear which saw a small net decline. However, there does not appear to be an obvious and consistent increase in the growth rate across all other sectors after 1998 which might be attributed to the introduction of the NMW.

On closer inspection, we see that the rate of growth in labour productivity did increase after 1998 in three sectors, namely Retail, Security and Hairdressing. The rate of growth also increased in Textiles after 1999. Figure 5 shows the average annual rate of growth in labour productivity in the period preceding the introduction of the NMW (1995-1998) and in the period that included and followed its introduction (1998-2000). For each of the seven sectors, the graph is effectively comparing the average annual rate of growth over the period January 1995-December 1998 with that over the period January 1999-December 2000. The graph helps to clarify that there was an acceleration in the rate of growth in labour productivity in Textiles, Security and Hairdressing. In Retail, the rate of growth between 1998-2000 was clearly greater than that seen over the period 1996-1998 (Figure 4). But once the earlier period is extended to include 1995, Figure 5 shows a slight deceleration in growth for Retail in 1998-2000. In Hospitality, we see an increase in the level of labour productivity growth in both periods, but a deceleration in the rate of growth in the period covered by the NMW. The two remaining sectors, Clothing and Footwear and Cleaning both show slight declines in the level of labour productivity in the period covered by the NMW.

In summary, if the introduction of the NMW had any effect on overall labour productivity in the seven low-paying sectors, this effect seems most likely to have been witnessed in Textiles, Security and Hairdressing.

Textiles is a shrinking sector of the economy but, over the period in question, saw an acceleration in labour productivity growth as a result of the rate of decline in labour inputs exceeding the rate of decline in output. The rate of decline in real value added rose from -1.5 per cent per annum in 1995-1998 to -8.2 per cent per annum in 1998-2000. But the rate of decline in hours worked rose to a greater extent, from -2.3 per cent per annum in 1995-1998 to -10.6 per cent per annum in 1998-2000.

Security and Hairdressing, in contrast, are growing sectors of the economy. In Security, the acceleration in labour productivity growth over the period covering the introduction of the NMW arose because the rate of growth in labour inputs fell markedly, from 10.3 per cent per annum in 1995-1998 to 1.6 per cent per annum in 1998-2000, whilst the rate of growth in real value added showed only a marginal slowdown, from 12.1 per cent to 8 per cent per annum. In Hairdressing, the opposite was true, since the rate of growth in real value added accelerated whilst growth in labour inputs remained steady. Growth in real value added in Hairdressing rose from 3.8 per cent per annum 1995-1998 to 10.2 per cent per annum 1998-2000, but the rate of growth in hours worked rose from 2.6 per cent to only 3.6 per cent.

To further understand the origins of the observed changes in labour productivity growth in these sectors, we use the method of growth accounting to decompose the growth in labour productivity into that part which is attributable to the substitution of capital for labour and that part which is due to other changes, which we collectively refer to as growth in TFP.

In Figure 6 we see Textiles has the highest ratio of capital to labour among the seven sectors currently under consideration. This might indicate that production methods in Textiles also offer greater scope for the further substitution of capital for labour than do the methods used in very labour intensive sectors such as Security, Cleaning and Hairdressing. Indeed, we can see that the capital-labour ratio in Textiles has increased in both periods (1995-1998 and 1998-2000) (Figure 6), and that the rate of substitution has actually increased in the later period (Figure 7). This increased rate of substitution of capital for labour enables the number of hours worked in Textiles to fall at a faster rate than real value added. This clearly provides a basis for an increase in labour productivity growth within the sector. In fact, it would appear to wholly account for the acceleration in productivity growth in Textiles, since there has been a decline in TFP in the period covered by the NMW (Figures 8 and 9).

The decomposition of labour productivity growth in Security shows a similar picture to that emerging from Textiles (Figure 10). There has been some substitution of capital for labour in Security over the period 1998-2000, reversing the trend seen in the earlier period. And this substitution of capital for labour would appear to account for the acceleration of productivity growth in the sector, since TFP has been declining since 1997. In Hairdressing, labour inputs have been growing faster than capital inputs, leading to a slight decline in the capital-labour ratio. Productivity growth has therefore accelerated within this sector as a result of an increase in the rate of growth in TFP.

The causes of the acceleration in the growth rate of TFP in Hairdressing are less obvious. One possibility is that there has been an increase in labour quality in the sector. Estimates from the Labour Force Survey of the proportion of employees in the sector with varying levels of qualifications does appear to suggest that there has been some increase in the skill levels of those employed in Hairdressing. Specifically, the proportion of employees with qualifications at NVQ level 4 and above has risen from around 3 per cent in 1995-1999 to 6 per cent in 2000, with a corresponding fall in the proportion of employees in qualifications at NVQ levels 1-3. However, on its own this could not be expected to account for the sharp rise in TFP between 1998 and 2000. One would therefore expect that there has either been an increase in the quality of the capital stock, an improvement in work organization or, perhaps most likely, an intensification of effort per hour at given levels of skill.

To summarize the results for these seven sectors, there has been an acceleration in labour productivity growth in Textiles, Security and Hairdressing over the period covered by the NMW. In Textiles and Security, this has been achieved through the substitution of capital for labour. In Hairdressing, it has been achieved through other means, with an increase in the share of skilled labour appearing to have played a minor part but the major causes remaining unexplained.

It is notable that two of the three sectors which have experienced an acceleration in labour productivity growth are ones in which the NMW is estimated to have had a relatively large impact on the sectoral wage bill, namely Cleaning and Hairdressing. Otherwise, there is no obvious relationship between trends in labour productivity shown in Figures 4 and 5 and the impact of the NMW shown in Figure 2. However, a more systematic investigation of this potential relationship would involve the consideration of a broader set of low paying sectors, and would also consider trends in labour productivity in sectors that were relatively unaffected by the NMW. To undertake such an investigation, we divide the group of 167 industries with complete information into four groups according to the degree of impact that the NMW had on the sectoral wage bill. The dividing lines between the four groups are set at the 25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup> percentiles of the distribution of wage bill impacts.<sup>7</sup> Those industries coming within the first quartile are therefore those in which the NMW had the least impact on the wage bill, whilst those coming in the fourth quartile are the sectors in which the NMW had the greatest impact.

Trends in labour productivity within each of these four quartiles over the period 1995-2000 are shown in Figure 11. The graph shows clearly that levels of labour productivity are positively correlated with wage levels, such that higher levels of labour productivity are seen in those sectors least affected by the NMW. These are also the most capital intensive sectors (Figure 13).

Each of the four quartiles show some growth in labour productivity over the period 1998-2000, with the fastest growth occurring in the first quartile. The NMW has little impact here and so it is more fruitful to focus on quartiles three and four. Here, we see that the growth in labour productivity in the fourth quartile was faster than in the third quartile over the period 1998-2000 (Figures 11 and 12). But the same was also true in over the period 1995-1998, before the introduction of the NMW. Moreover, the rate of growth in labour productivity actually decreased in the later period in both quartiles (Figure 12). As a result, it seems difficult to argue that any differential in growth rates between the third and fourth quartiles over the period 1998-2000 is due to the NMW.

Nevertheless, it is interesting to consider the differences in the causes of labour productivity growth within each of the quartiles. The first quartile shows an increasing substitution of capital for labour in the period 1998-2000 (Figures 13 and 14) and a slight acceleration in the rate of growth in TFP (Figures 15 and 16). Both factors have therefore contributed to the growth in labour productivity over the period 1998-2000 and to the acceleration in the rate of growth in this period compared with 1995-1998 (Figure 17). In the remaining three quartiles, the substitution of capital for labour alone is has driven the growth in labour productivity over the period 1998-2000. The fourth quartile in particular shows a substantial degree of capital deepening over the period covering the introduction of the NMW, but only a slight acceleration in the rate of substitution, indicating that it forms part of a longer term trend rather than having arisen as a response to regulatory changes. In each of the bottom three quartiles, a deceleration in the rate of growth of TFP over the period 1998-2000 was sufficient to slow down the rate of productivity growth when compared with the earlier period.

---

<sup>7</sup> The 25<sup>th</sup> percentile corresponds to a wage bill impact of 0.04 per cent; the 50<sup>th</sup> percentile to an impact of 0.13 per cent and the 75<sup>th</sup> percentile to an impact of 0.32 per cent.

Thus far, our investigation has provided little evidence that the introduction of the NMW had a general impact on labour productivity growth in low-paying sectors. To verify this conclusion we move from a descriptive to a more analytical approach which takes the individual industry sectors in our database as the unit of analysis. This involves, first, an examination at the sectoral level of the correlation between the wage bill impact of the NMW the rate of growth in labour productivity. Second, it involves panel regressions of the form described in Section 5.4.

Table 4 presents the correlations between the estimated wage bill impact of the NMW in each sector and that sector's rate of growth in labour productivity, calculated over a range of periods and for a number of different sub-samples of the 183 industries in our database. The first row of the table presents the coefficients that arise when the correlations are calculated across all 183 industries. We see that a small positive correlation falls almost to zero in the period covering the introduction of the NMW. This indicates that the rate of growth in labour productivity across our 183 industries is unrelated to the 'bite' of the NMW.

One might argue, however, that any impact is being masked by the changes in labour productivity that have taken place in higher-paying sectors where the introduction of the NMW was at most a very minor issue. Yet the pattern is almost unchanged when we restrict our attention to those 87 industries in quartiles three and four of the distribution of wage bill impacts. Restricting our attention further to those 42 industries in quartile four, we see that the correlation coefficients remain extremely small and continues to decrease in size over time. The same is true when we focus solely on the 24 SIC(92) Groups that comprise the seven sectors most commonly highlighted by the Low Pay Commission. Those sectors most affected by the NMW appear to have experienced slightly faster productivity growth than higher-paying sectors in the few years preceding the NMW, but this small positive association disappears over the period when the NMW was actually conceived and introduced.

To evaluate the significance of these correlations we first regressed labour productivity, total factor productivity and the capital labour ratio on the wage bill impact variable and year dummy variables to account for cyclical effects. The results are shown in Table 5 for the time periods 1995-1998 and 1998-2000. In the earlier period the wage impact variable is significant in the TFP equation and in the labour productivity equation at the 90 per cent level. In the later period these effects disappear, with the coefficients turning negative although with a very low level of significance. The growth in the capital labour ratio is not related to the wage impact variable in either time period.

We now turn to panel regressions controlling for a range of other influences on industry productivity growth. Obvious candidates were skill proportions of the work force and new technology equipment (labour and capital quality variables). In the case of the former we included two skill distinctions, higher skilled (degree and above and other NVQ4) and intermediate (NVQ1-3). Data on new technology equipment was not available for the industry detail considered in this study. Instead we experimented with using sector level (approximately 2-digit SIC) shares of Information and Communications Technology (ICT) equipment in total capital but these turned out to be insignificant. In addition to overall year dummies we also constructed time trends

which were broad sector specific, i.e. manufacturing, other production industries and service sectors. These again turned out to be insignificant. Therefore the final specification included only labour force skills as controls.

The results are shown in Table 6. The first three columns show the results when the wage impact variable was included for each year, whereas the second three columns show the impact when this variable is only included from 1988-2000. Note this variable does not change over time so that it is not possible to include it together with a time interaction effect. The results confirm the findings from the earlier correlations that the wage impact variable has a significant impact on productivity for the entire period but disappears when attention is restricted to the years after the introduction of the minimum wage. Finally, we also carried out regressions using dependent variables based on gross output, with real material inputs as an explanatory variable. This yielded similar results on the wage impact variable as for the value-added labour productivity and TFP equations, namely a significantly higher productivity growth in low wage sectors for the entire period but not post 1998.

In conclusion, the introduction of the NMW may have led to an acceleration in labour productivity growth in some sectors, such as Textiles, Security and Hairdressing. Nevertheless, there does not appear to have been a general impact (positive or negative) on sectoral rates of labour productivity growth at the level of aggregation employed in our database (primarily SIC(92) Group level).

## **6.2. Unit Labour Costs**

In the previous section, we observed that the level of labour productivity rose in most of the low-paying sectors over the period 1995-2000. The direction of change in unit labour costs in these sectors is therefore determined by whether this growth in labour productivity was greater than or less than the change in employment costs per hour worked.

Figure 18 shows the level of unit labour costs (measured in terms of constant prices) in each of the seven sectors commonly highlighted by the Low Pay Commission. The graph shows that there was a net increase in the level of unit labour costs in just two of these seven sectors over the period 1995-2000, namely Security and Cleaning. Unit labour costs in these two sectors were already higher than in the remaining five sectors in 1995; the pattern of change served to further increase the disparity. Each of the five remaining sectors witnessed marginal net declines in unit labour costs over the full period in question.

Focusing on the period covering the introduction of the NMW (1998-2000), we find that unit labour costs rose only in Hospitality (Figure 19). However, the rate of decline in unit labour costs did slow down in Retail and Hairdressing in this later period. In the remaining four sectors – Textiles, Clothing and Footwear, Security and Cleaning – unit labour costs declined over the period 1998-2000 after rising between 1995 and 1998. The reasons for these divergent trends are apparent when we consider changes in the components of unit labour costs, namely employment costs per hour worked and labour productivity.

In the Hospitality sector, employment costs per hour worked rose by 4 per cent per annum (at constant prices) over the period 1998-2000. This mirrored the rate of growth over the period 1995-1998. However, the rate of growth in labour productivity slowed down from 6.2 per cent per annum to 2.6 per cent per annum. As a consequence, unit labour costs rose in the period 1998-2000 after having declined between 1995 and 1998.

The situation in Security was slightly different. Here, employment costs per hour worked also grew by around 4 per cent per annum over the period 1998-2000, as they had between 1995 and 1998. But labour productivity growth accelerated from 1.8 per cent per annum to 6.5 per cent per annum, bringing about a decline in unit labour costs.

In Textiles, employment costs per hour worked stopped growing in the period 1998-2000. Both total employment costs and total hours worked fell by around 11 per cent over this period. One reason may be the increased substitution of capital for labour, discussed in Section 6.1, although this sector has also witnessed a general decrease in size in recent years. Since labour productivity did grow slightly in Textiles between 1998 and 2000, by 2.4 per cent per annum on average, this led to the decline in unit labour costs, which averaged 3.3 per cent per annum.

Finally, in Clothing and footwear and in Cleaning, the fall in unit labour costs was brought about by the combination of a fall in employment costs per hour worked and almost static levels of labour productivity. Employment costs per hour worked fell by 5 per cent per annum between 1998 and 2000 in Clothing and footwear, and by 2 per cent per annum in Cleaning over the same period. The declines in unit labour costs in each sector were of a similar magnitude.

To summarise the patterns emerging from Figures 18 and 19, unit labour costs rose only in Hospitality over the period covering introduction of NMW. They fell in four of the remaining six sectors, including Security and Cleaning which were two of the hardest hit by NMW. The introduction of the NMW does not therefore appear to have brought about any general increase in aggregate unit labour costs across these seven sectors.

Turning to examine the fortunes of sectors in each of our four quartiles, we find a similar lack of evidence that the NMW has brought about a general increase in aggregate unit labour costs in low-paying sectors. Figures 20 and 21 show that unit labour costs have increased in the second, third and fourth quartiles. However, the increase is smallest in the fourth quartile, where the 'bite' of the NMW was at its greatest. It is true that the trend in labour costs reversed in the fourth quartile when compared with the period 1995-1998, which saw a marked decline. But a reversal of a similar magnitude was also seen in the second quartile, making it difficult to argue that this was caused by the NMW.

These conclusions are bolstered by the results of our correlation analysis. Table 6 shows very weak correlations between the wage bill impact of the NMW and the annual rate of growth in unit labour costs. There is a broad indication that the correlation changed from a negative one in the period 1995-1998 to a positive one in the period 1998-2000. However, the correlation coefficients do not exceed 0.2 in any

of the periods for any of the sub-samples. Consequently, one may conclude that there is, at most, a very weak relationship at industry level between the wage bill impact of the NMW and changes in unit labour costs.

These correlations represent the final point of our analysis of unit labour costs, since there is not an appropriate regression framework for the analysis of growth in unit labour costs equivalent to that employed in the case of labour productivity. To summarize our results, we find little evidence either from our descriptive analysis or our industry-level correlations that the introduction of the NMW brought about a general increase in aggregate unit labour costs in low-paying industries. Where increases did occur in employment costs per hour worked, these appear to have been approximately counterbalanced by labour productivity growth, thereby minimizing any resultant impact on unit labour costs.

## **7. Conclusions**

In conclusion, we have found little evidence in our analysis to suggest that the introduction of the NMW in 1999 provided a general boost to labour productivity growth in low-paying sectors, or that it led to a general increase in unit labour costs.

It is true that the NMW may have had some effect in specific sectors. Our descriptive analysis of labour productivity growth suggested that the rate of growth did accelerate in Textiles, Security and Hairdressing over the period covering the introduction of the NMW. But our statistical analysis found no robust association between the wage bill impact of the NMW and rates of labour productivity growth across a wider range of sectors. Similarly, we found that unit labour costs did rise in Hospitality over the period covering the introduction of the NMW. But again our statistical analysis found no robust association at a more general level.

There are a number of possible reasons why the NMW appears not to have had the impact that some anticipated.

First, the overall impact of the introduction of the NMW on sectoral wage bills is generally rather small. Across the 183 industries in our database, the 75<sup>th</sup> percentile in the wage bill distribution was represented by an impact of only 0.32 per cent. Moreover, in only 5 of these 183 sectors was the impact greater than 2 per cent (Security; Cleaning; Hairdressing; Camping; and Restaurants). It is also clear that this aggregate effect will vary considerably across different firms, and that even within most low-paying sectors, many firms will have been untouched by the NMW.

Second, it is clear that employers' responses to the introduction of the NMW took a variety of different forms. Many did report taking action to improve levels of labour productivity, either by tightening control of labour costs, introducing new technology or changing the organization of work. However, these initiatives were commonly combined with other measures, such as increasing prices or cutting profits (Low Pay Commission, 2001: 123). The extent of the improvement in productivity may therefore have been marginal in many cases.

Third, it is also apparent that the 'bite' of the NMW would have been felt most painfully among small businesses (Low Pay Commission, 1998: 49). Small firms are extremely numerous but make only a minor contribution to aggregate levels of employment and output. Official statistics suggest that, in the private sector in 1999, firms with 1-9 employees accounted for 86 per cent of all firms with 1 or more employees, but only 20 per cent of aggregate employment and 19 per cent of aggregate turnover (Department of Trade and Industry, 1999). In contrast, firms with 500 or more employees accounted for less than 0.5 per cent of all firms, but 45 per cent of employment and 43 per cent of turnover. Considerable changes in levels of output, hours and employment within small firms can therefore be expected to make a relatively small impression on industry-level aggregates.

It is difficult to argue that the introduction of the NMW had no noticeable impact on labour productivity and unit labour costs among low-paying employers. However, this impact is likely to have been most apparent in firms with substantial proportions of low-paid employees and with limited opportunities to make other responses, perhaps because they operate in extremely price-sensitive markets or have very low profit margins. These are likely to form only a small proportion of all firms in any one sector.

It may be possible to identify such employers in firm or establishment-level datasets. One obvious candidate would be the 1998 Workplace Employee Relations Survey (WERS98) which, although it lacks data on output levels and employment costs, has the potential to be linked to returns made by the same employers as part of the Annual Business Inquiry. A similar matching process might also be attempted using the Low Pay Commission's survey of employers undertaken in September-October 1999. However, the relatively low response rate achieved in the Low Pay Commission survey, and its limited range of control variables, appear to limit its potential in comparison with WERS98.

A further avenue of interest is the potential for productivity gains arising from the recent uprating of the NMW in October 2002. The Low Pay Commission estimate that between 1.3 million and 1.5 million jobs will be affected and that impact on the national wage bill will in the region of 0.3 per cent: a similar impact to that seen at the introduction of the NMW. It is possible that firms had sufficient room for manoeuvre to cope with the introduction of the NMW, but that they may find it more difficult to absorb another rise in their wage bills without paying greater attention to productivity levels or without witnessing some increase in unit labour costs.

Further research would be merited in each of these two respects.

## References

- Bullock A, Hughes A and Wilkinson F (2001) *The Impact of the National Minimum Wage on Small and Medium Sized Businesses in the Cleaning and Security Sectors*, Cambridge: Centre for Business Research.
- Card D (1992a) "Do minimum wages reduce employment? A case study of California, 1987-1989" *Industrial and Labor Relations Review*, 46: 38-54.
- Card D (1992b) "Using regional variation in wages to measure the effects of the federal minimum wage" *Industrial and Labor Relations Review*, 46: 22-37.
- Card D and Krueger A (1994) "Minimum wages and employment: a case study of the fast-food industry in New Jersey and Pennsylvania", *American Economic Review*, 84: 772-93.
- Cubitt R and Heap S (1999) "Minimum wage legislation, investment and human capital", *Scottish Journal of Political Economy*, 46: 135-57.
- Daffin C and Lau E (2002) "Labour productivity measures from the Annual Business Inquiry", *Economic Trends*, 589.
- Department of Trade and Industry (1999) *Small and Medium Enterprise (SME) Statistics for the UK 1999*, London: Department of Trade and Industry.
- Department of Trade and Industry (2001) *A Detailed Guide to the National Minimum Wage* (October 2001 edition), London: Department of Trade and Industry.
- Dolado J, Kramarz F, Machin S, Manning A, Margolis D and Teulings C (1996) "The economic impact of minimum wages in Europe", *Economic Policy*, 23: 319-72.
- Forth J, Mason G and O'Mahony M (2002) "Industrial performance, ICT investments and workforce skills: literature and statistical review", National Institute of Economic and Social Research, mimeo.
- Gilman M, Edwards P, Ram M and Arrowsmith J (2002) "Pay determination in small firms in the UK: the case of the response to the National Minimum Wage", *Industrial Relations Journal*, 33, 1: 52- 67.
- Hayes J and Gray A (2001) "The impact of the National Minimum Wage on the textiles and clothing industry", *Policy Studies*, 22, 2: 83-98.
- Jones G (2000) "The development of the Annual Business Inquiry", *Economic Trends*, No. 564, pp.49-57.
- Jorgenson D, Gallup F and Fraumeni B (1987) *Productivity and US Economic Growth*, Cambridge, MA: Harvard University Press.

Low Pay Commission (1998) *The National Minimum Wage. First Report of the Low Pay Commission*. Cm 3976. London: HMSO.

Low Pay Commission (1999) "Pay Structures and the Minimum Wage", Low Pay Commission Occasional Paper No. 3.

Low Pay Commission (2000) *The National Minimum Wage: The Story So Far. Second Report of the Low Pay Commission*. Cm 4571. London: HMSO.

Low Pay Commission (2001a) *The National Minimum Wage: Making a Difference. Third Report of the Low Pay Commission (Volume 1)*. Cm 5075. London: HMSO.

Low Pay Commission (2001b) *The National Minimum Wage: Making a Difference. Third Report of the Low Pay Commission (Volume 2)*. Cm 5075. London: HMSO.

Machin S, Manning A and Rahman L (2002) "Where the Minimum Wage bites hard: the introduction of the UK National Minimum Wage to a low wage sector", Centre for Economic Performance, London School of Economics, Discussion Paper No. 544.

Manning A (2001) "Monopsony and the efficiency of labour market interventions", Centre for Economic Performance, London School of Economics, Discussion Paper No. 514.

National Statistics (2002) *Improved Estimates of Low Pay 1998-2001*, 3<sup>rd</sup> October 2002, London: National Statistics.

Rebitzer J and Taylor L (1995) "The consequences of minimum wage laws: some new theoretical ideas", *Journal of Public Economics*, 56: 245-55.

Rubery J (1997) "Wages and the labour market", *British Journal of Industrial Relations*, 35, 3: 337-366.

Stewart M (2002) "The Impact of the Introduction of the UK Minimum Wage on the Employment Probabilities of Low Wage Workers", University of Warwick, mimeo.

Williams R (2002) "Hours worked: a comparison of estimates from the Labour Force and New Earnings Surveys", *Labour Market Trends*, August: 429-442.

**Table 1 Number of jobs paid below National Minimum Wage rates**

	<b>All jobs</b>		<b>Jobs filled by people aged 18-21</b>		<b>Jobs filled by people aged 22 and over</b>	
	Thousands	Per cent	Thousands	Per cent	Thousands	Per cent
April 1998	1,420	6.0	120	7.3	1,310	5.9
April 1999	530	2.2	40	2.3	490	2.2
April 2000	240	1.0	40	2.2	200	0.9
April 2001	250	1.0	40	2.1	210	0.9

Source: National Statistics (2002)

**Table 2 Changes in National Minimum Wage rates**

<b>Date announced</b>	<b>Date implemented</b>	<b>Main rate <sup>a</sup></b>	<b>Development rate (Workers aged 22 and over) <sup>b</sup></b>	<b>Development rate (Workers aged 18-21) <sup>b</sup></b>
	1 <sup>st</sup> April 1999	£3.60	£3.20	£3.00
		per hour	per hour	per hour
15 <sup>th</sup> February 2000	1 <sup>st</sup> June 2000			£3.20
15 <sup>th</sup> February 2000	1 <sup>st</sup> October 2000	£3.70		
March 2001	1 <sup>st</sup> October 2001	£4.10	£3.50	£3.50
March 2001	1 <sup>st</sup> October 2002	£4.20	£3.60	£3.60

a Main rate applies to workers aged 22 and over, except those in the first 6 months of a new job with a new employer and are receiving accredited training.

b Development rate applies to all workers aged 18-21 inclusive. It is also payable to workers aged 22 and over who are in the first 6 months of a new job with a new employer and are receiving accredited training.

Source: Department of Trade and Industry (2001). A more detailed history of the National Minimum Wage is presented at: <http://www.dti.gov.uk/er/nmw/nmwhist.htm>

**Table 3 Gross value-added per job at current prices, £ thousand**

SIC92 Section	Description	Year	Daffin and Lau (2002)		Our ABI database	
			£ thousand	Index	£ thousand	Index
C-O*	All ABI sections	1998	28.8	100.00	28.1	100.00
		1999	30.3	105.21	29.5	104.71
		2000	31.3	108.68	30.6	108.60
D	Manufacturing	1998	34.0	100.0	33.7	100.0
		1999	35.2	103.5	34.7	103.0
		2000	36.5	107.4	36.0	106.7
C-F	Production & construction	1998	36.1	100.00	34.4	100.00
		1999	38.0	105.26	36.1	104.89
		2000	40.2	111.36	38.5	111.98
G-O*	Service sector	1998	25.3	100.00	25.0	100.00
		1999	26.8	105.93	26.4	105.23
		2000	27.4	108.30	27.0	107.77

\* Excludes SIC(92) Divisions 65, 67, 70, 75, 80 and 85.

**Table 4 Correlation Between Growth in Labour Productivity and Wage Bill Impact of NMW**

	<b>Overall</b>	<b>1995-96</b>	<b>1996-97</b>	<b>1997-98</b>	<b>1998-99</b>	<b>1999-2000</b>	<b>1995-98</b>	<b>1998-2000</b>
All industries ( <i>n=183</i> )	0.04	0.14*	0.06	-0.02	-0.02	0.01	0.12	0.01
Quartiles 3 and 4 ( <i>n=87</i> )	0.05	0.17	0.03	-0.04	0.01	0.04	0.12	0.04
Quartile 4 ( <i>n=42</i> )	0.06	0.08	0.04	0.10	0.03	0.06	0.13	0.07
LPC sectors ( <i>n=24</i> )	0.06	0.03	0.25	-0.11	-0.003	0.12	0.29	0.02

\* significant at 10 per cent level.

**Table 5 Regressions of Labour Productivity Growth, Total Factor Productivity and Capital-Labour Ratio on the Wage Bill Impact of the NMW**

	1995-1998			1998-2000		
	Labour productivity	Total factor productivity	Capital labour ratio	Labour productivity	Total factor productivity	Capital labour ratio
Constant	0.007 (0.47)	0.008 (0.54)	-0.015 (1.15)	0.029** (1.94)	0.012 (0.90)	0.048* (3.48)
Wage bill impact of NMW	0.022** (1.91)	0.023* (2.12)	0.006 (0.06)	-0.005 (0.49)	-0.002 (0.25)	-0.005 (0.57)
Adjusted R <sup>2</sup>	0.018	0.029	0.011	0.007	0.001	0.002
Observations	522	522	522	362	362	362

*Notes:*

1. Absolute values of t-ratios in parentheses
2. Standard errors are heteroscedastic consistent
3. Time dummy variables included in all regressions
4. \*significant at 95% level, \*\* significant at 90% level,

**Table 6 Regressions of Labour Productivity Growth, Total Factor Productivity and Capital-Labour Ratio on the Wage Bill Impact of the NMW**

	1995-1998			1998-2000		
	Labour productivity	Total factor productivity	Capital labour ratio	Labour productivity	Total factor productivity	Capital labour ratio
Constant	-0.096 (1.49)	-0.095 (1.42)	0.011 (0.178)	-0.090 (1.39)	-0.088 (1.31)	0.009 (0.133)
Capital-labour ratio	0.681* (8.54)	-	-	0.680* (8.52)	-	-
Proportion high skilled labour	0.159* (2.23)	0.160* (2.21)	-0.09 (1.41)	0.147* (2.07)	0.147* (2.04)	-0.088 (1.39)
Proportion intermediate skilled labour	0.135 (1.53)	0.120 (1.31)	-0.012 (1.37)	0.137 (1.55)	0.122 (1.33)	0.011 (0.128)
Wage bill impact of NMW	0.016* (2.13)	0.017* (2.18)	-0.005 (0.77)	-	-	-
Wage bill impact of NMW post 1998	-	-	-	0.001 (0.101)	0.001 (0.118)	-0.009 (1.06)
Adjusted R <sup>2</sup>	0.259	0.028	0.013	0.258	0.018	0.013
Durbin Watson	1.66	1.79	1.81	1.66	1.78	1.81

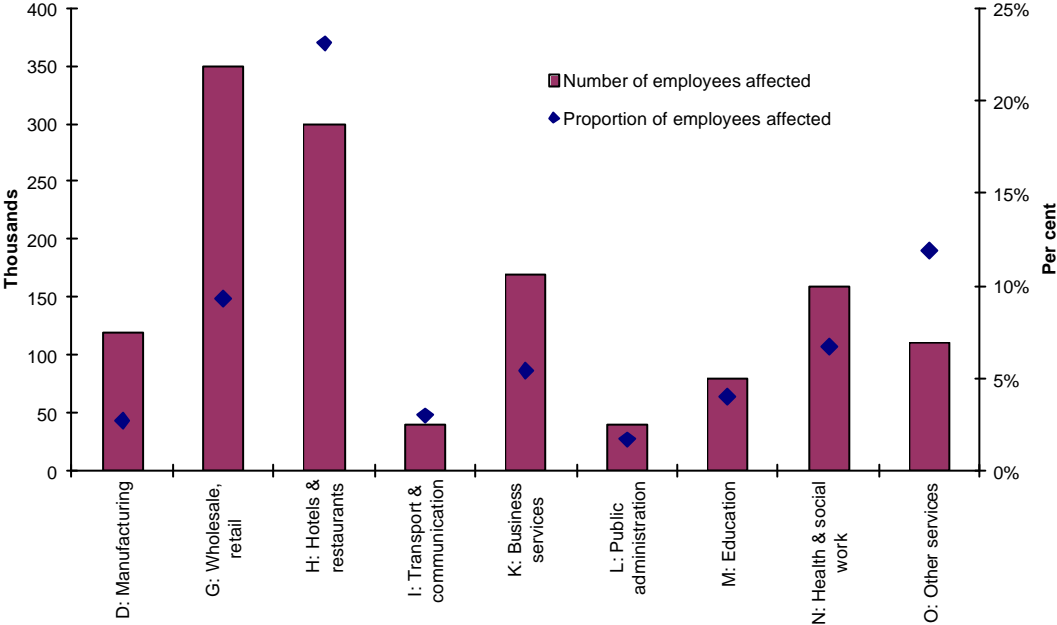
*Notes:*

1. Number of observations: 884
2. Absolute values of t-ratios in parentheses
3. Standard errors are heteroscedastic consistent
4. Time dummy variables included in all regressions
5. \*significant at 95% level, \*\* significant at 90% level,

**Table 7 Correlation Between Growth in Unit Labour Costs and Wage Bill Impact of NMW**

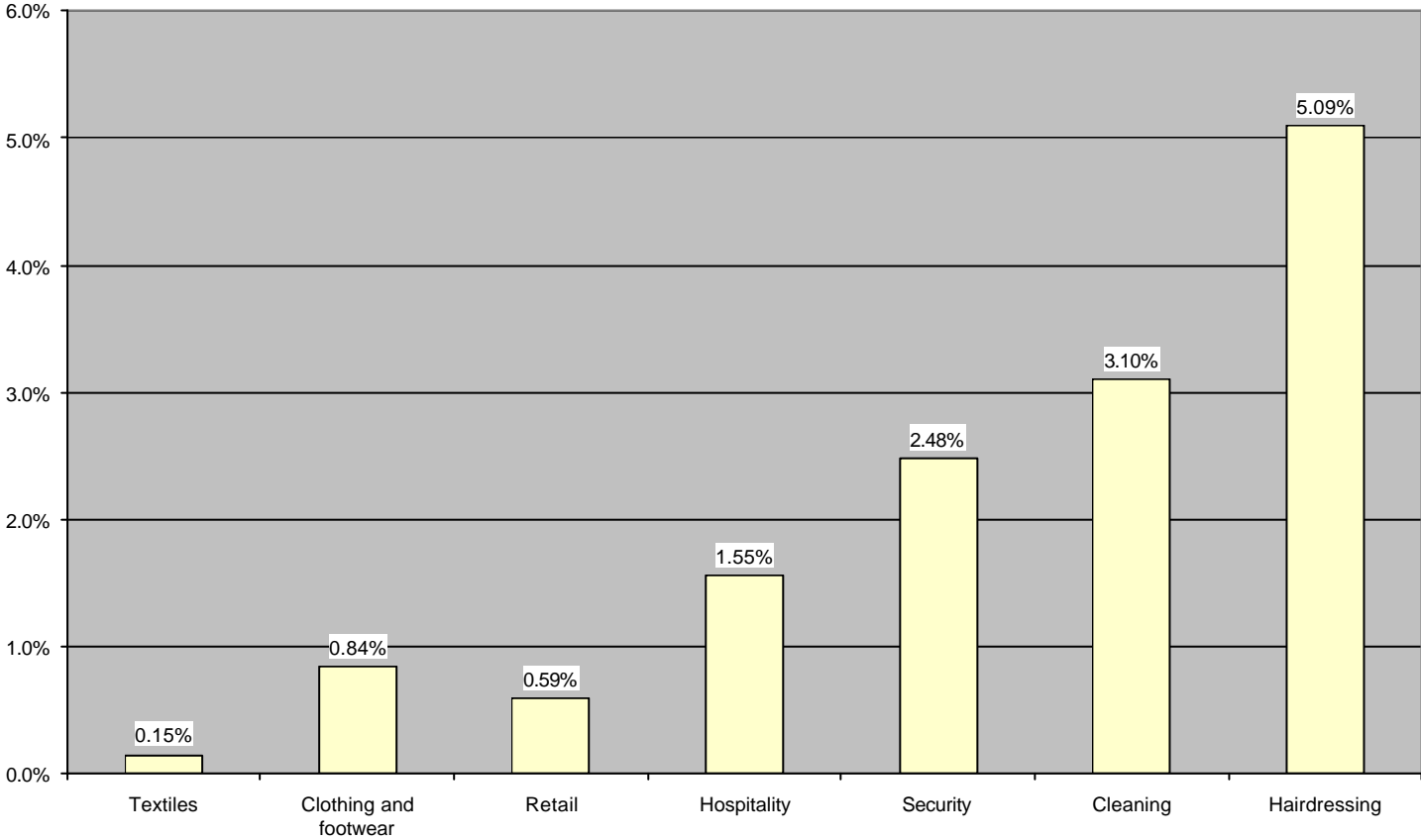
	<b>Overall</b>	<b>1995-96</b>	<b>1996-97</b>	<b>1997-98</b>	<b>1998-99</b>	<b>1999-2000</b>	<b>1995-98</b>	<b>1998-2000</b>
All industries ( <i>n=183</i> )	0.001	-0.11	-0.09	0.10	0.08	0.01	-0.08	0.07
Quartiles 3 and 4 ( <i>n=87</i> )	0.01	-0.07	-0.07	0.10	0.08	-0.01	-0.02	0.08
Quartile 4 ( <i>n=42</i> )	-0.01	-0.07	-0.04	0.02	0.01	0.01	-0.05	0.03
LPC sectors ( <i>n=24</i> )	0.002	-0.17	-0.02	0.16	0.02	-0.01	-0.01	0.04

**Figure 1 Numbers and Proportions of Jobs Paid Below National Minimum Wage Rates in April 1998 by Industry**

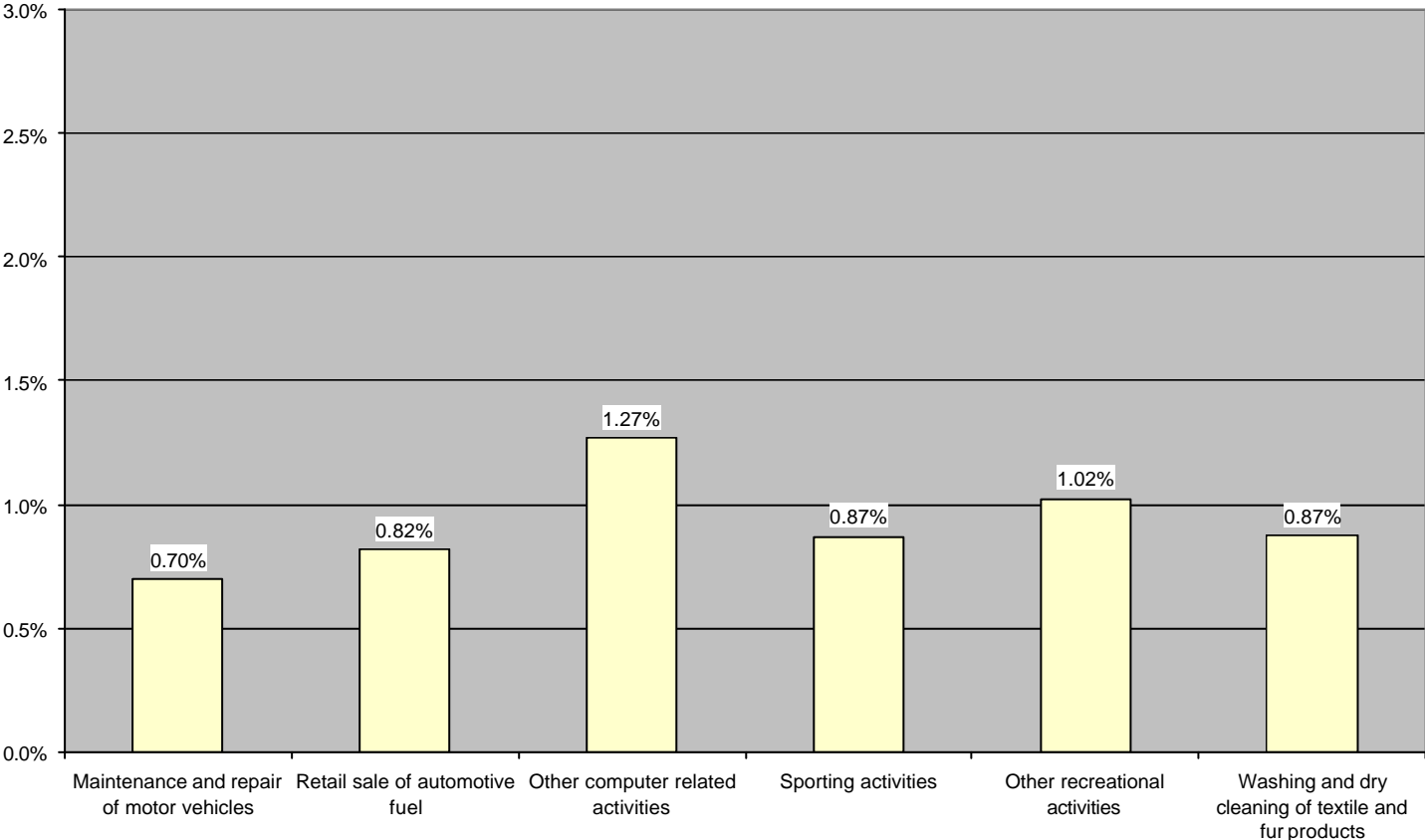


Notes: All other industry sectors omitted due to low numbers and proportions of employees affected.  
 Source: National Statistics (2002).

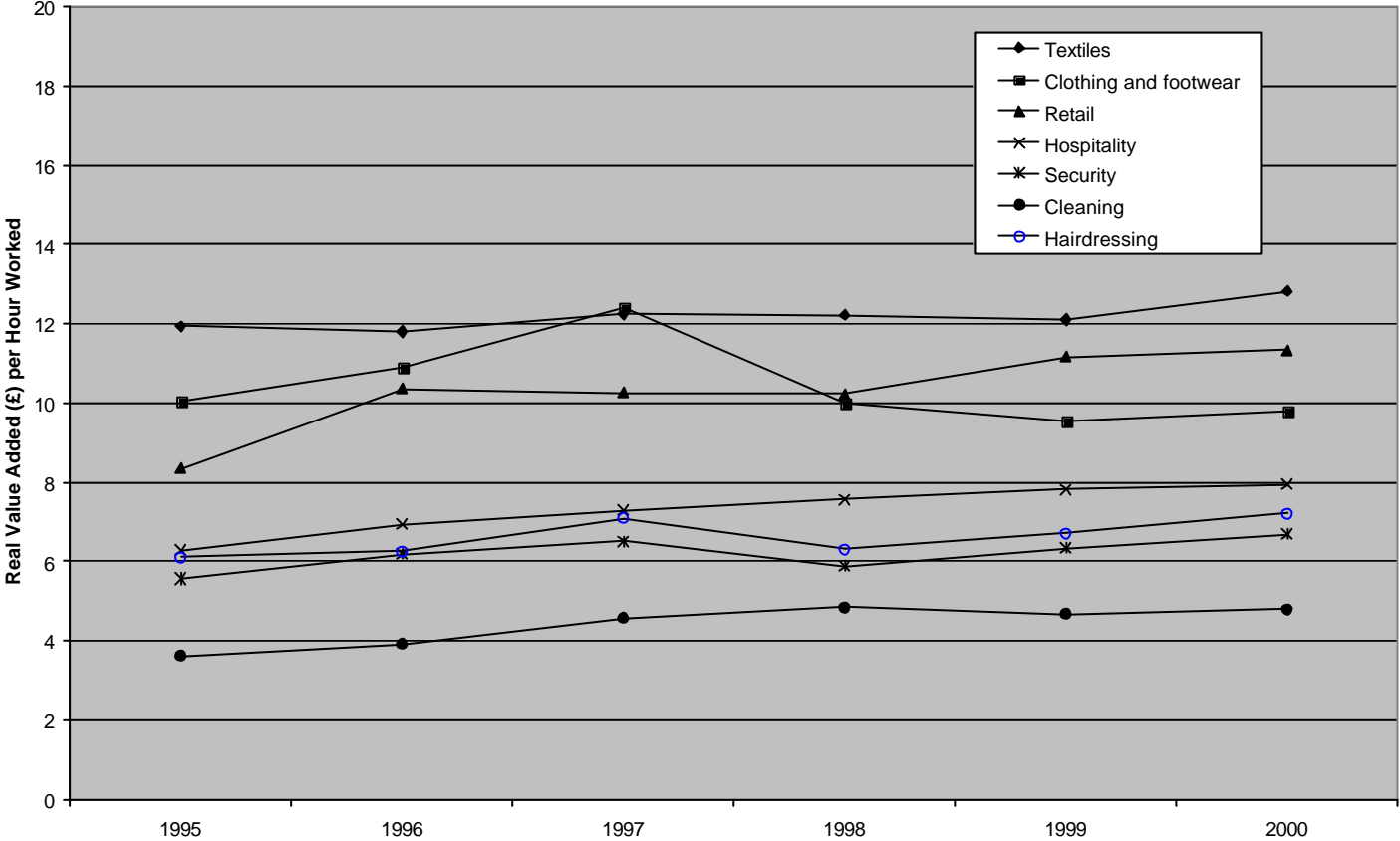
**Figure 2 Impact on the Sectoral Wage Bill of the Introduction of the NMW, LPC Sectors**



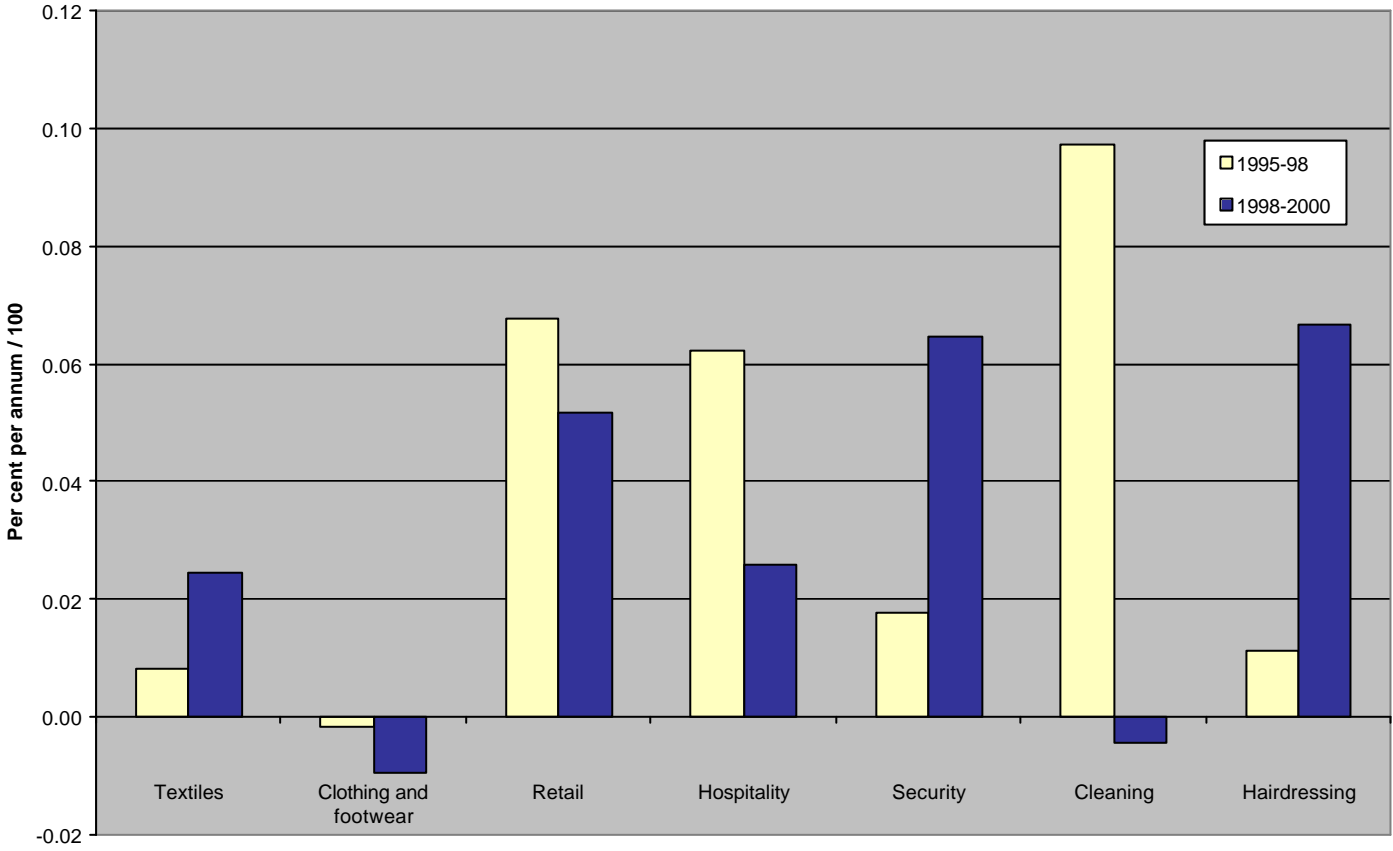
**Figure 3 Impact on the Sectoral Wage Bill of the Introduction of the NMW, Other Low-Paying Sectors**



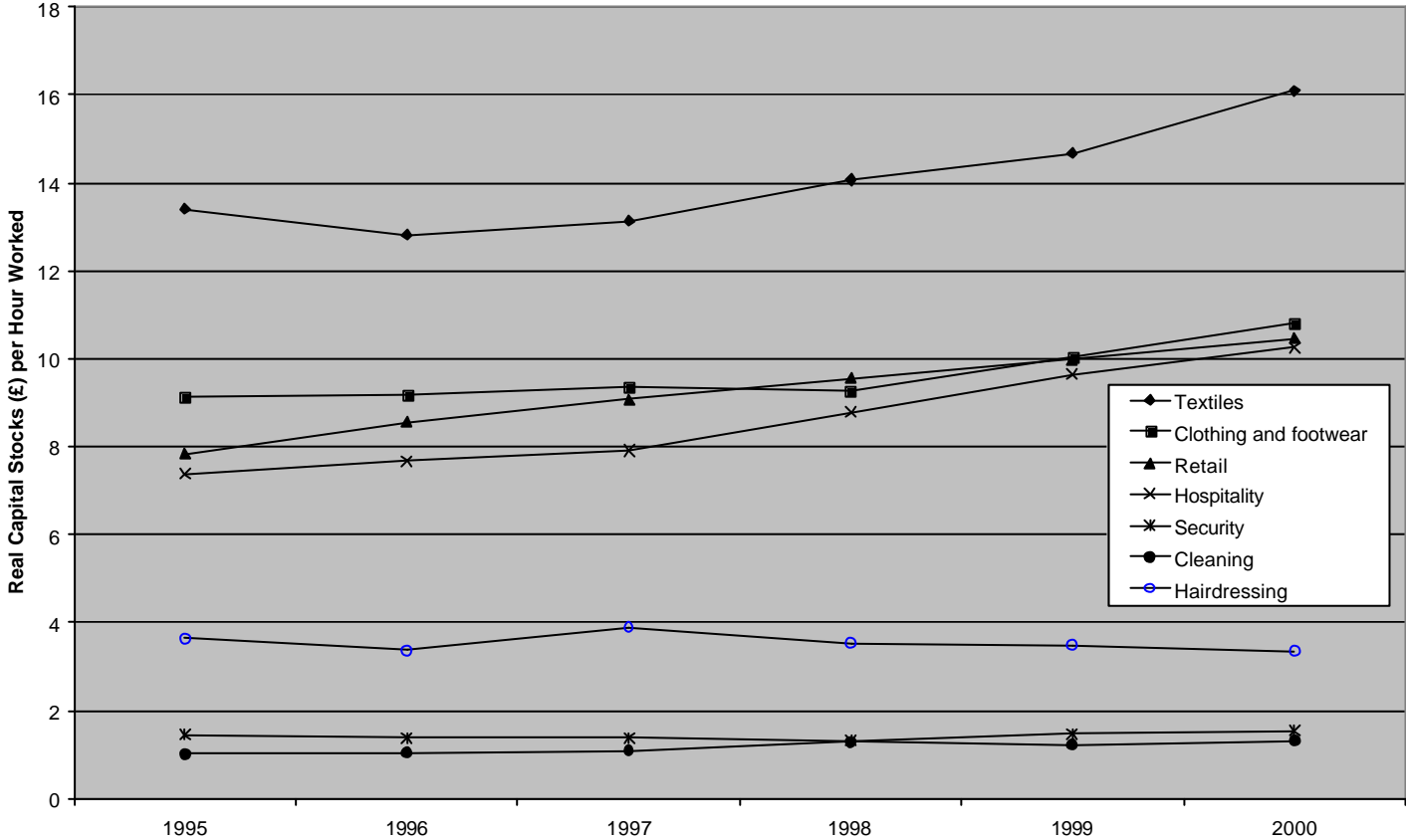
**Figure 4 Labour Productivity (Real Value Added per Hour Worked) in Low-paying Sectors, 1995-2000**



**Figure 5 Growth in Labour Productivity (Real Value Added per Hour Worked) in Low-paying Sectors, 1995-2000**



**Figure 6 Capital-Labour Ratio (Real Capital Stocks per Hour Worked) in Low-Paying Sectors, 1995-2000**



**Figure 7 Growth in Capital-Labour Ratio (Real Capital Stocks per Hour Worked) in Low-Paying Sectors, 1995-2000**

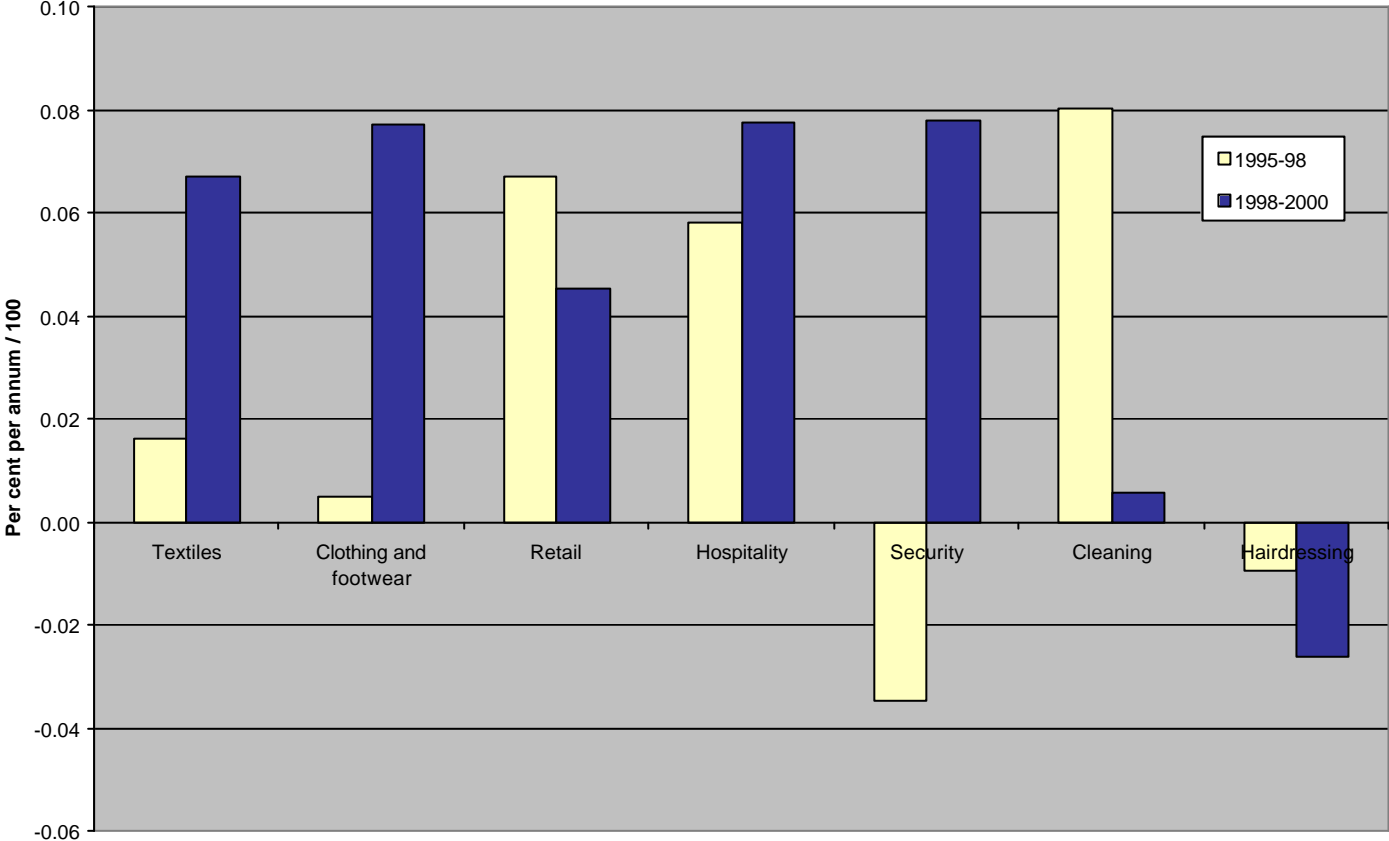
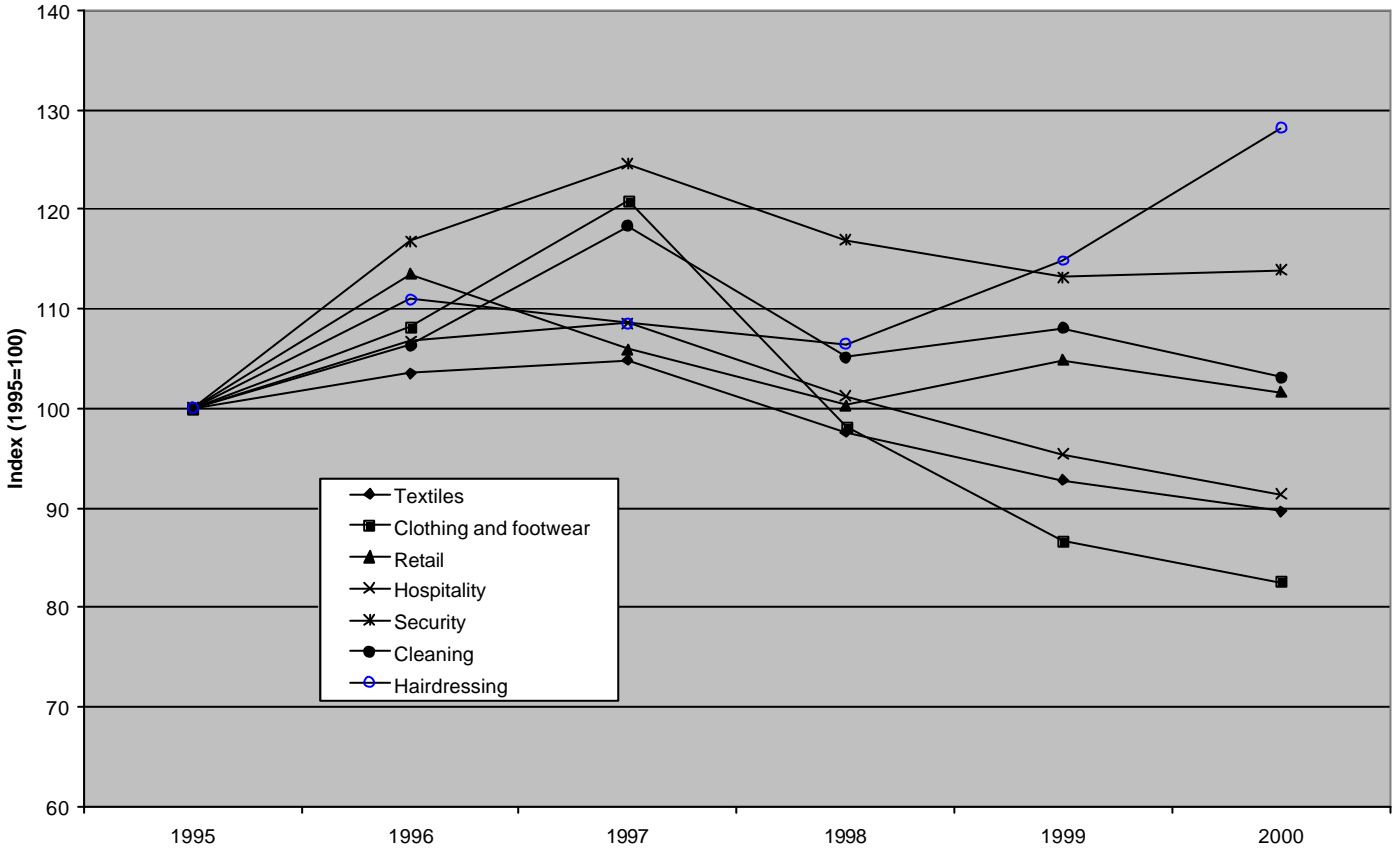
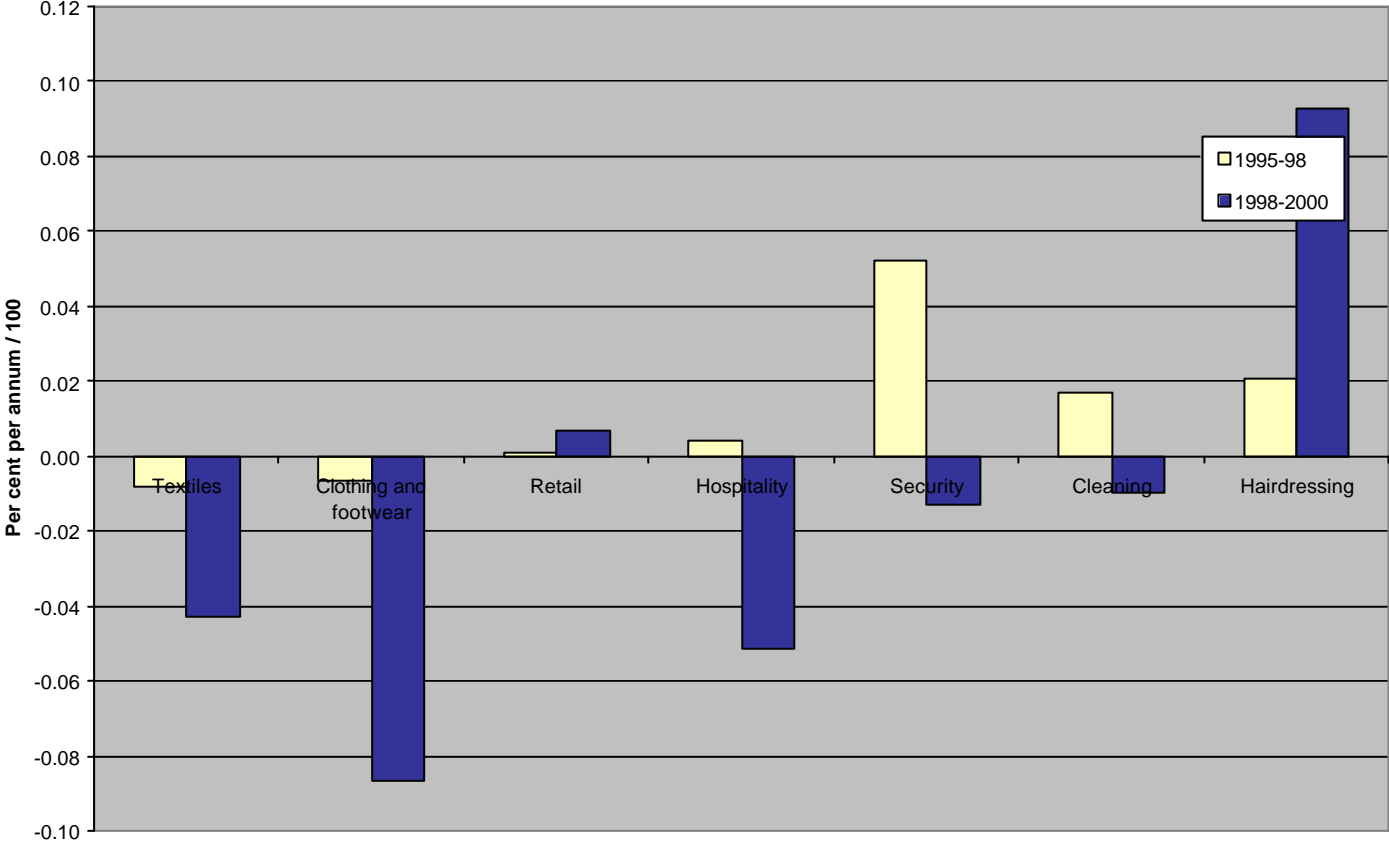


Figure 8 Total Factor Productivity in Low-Paying Sectors, 1995-2000 (Index: 1995=100)



**Figure 9 Growth in Total Factor Productivity in Low-Paying Sectors, 1995-2000**



**Figure 10 Components of Labour Productivity Growth in Low-Paying Sectors, 1995-2000**

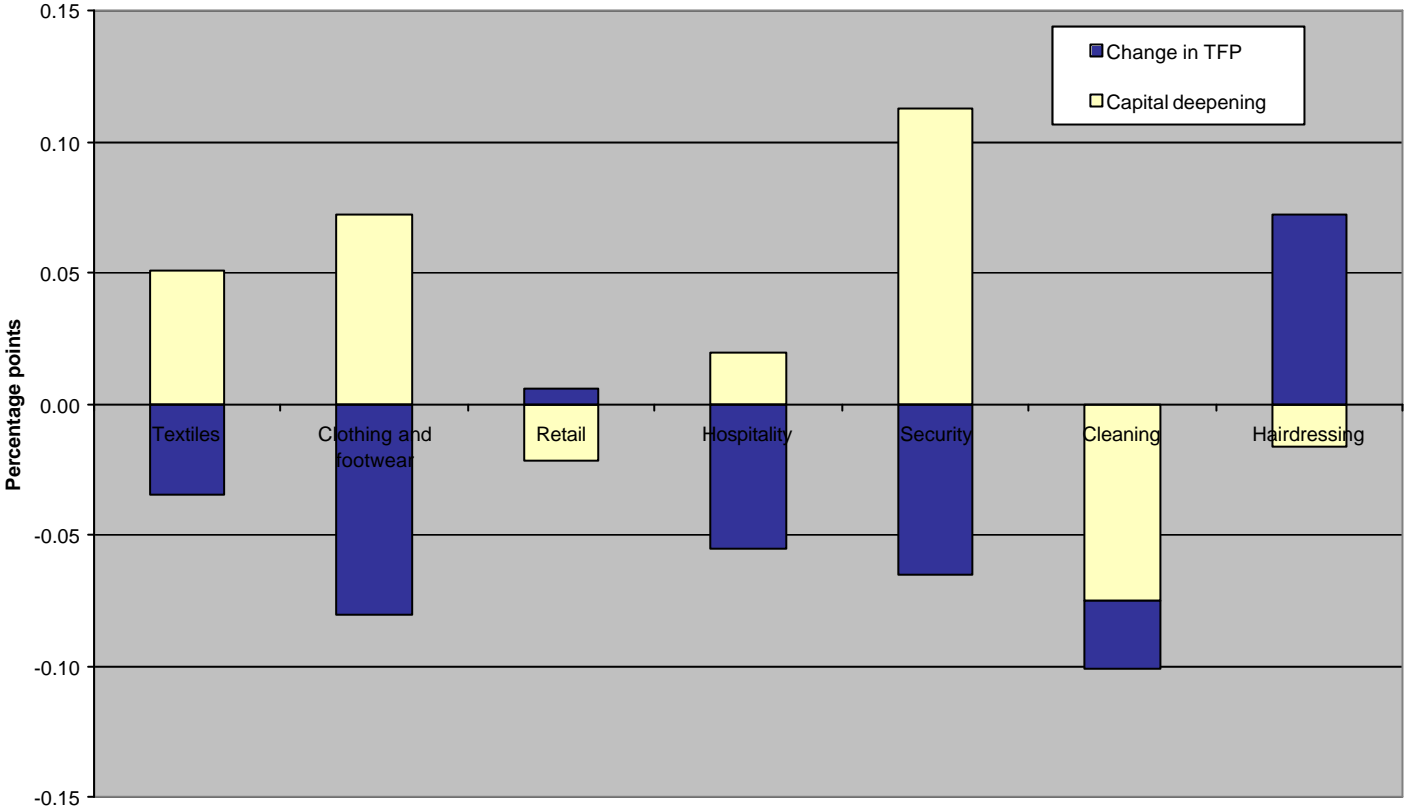
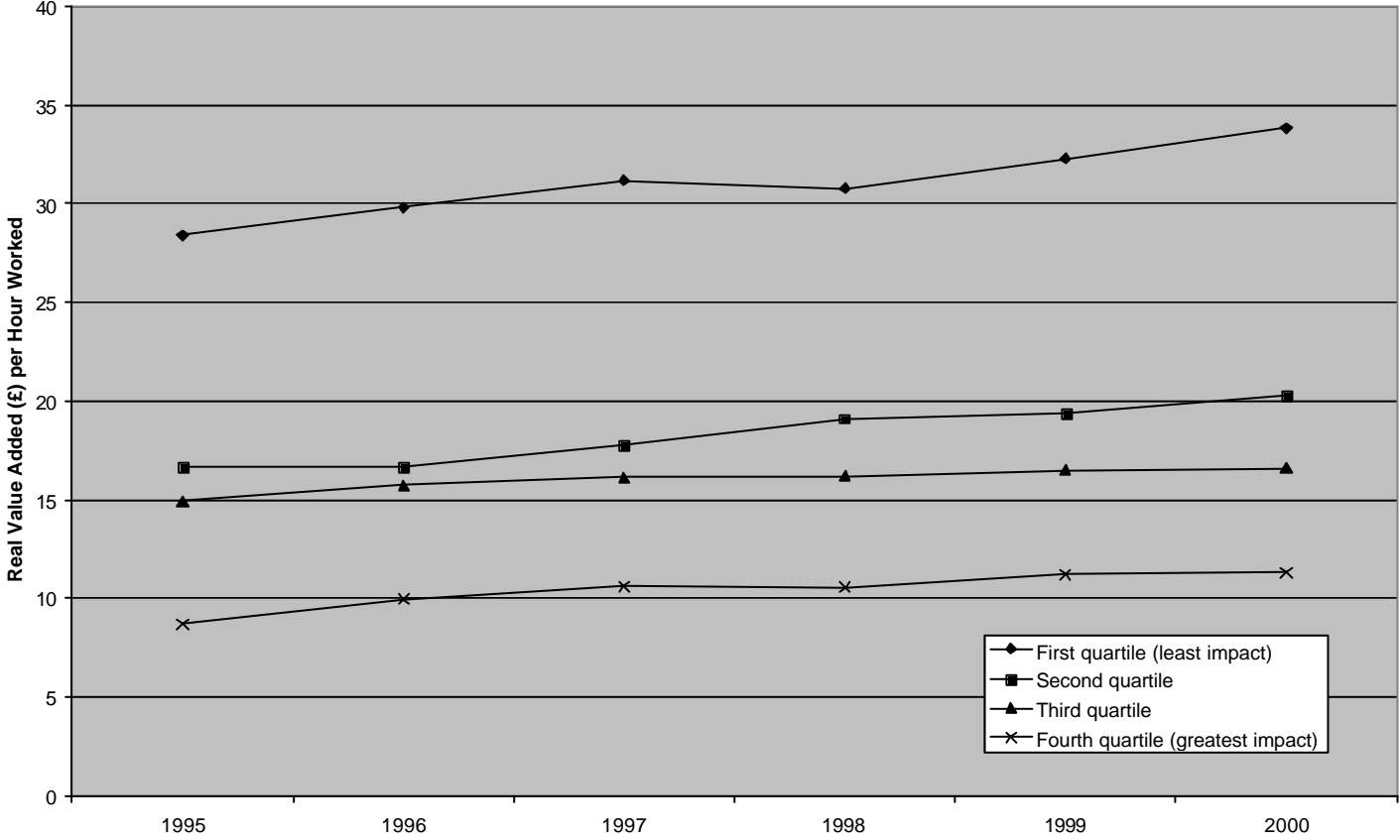


Figure 11 Labour Productivity (Real Value Added per Hour Worked) by Quartile of Wage Bill Impact, 1995-2000



**Figure 12 Growth in Labour Productivity (Real Value Added per Hour Worked) by Quartile of Wage Bill Impact, 1995-2000**

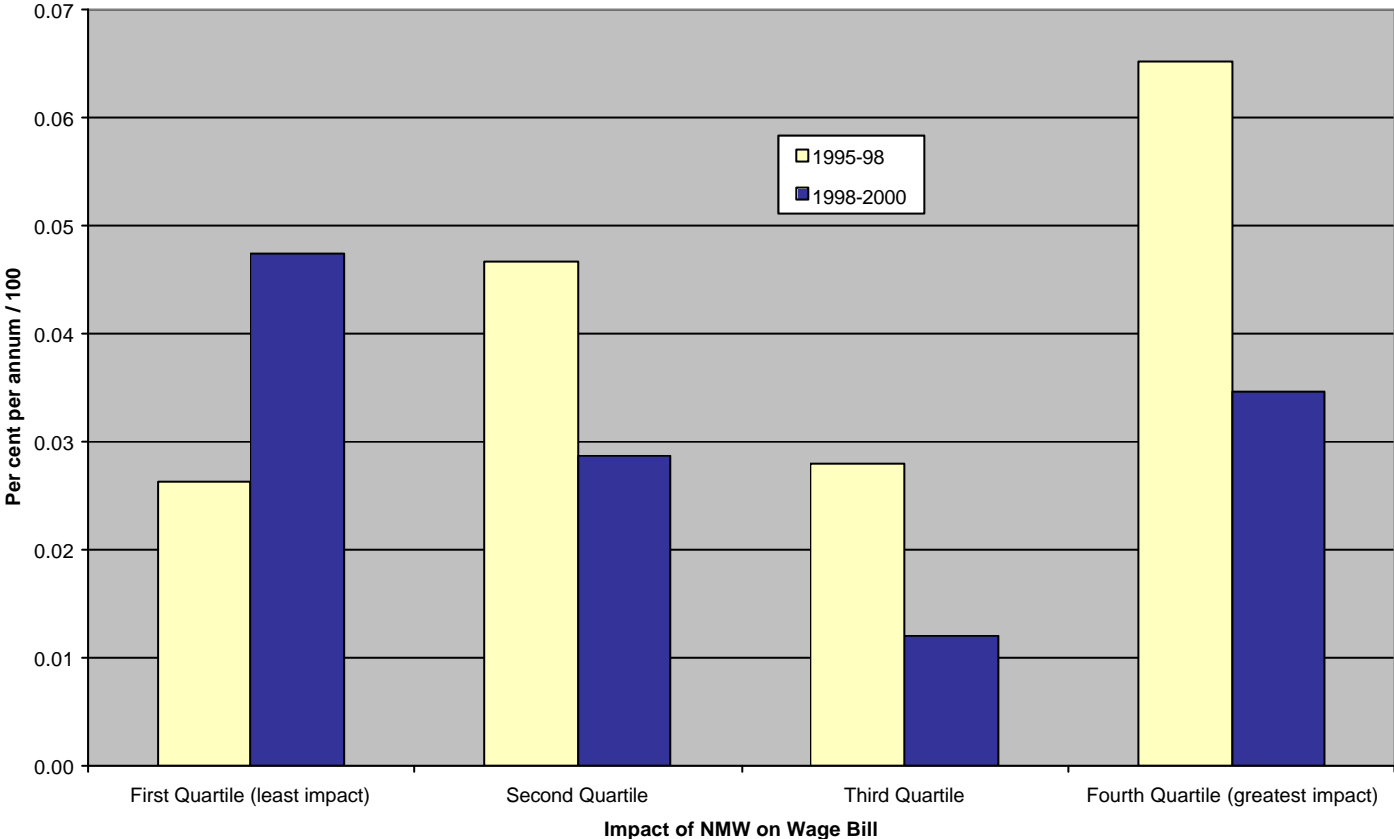
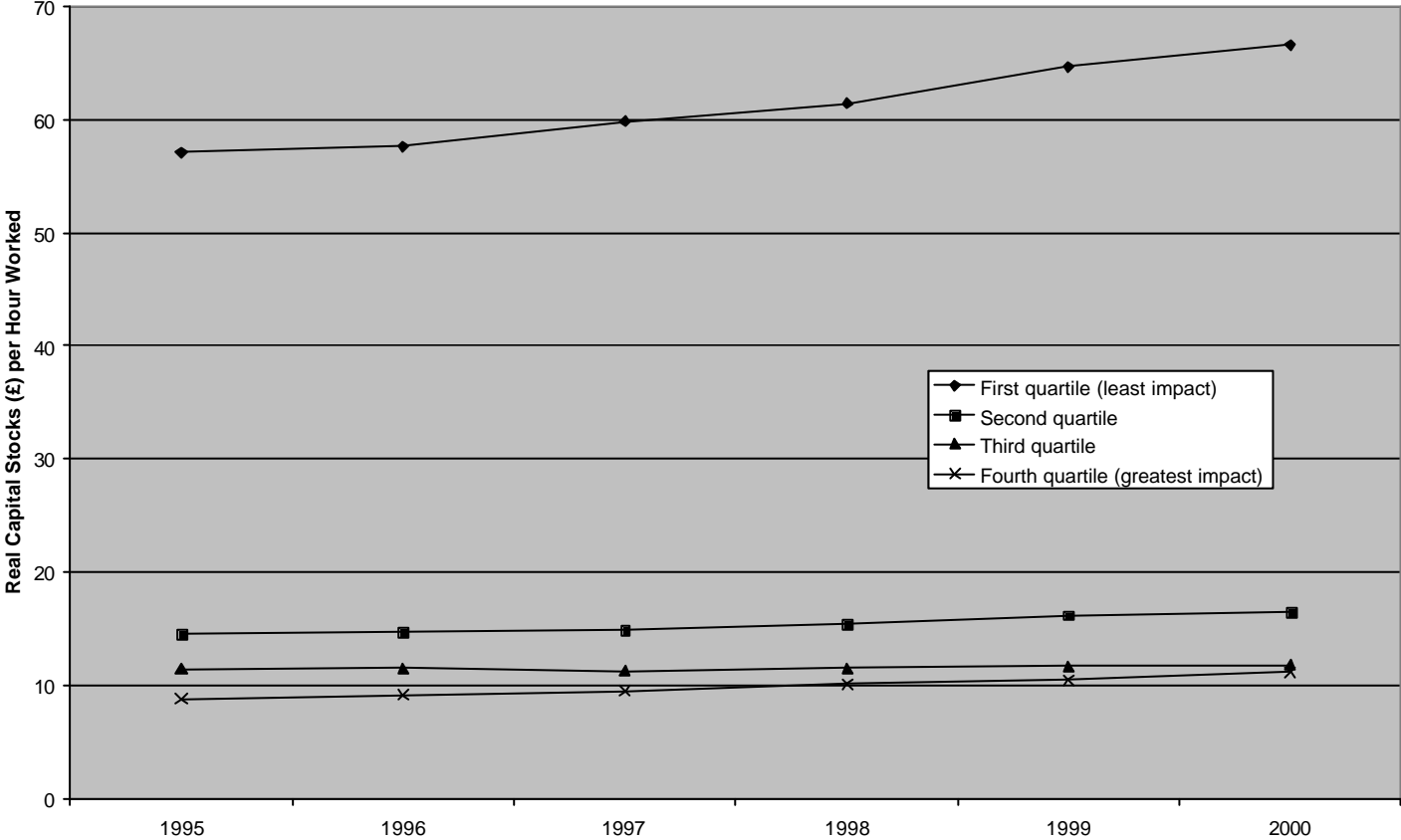


Figure 13 Capital-Labour Ratio (Real Capital Stocks per Hour Worked) by Quartile of Wage Bill Impact, 1995-2000



**Figure 14 Growth in Capital-Labour Ratio (Real Capital Stocks per Hour Worked) by Quartile of Wage Bill Impact, 1995-2000**

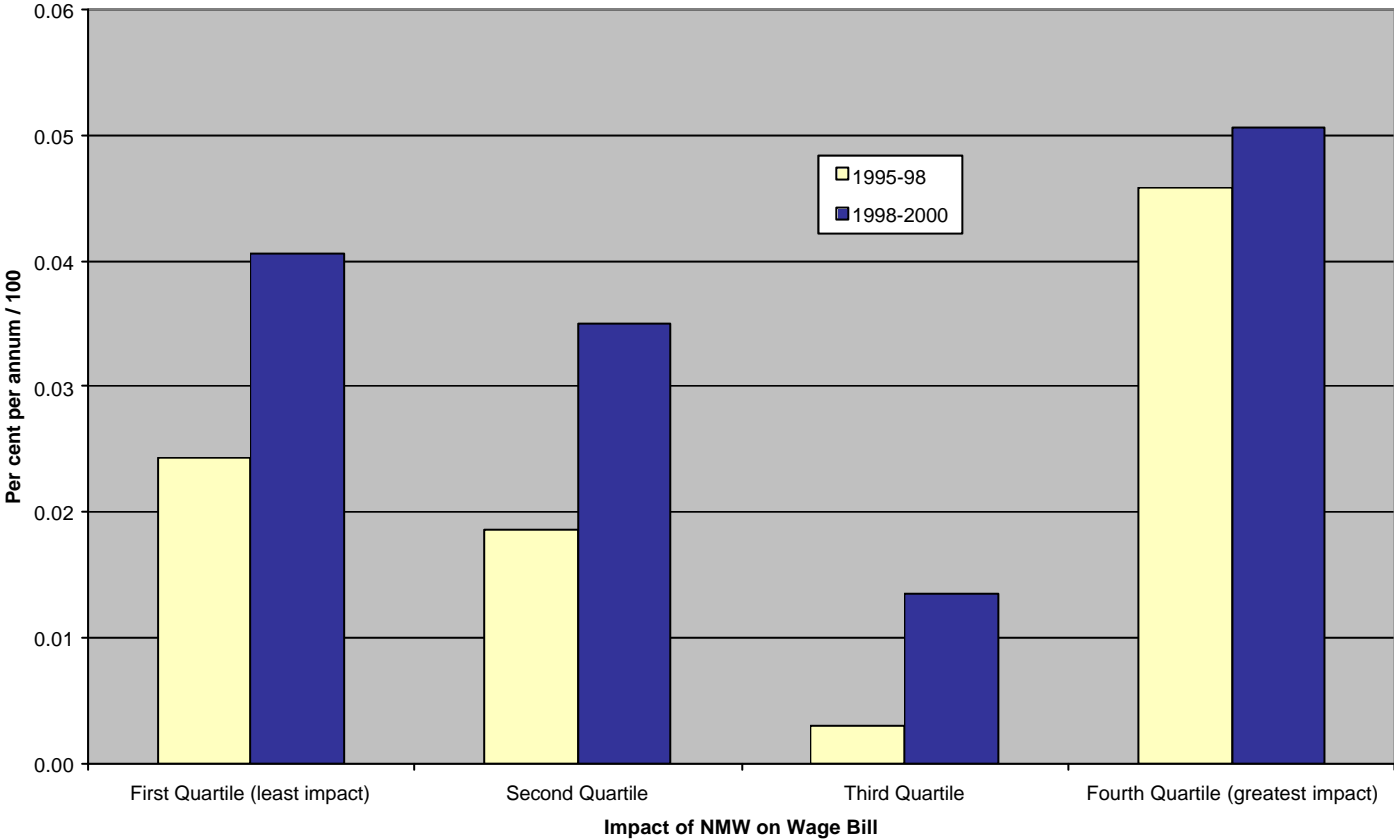
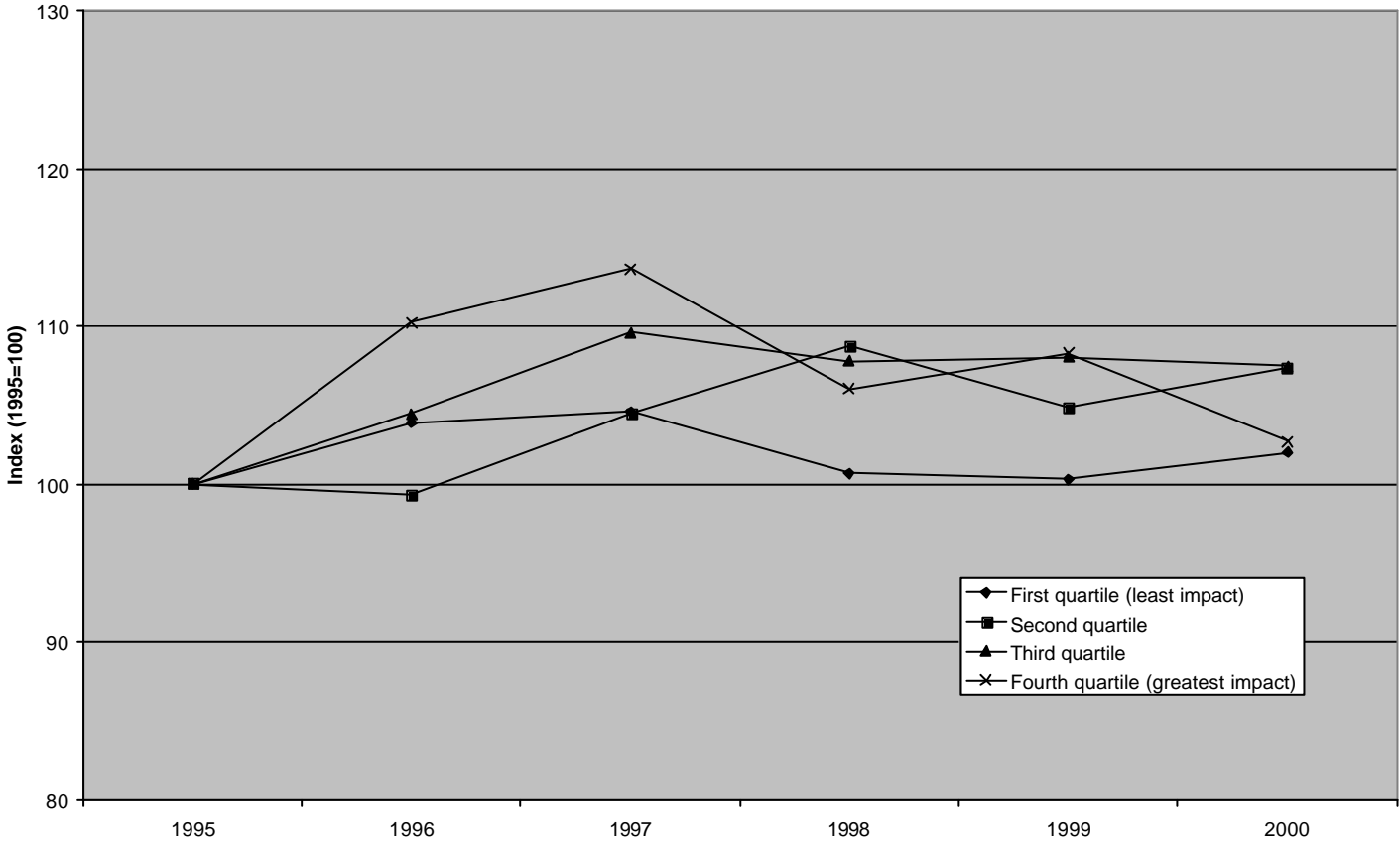
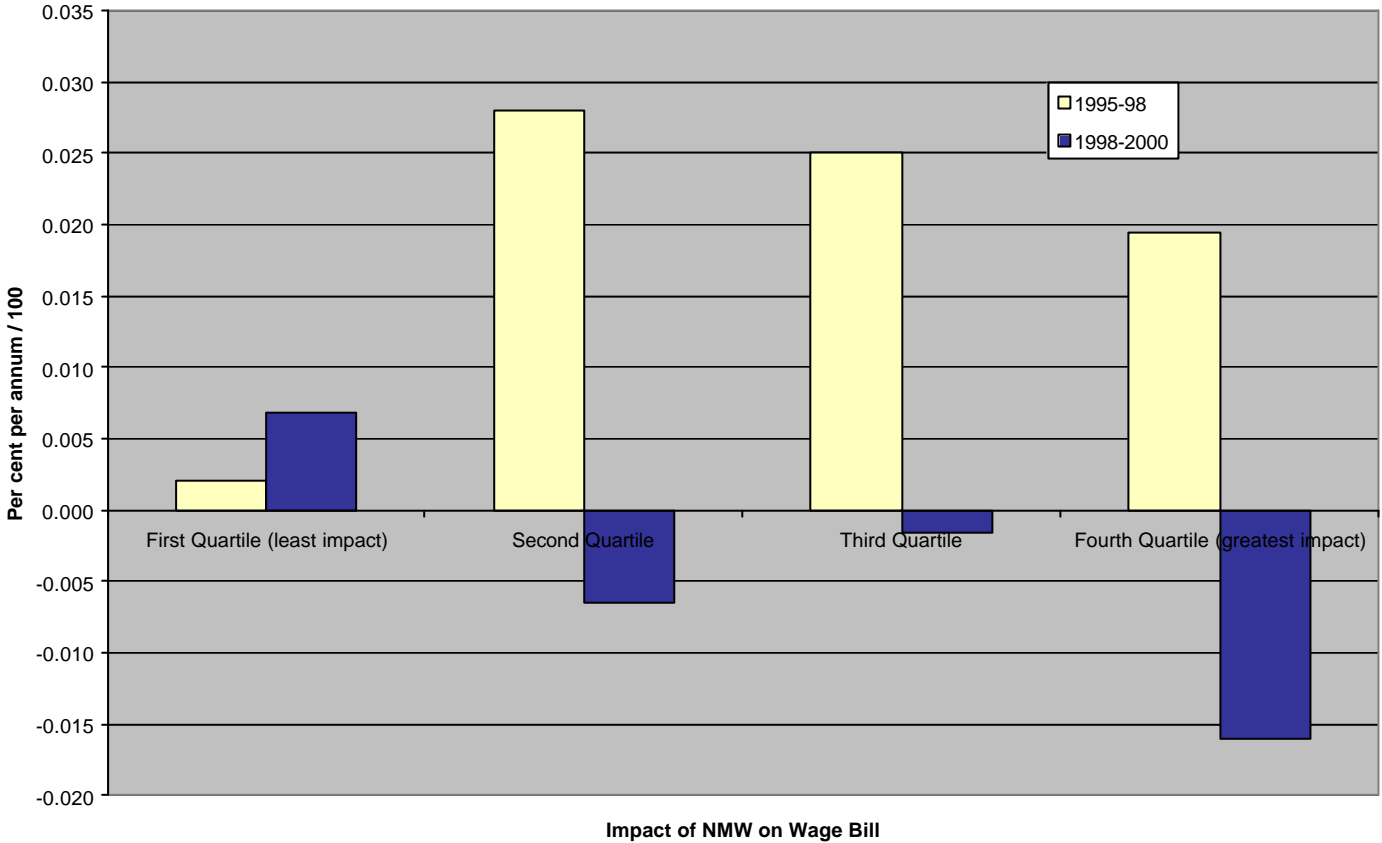


Figure 15 Total Factor Productivity by Quartile of Wage Bill Impact, 1995-2000 (Index: 1995=100)



**Figure 16 Growth in Total Factor Productivity by Quartile of Wage Bill Impact, 1995-2000**



**Figure 17 Components of Labour Productivity Growth by Quartile of Wage Bill Impact, 1995-2000**

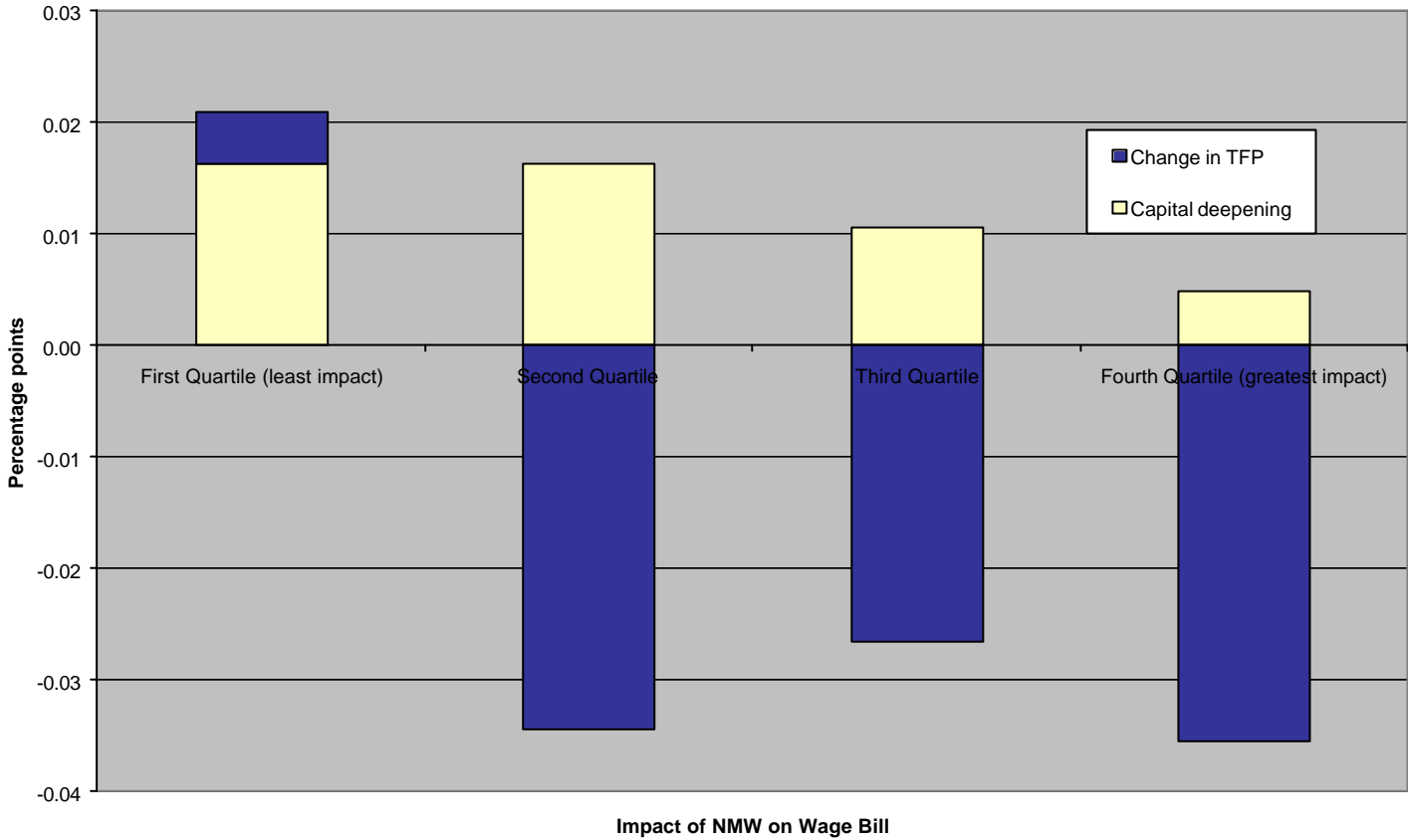
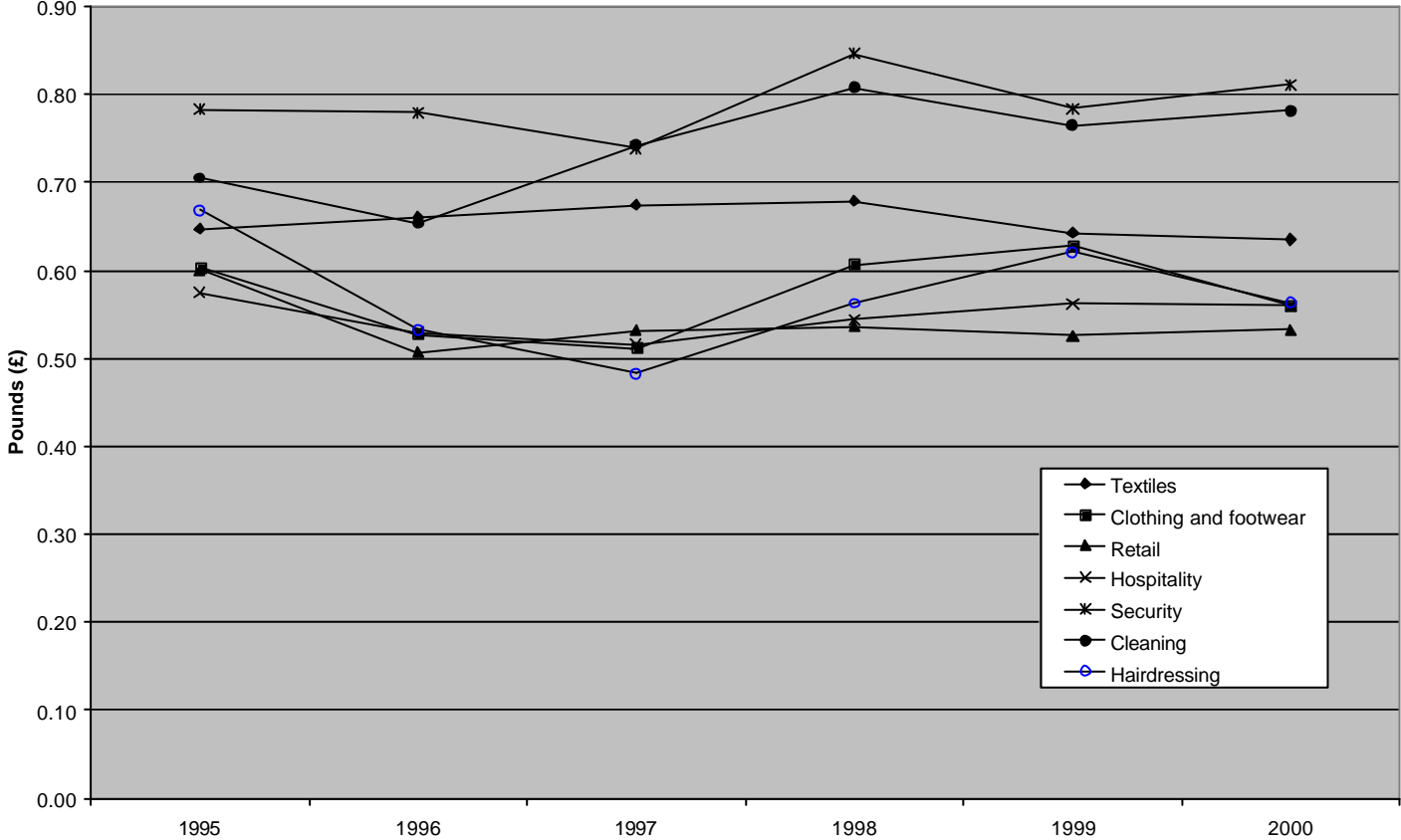
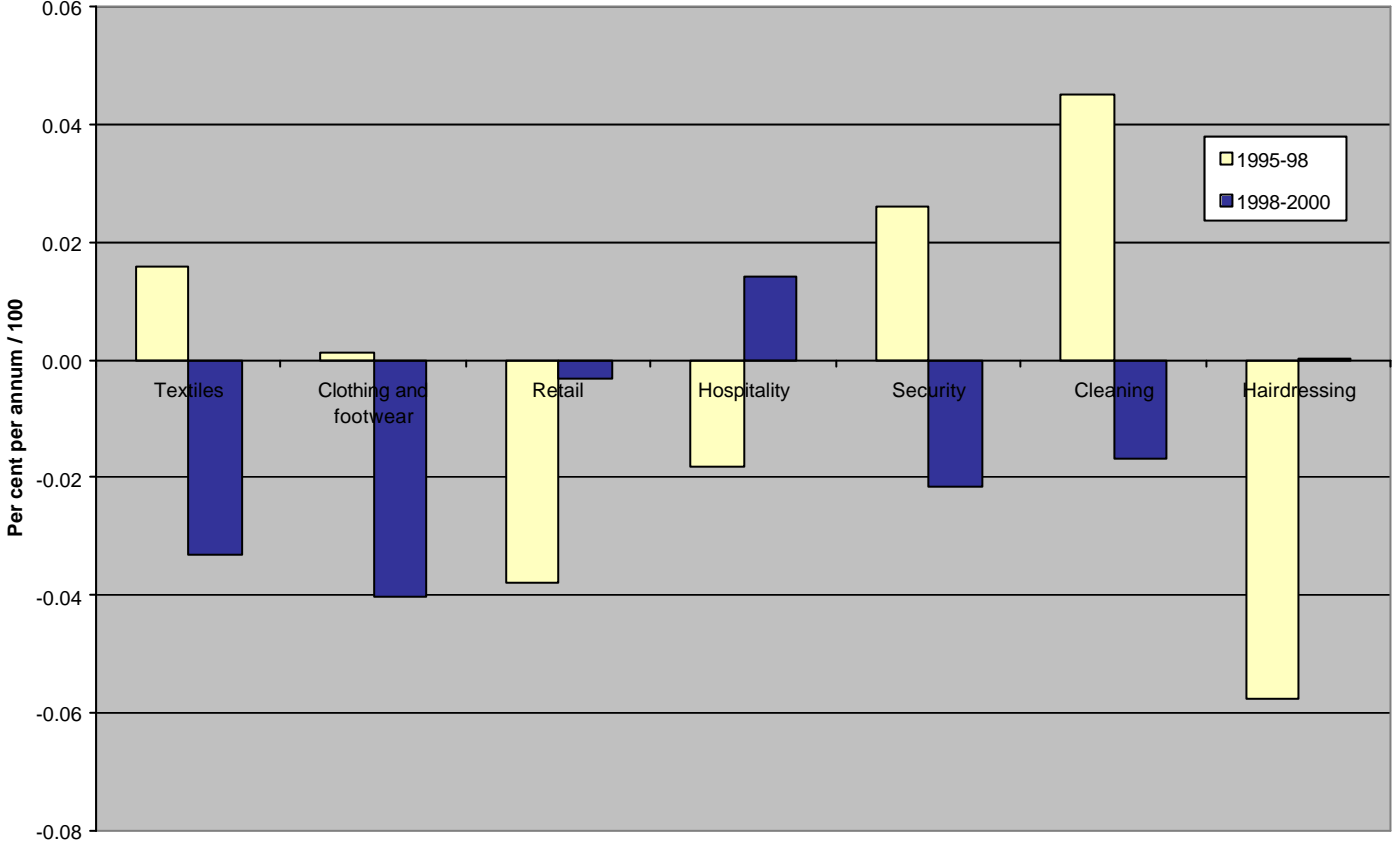


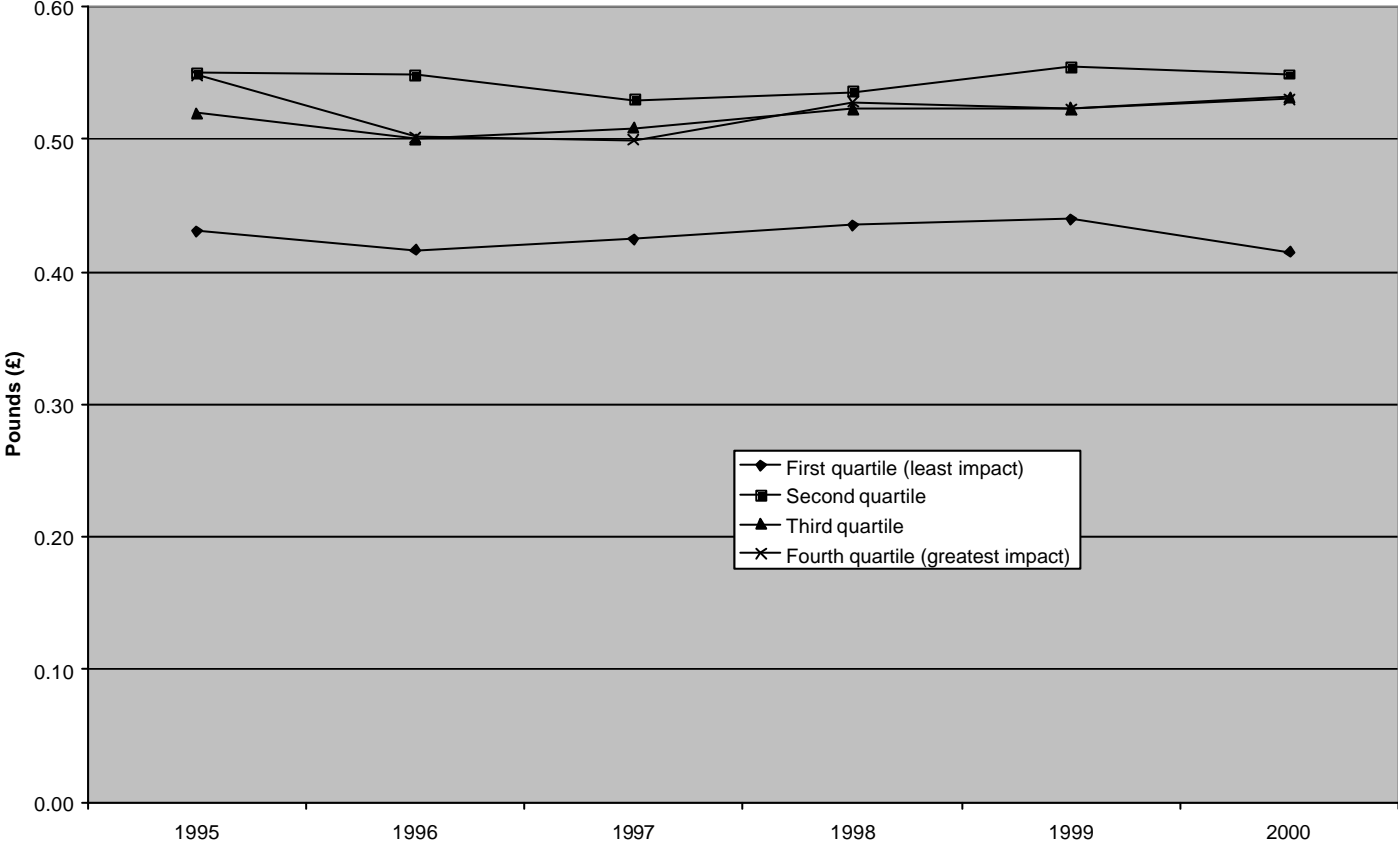
Figure 18 Unit Labour Costs in Low-Paying Sectors, 1995-2000



**Figure 19 Change in Unit Labour Costs in Low-Paying Sectors, 1995-2000**



**Figure 20 Unit Labour Costs by Quartile of Wage Bill Impact, 1995-2000**



**Figure 21 Change in Unit Labour Costs by Quartile of Wage Bill Impact, 1995-2000**

