Skill Shortages and Firms' Employment Behaviour

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Abstract

This study investigates the effects of skill shortages on the dynamics of employment at the firm level for UK manufacturing between 1984-94. We find that shortages of skilled labour have a statistically significant effect on firms' employment behaviour. It has a positive effect on firms' adjustment costs leading to employment being more sluggish to respond when the labour market is tight, implying that employment adjustment will be more responsive in the downward direction.

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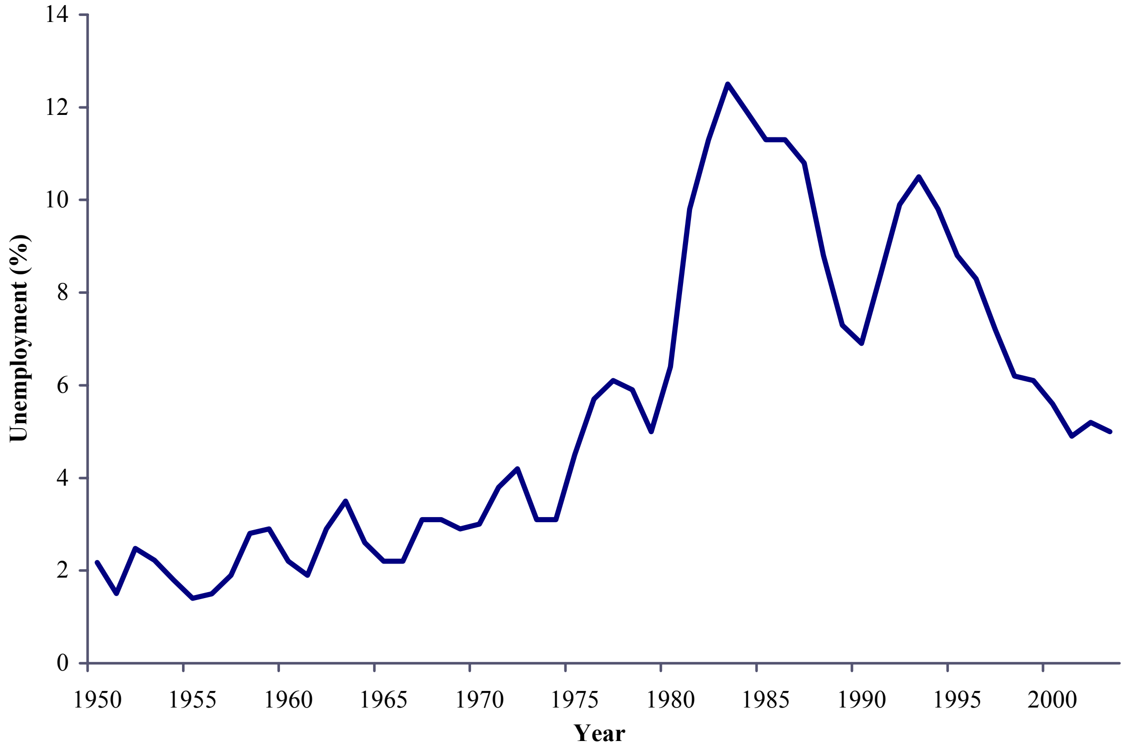
1 Introduction

A common feature of labour markets in most western European economies in the previous two decades was the high degree of persistence in unemployment. There have been many potential explanations suggested for this persistence, from insider-outsider theory to globalisation and skill-biased technical change. In this paper we investigate one of the possible sources of this persistence, namely non-linearity in the employment behaviour of firms. If employment were more flexible in the downward direction, the aftermath of a shock to the economy would consist of a period of rapid reduction in employment followed by a slow recovery. Such a mechanism would lead to persistence in the effects of shocks and, if the economy does not have time to recover between the shocks, the possibility that unemployment will ratchet upwards in the manner observed during the seventies and eighties (see Figure 1).



Source: OECD *Main Economic Indicators* and *Labour Market Statistics*.

Figure 1 UK Unemployment

In this paper, we examine the effects of skill shortages on firms' employment behaviour. The idea that firms' adjustment costs may depend upon the state of the labour market is the subject of Burgess (1992, 1993). However, these studies use aggregate data. In this study we use firm-level micro data supplemented by industry-level survey data. We shall show that a disaggregated analysis will generate a genuine increase in the amount of information available because of the heterogeneity in the data. The remainder of this paper is set out as follows. Section 2 provides an introduction and background. We present the model that we shall be estimating and the econometric methodology that we utilise to undertake this in Section 3. Section 4 presents our results and Section 5 concludes.

2 Background

One of the features of labour market dynamics in most industrialised economies is the presence of asymmetric employment adjustment over the economic cycle[2]. During the last two decades unemployment was consistently higher than in the previous quarter century (Figure 1). Unemployment has increasingly exhibited a tendency to return to mean only over a long period, i.e. it displays considerable persistence. This phenomenon is not merely of academic interest as these prolonged periods of unemployment are the source of much misery, particularly since they are usually the result of increased duration rather than an increase in the inflows into unemployment (Layard, Nickell and Jackman, 1991; Stevens, 2003a).

There have been many different explanations offered for the persistence of unemployment, such as price rigidities (Caballero and Engel, 1992), the deskilling of the long-term unemployed (Budd *et al.*, 1988), reductions in the capital stock associated with employment reductions (Burda, 1988; Rowthorn, 1995), the birth and death of firms (Hamermesh, 1993, chapter 4), the investment strategies of risk-averse firms (Lee and Chalkley, 1994), asymmetric information in wage bargaining (Acemoglu, 1995), insider-outsider behaviour (Blanchard and Summers, 1986; Lindbeck and Snower, 1988; Huizinga and Schiantarelli, 1992), and employment adjustment/turnover costs (Burgess, 1992 & 1993; Hamermesh and Pfann, 1992; Pfann and Palm, 1993). It is the last of these explanations with which this paper is primarily concerned - the idea that variation in the costs of adjusting firms' work-force lead to the observed non-linearity in the time series of employment and unemployment.

[2] cf. Burgess (1992) and Acemoglu and Scott (1994) for evidence asymmetries in the UK and Franses (1995) for a discussion of US unemployment; see also Falk (1986), Sichel (1989), and Stock (1989), for more general discussion of asymmetric business cycles.

Economists have long known that the existence of adjustment costs is likely to lead to labour hoarding in recession and to firms hiring fewer new workers during economic expansion. If adjustment costs are higher during upturns than during downturns, then this may lead to the higher levels of unemployment experienced since employment will be quick to fall but slow to rise. Moreover, employment cycles will not be symmetric.

We can see how adjustment costs might be not be symmetric by considering the following identity

$$\Delta N \equiv E - S \equiv E - (Q + L) \tag{1}$$

where ΔN = the change in employment, E = engagements, S = separations, Q = quits, L = layoffs[3]. If, for example, quits were costless to the firm and layoffs and hires incurred some cost, it is simple to see that with a positive quit rate firms will be able to use this to costlessly reduce employment in the presence of a fall in demand (up to the quit rate), whereas increasing employment (or even keeping it relatively constant) will induce an extra cost over and above the wage cost incurred by employing more workers. It is important to note that in this paper we are referring to the demand for workers and not for total worker-hours[4].

It is not, however, merely the existence of quitting by some of the workforce which we wish to allow for in this paper. The cost to the firm of hiring new workers depends upon the number of applicants per vacancy as well as the number of vacancies themselves. The number of applicants themselves will depend upon the relative wage and the general state of the labour market as well as exogenous factors such as legislation covering employment protection and those influencing labour mobility (costs involved with geographical mobility, the housing market etc.). Thus the cost of hiring a new worker will increase if there are fewer job-searchers (i.e. the labour market is tighter). Furthermore, there are also likely to be other costs involved with hiring such as expenditure on training and loss of output while the new worker learns the job[5] and these costs may also be higher in booms.

[3] Following Burgess and Nickell (1991) and Nickell (1995) we define quits as separations decided by the worker and layoffs as those decided by the firm, voluntary redundancies are considered a combination of quits and layoffs.

[4] Millard *et al.* (1997) find that changes in total hours are split approximately equally between average hours worked and employment, so we believe that in the light of this fact our study is valid.

[5] Nickell (1986), p. 475

2.1 The Pattern of Skill Shortages in the UK

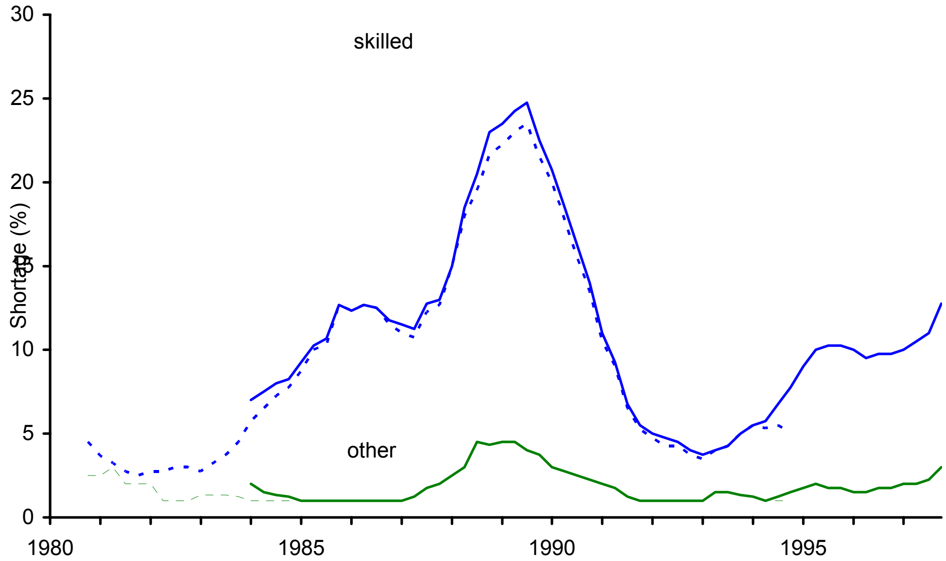
The measure of labour market tightness that we use in this study is the proportion of firms in an industry reporting shortages of skilled labour[6]. We discuss shortages of skilled labour in the light of Stevens' (1994, 1996) definition of 'transferable' human capital. That is to say, these shortages are likely to affect all firms within the sector in a similar way, but have little effect on other industries[7]. For example, if the construction industry faces a shortage of skilled bricklayers it is likely to affect the search costs of all construction firms (at least within a geographical locality) similarly. However, these bricklayers are of little use as skilled labour within the electronics industry, where they would probably have to accept an unskilled job at a lower wage. Thus one can see that this analysis is intimately linked to the problem of mismatch where the dynamic nature of industrialised economies means that as one industry declines and another expands, there will be a shortage of skilled labour in the expanding industry as workers previously considered skilled find their skills are no-longer of use and become, effectively, unskilled workers.

Before we continue, we take a closer look at the pattern of skill shortages in the UK as highlighted by the proportion of firms in an industry who say that skilled or 'other' labour is likely to limit their output in the future. The data come from the CBI Industrial Trends Survey[8]. Figure 2 shows the percentage of firms reporting that their output would be constrained by a lack of skilled or other labour.

As we can see from Figure 2, shortages of labour are pro-cyclical. As the economy expands firms soon experience shortages of skilled labour. What is interesting to note is that 'other' labour is rarely, if ever, in short supply. It is only in the aftermath of the 'Lawson boom' in the mid 1980s that firms begin to report shortages of non-skilled labour in any number. The proportion of firms facing shortages of skilled labour rarely falls below four percent and yet the proportion of firms facing shortages of other labour rarely climbs above this level.

[6] For a precise definition the data appendix
[7] In contrast to Becker's (1962, 1964) analysis.

[8] A precise description of the question is given in the data appendix.



(1) Four-month moving average
(2) Dotted lines indicate old definition
(3) Source CBI Industrial Trends

Figure 2 Shortages of skilled and 'other' labour 1980-97 in manufacturing

Skill Shortages by Industry

What is of particular interest to this study is how these shortages of labour affect different industries. Figures 5a-f present the annualised figures for a selection of industries. These series are the actual series used in the estimation in this paper.

The first point to note from Figure 3 is that there is considerable heterogeneity in the experiences of the various industries shown. For example, the metal manufacture and metal products sectors experience fairly pro-cyclical skill-shortages. However, the peak value of skill shortages in the electronic consumer goods industry appeared in 1985-6, a period corresponding to the highest levels of unemployment during the period studied. The electronic industrial goods industry is another anomaly, with a sustained period of output limited by a dearth of skilled labour until 1990 – again a period of sustained high levels of unemployment. Moreover, whereas the maximum proportion of firms in the economy as a whole who experienced shortages of skilled workers was just under 25%, in a number of sectors it approaches twice that figure and in the industrial electronic goods industry it reaches over 60%.

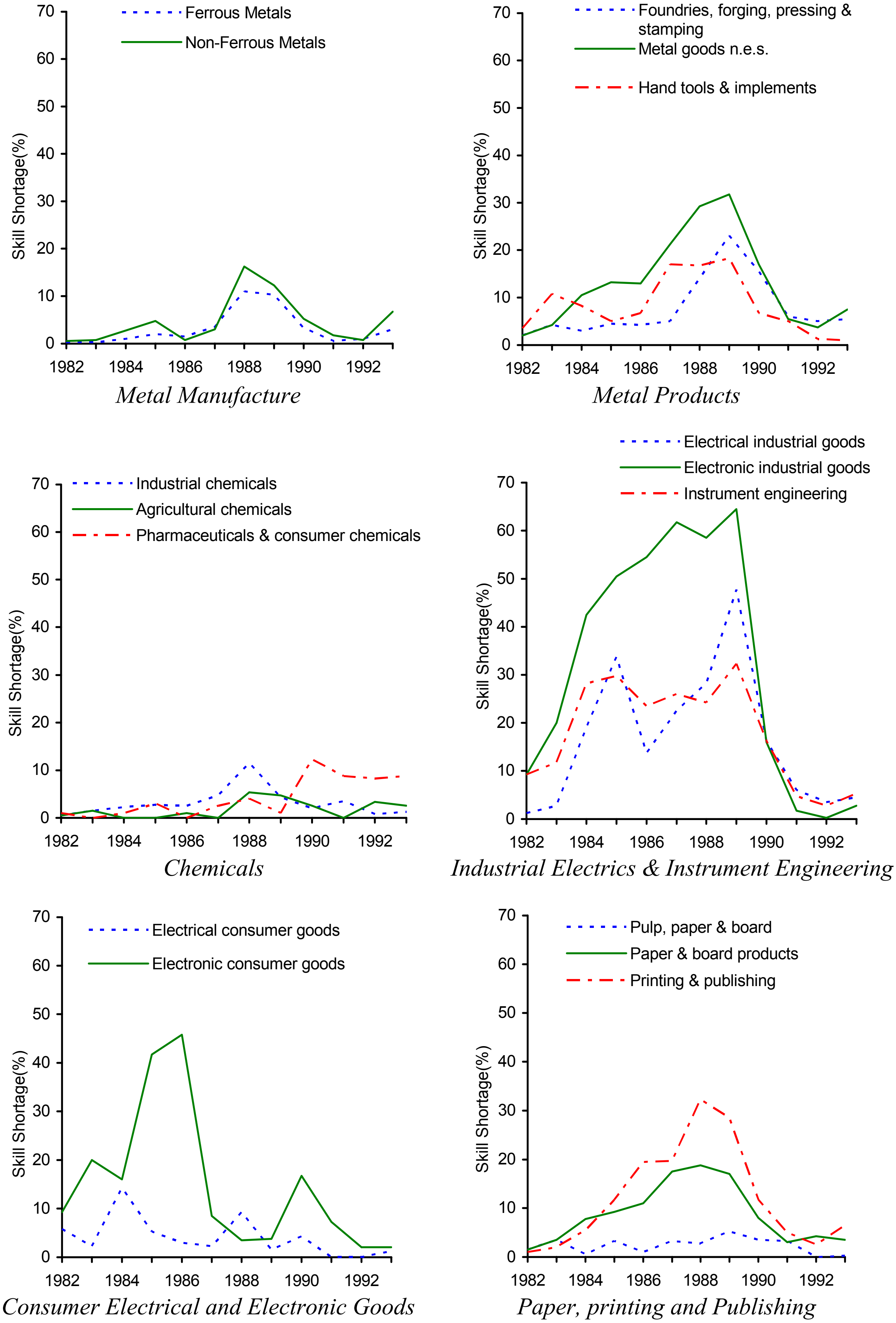


Figure 3 Skill Shortages by industry

This heterogeneity suggests that industry-specific skills play a part in explaining labour market behaviour. It also suggests that any aggregation of these shortages will distort the actual labour market conditions experienced by firms when they adjust employment, and skilled employment in particular. We can see that a disaggregated analysis will generate a genuine increase in the amount of information available because of the heterogeneity we have observed.

3 Model of Employment Determination

In this section we outline our model of employment. We begin with a dynamic model of labour demand developed from models such as that of Sargent (1978) and surveyed in Nickell (1986), particularly as used in Nickell and Nicolitsas (1999).

Consider a firm *i* with production function

$$Y_i = A_i F(N_i, K_i) \qquad (2)$$

where Y = output, N = employment, K = capital stock and A = technical efficiency. Since wages in UK industry are generally set at discrete intervals and employment is adjusted continuously, we assume that employment decisions are made in the context of a predetermined wage[9]. So, if the firm operates in an imperfectly competitive goods market, the long-run equilibrium level of employment N_i^* is given by

$$A_i F_N(N_i, K_i) = W_i \frac{(1+t_1)}{P_i \kappa_i} \qquad (3)$$

where W_i is the predetermined wage, t_1 is the payroll tax rate, P_i is the price of firm *i*'s output and $\kappa_i = (1 - \varepsilon^{-1})$, where ε is the demand elasticity in the (imperfectly competitive) product market (i.e. the inverse of κ_i is the mark-up of price over marginal cost). The presence of this measure of product market competitiveness leads one to include the industry output as a supplementary argument of the variation in profits and employment because of the systematic fluctuations of the mark-up over the cycle, best measured by output fluctuations[10].

The firm's static profit function is as follows

[9] Nickell and Wadhwani (1991); p. 955 and 957.

[10] C.f. Bils (1987), and general discussion in Layard *et al.* (1991) p. 339-41.

$$\pi = P_i A_i F(N_i, K_i) - W_i(1+t_1)N_i \tag{4}$$

where

$$A_i F(N_i, K_i) = P_i^{-\varepsilon},$$

or $\pi(N_i, \mathbf{X}_i)$, where $\mathbf{X}_i$ is a vector of the other variables affecting profits. For the purposes of this study we assume that the firm's capital stock is predetermined when employment decisions are made.

With quadratic adjustment costs, the firms' demand for labour at time t is determined by its maximisation of the discounted value of its expected profit stream. That is, the firm solves

$$\underset{\{N_{(t+s)}\}}{Max} \underset{t}{E} \sum_{s=0}^{\infty} \beta^{(t+s)} \left\{ \pi\left(N_{i,(t+s)}, \boldsymbol{X}_{i,(t+s)}\right) - c_{it}\left[N_{i,(t+s)} - N_{i,(t+s-1)}(1-q)\right]^2 \right\} \tag{5}$$

where $\underset{t}{E}$ is the expectations operator (taken over the distribution of $\boldsymbol{X}_t$), β is the discount factor, and q is the quit rate. Of particular interest to us in this paper is $c_{it} = (c_i + c_{2jt}(\mu_{jt}))$, the adjustment cost parameter, where μ_{jt} is the proportion of firms in industry j who report shortages of skilled labour. In order to obtain a closed-form solution to the above we require firms to form their expectations of future profits based upon an expectation that the adjustment cost parameter will in fact be constant. At first this appears an excessively strong assumption, particularly bearing in mind that we are studying the case when it is not constant. However, this is not such a strong assumption if the time path of the variable upon which c_{it} depends follows a random walk. In this case $\underset{t}{E}(c_{it+s}) = c_{it}$, since we model adjustment costs as the combination of the time-invariant costs of adjustment and those associated with labour market tightness. A glance at the time-series of our measure of labour market tightness – shortages of skilled labour – depicted in figures 3-5 reveals that this is a fairly realistic assumption. Thus the firms best expectation of future values of c_{it} will be that experienced at time t. For the purposes of this study we shall assume a constant quit rate.

The standard quadratic adjustment cost model generates the 'fundamental employment equation'[11]

$$N_{it} = \lambda_{it} N_{i,(t-1)} + (1-\lambda_{it})(1-\beta\lambda_{it}) \sum_{s=0}^{\infty} (\beta\lambda_{it})^s N_{i,(t+s)}^{*} \tag{6}$$

where λ_{it} is the stable root of the Euler equation (so $0 < \lambda_{it} < 1$) and is dependent upon c_{it}, $\beta < 1$, and N^* is the solution to (3). Approximating (6) in log form gives us

$$n_{it} = \lambda_{it} n_{i,(t-1)} + (1-\lambda_{it})(1-\beta\lambda_{it}) \sum_{s=0}^{\infty} (\beta\lambda_{it})^s n^*_{i,(t+s)} \tag{7}$$

where lower cases denote natural logarithms.

We can obtain an expression for the log of equilibrium employment n^*_{it} by log linearising (3)

$$n^*_{it} = a_{0i} + a_{0t} + a_1 k_{it} - a_2 (w_{it} - p_{it}) + a_3 d_{it} \tag{8}$$

where a_{01} is a firm effect, a_{0t} is a time effect, k, w, p are the logs of capital, wages and prices respectively and d is the demand effect associated with κ. The firm effect, a_{01}, refers to all those factors (such as efficiency) which are company specific but fixed over time. The time effect, a_{0t}, captures factors common to all firms which may vary over time, such as the payroll tax rate, t_1.

In order to generate an observable model, we must specify the stochastic process generating all the variables that determine n^*_{it}. Suppose we assume the following

$$k_{it} = k_{i,(t-1)} + \varepsilon_{1it}$$

$$(w_{it} - p_{it}) = b_{0i} + b_1 (w_{i,(t-1)} - p_{i,(t-1)}) + \varepsilon_{2it}$$

$$d_{it} = c_{0i} + c_1 d_{i,(t-1)} + \varepsilon_{3it}$$

where ε_{1t}, ε_{2t}, ε_{3t} are all *iid* errors. Then the 'reduced form' employment equation has the form

$$n_{it} = \lambda_{it} n_{i,(t-1)} + (1-\lambda_{it})(\alpha_2 \tilde{w}_{it} + \alpha_3 k_{it} + \alpha_4 y_{jt}) + \alpha_t + \eta_i + \varepsilon_{it} \tag{9}$$

where $\tilde{w}_i$ = (log) real wage $(w_i - p_j)$[12], k_i = (log) capital stock, y_j = (log) industry output, α_t = time effect and η_i = firm effect, ε_{it} = error term. The adjustment parameter λ_{it} is the item of

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[11] C.f. Nickell (1986)

[12] The price being the industry price level (3-digit SIC)

particular interest to this paper. It is dependant upon the state of the labour market as measured by shortages of skilled labour in the particular industry. In our empirical work we include lags of the capital stock, wages and industry output and consider changes in order to allow for more general dynamics in their effects on employment. This is a policy which is followed by many studies (Arellano and Bond, 1991 and Nickell and Wadhwani, 1991, Nickell and Nicolitsas, 1999, for example). Including these terms and allowing for the possibility that firms' employment behaviour may also be affected by their financial situation[13] we obtain

$$\begin{aligned} n_{it} &= \lambda_{it} n_{i,(t-1)} \\ &+ (1-\lambda_{it})\left(\alpha_{20}\widetilde{w}_{it} + \alpha_{21}\widetilde{w}_{i(t-1)} + \alpha_{30}k_{it} + \alpha_{31}k_{i(t-1)} + \alpha_{40}y_{jt} + \alpha_{41}y_{j(t-1)} + \alpha_5 FP_{i(t-1)}\right) \\ &+ \alpha_t + \eta_i + \varepsilon_{it} \end{aligned} \tag{10}$$

where *FP* is the 'financial pressure' variable or borrowing ratio (see data appendix for more details). This is the expression upon which the empirical estimation in this paper is based.

In order to estimate the parameters in equation (10), we utilise a generalised method of moments (GMM) estimator due to Arellano and Bond (1991)[14]. Firstly, we difference the equation to eliminate the firm (or industry) effect obtaining

$$\begin{aligned} \Delta n_{it} &= \Delta\lambda_{it} n_{(t-1)} \\ &+ \Delta(1-\lambda_{it})\left(\alpha_{20}\widetilde{w}_{it} + \alpha_{21}\widetilde{w}_{i(t-1)} + \alpha_{30}k_{it} + \alpha_{31}k_{i(t-1)} + \alpha_{40}y_{jt} + \alpha_{41}y_{j(t-1)} + \alpha_5 FP_{i(t-1)}\right) \\ &+ \Delta\alpha_t + \Delta\varepsilon_{it} \end{aligned} \tag{11}$$

Endogenous variables are instrumented using exogenous variables and lags of the endogenous variables as instruments[15]. The lagged dependent variable is clearly endogenous and wages are also treated as endogenous. We also treat the capital stock as endogenous.

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[13] C.f. Nickell and Nicolitas (1995), in particular, but also Sharpe (1994).

[14] The validity of this method, depends upon the absence of serial correlation in the error, that is, the absence of second order serial correlation in the first differenced error, which is investigated using a robust statistic developed by Arellano and Bond

[15] See Arellano and Bond (1991) for a more explicit discussion of the variables that can be included in the instrument matrix. The actual instruments used in each estimation are included in the tables of results.

Another potential endogeneity problem concerns our measure of financial pressure, the ratio of interest payments to cash flow, (*FP*). This is likely to be highly counter-cyclical since the denominator includes the firm's profits[16]. We therefore instrument *FP*.

The costs of adjustment will depend on the costs to the firm of finding a worker suitable for the job (hiring costs)[17]. These will depend upon the number of potential applicants. The more workers who are in a position to apply for jobs and the fewer firms who are competing for applicants, the lower the cost of hiring. Obviously, as the number of offers the firm needs to make in order to obtain a given amount of new workers increases, the cost of adjustment increases. Therefore, when the labour market becomes tight, the cost to firms of searching for a skilled worker increases as the flow of applicants to it falls. We define our time-varying adjustment parameter as $\lambda_{it} = \alpha_0 + \alpha_1\mu_{jy}$, where μ_j is the proportion of firms in industry *j* reporting shortages of skilled labour.

In the absence of a time varying adjustment parameter the estimation of (11) would be fairly simple. However, with the inclusion of the λ_{it} adjustment parameter it is impossible to estimate (11) using standard linear methods as it varies over time. We shall, therefore, estimate it using the non-linear (iterative) procedure used by Stevens (2003b). This is done by creating a variable $\mu_{jt}n_{i,(t-1)}$ (where μ_{jt} is as defined above) and estimating (11) without the time-varying term on the variables in the vector $\boldsymbol{x}_{it}$ to yield

$$\Delta n_{it} = \Delta\left(\hat{\alpha}_0 + \hat{\alpha}_1\mu_{jt}\right)n_{i,(t-1)} + \hat{\xi}\Delta\mathbf{x}_{it} \tag{12}$$

where $\mathbf{x}_{it}$ is the row vector representing the independent variables (*w*, *k*, *y*, *FP* etc.) and ξ is a column vector of the estimated coefficients (α_{20} ... α_5). We use the estimates $\hat{\alpha}_0$ and $\hat{\alpha}_1$ to undertake the following transformation of $\boldsymbol{x}_{it}$

$$\tilde{\boldsymbol{x}}_{it} = \left(1 - \hat{\alpha}_0 - \hat{\alpha}_1\mu_{jt}\right)\boldsymbol{x}_{it} \tag{13}$$

and then estimating

$$\Delta n_{it} = \hat{\hat{\alpha}}_0\Delta n_{i,(t-1)} + \hat{\hat{\alpha}}_1\mu_{jt}\Delta n_{i,(t-1)} + \hat{\hat{\xi}}\Delta\tilde{\mathbf{x}}_{it} \tag{14}$$

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[16] As noted in Nickell and Nicolitsas (1999)

This procedure is repeated iteratively until the coefficients on the variables converge to α_0, α_1 and ξ. In fact, we iterate the procedure twenty times for safety's sake although the coefficients converge within three decimal places after about five iterations.

4 Results

The results from our estimation are set out in Table I. In the first column, we have the results of estimating the general specification of the employment equation (without the financial pressure variable). From equation (a) we remove $\tilde{w}_{it}$ (Wald test for $\tilde{w}_{it}$'s inclusion = 0.1556, p = 0.693).

As we have noted above, our reasons for the inclusion of $k_{(t\text{-}1)}$ are rather *ad hoc* and merely enable us to account for any dynamics not explicitly analysed in our theoretic discussion. Many studies of this nature (e.g. Nickell and Nicolitsas, 1995; Nickell and Wadhwani, 1991) only include the current value of capital k_t. Therefore, in columns (c) and (d) we present results equivalent to columns (a) and (b), but without the lagged value of capital. However, on its own, this simplification induces an unacceptable amount of second-order autocorrelation, making the Arellano and Bond estimation technique invalid.

In the final two columns we investigate the additional impact of financial pressure, as measured by the ratio of interest payments to cash flow (*FP*), on the firms' employment behaviour. As we have noted above, this measure is likely to be highly counter-cyclical since the denominator includes the firm's profits. It will be interesting to note, therefore, whether or not its inclusion will have any effect on our measure of the effect of labour market tightness on the dynamics of employment adjustment.

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[17] Ever since the classic work of Oi (1962), it has been known that there is a large discrepancy between the hiring costs of skilled and unskilled labour. Firing costs are on average much smaller and do not depend as much on the skill level, being mainly institutional in origin. In this study, therefore, we concentrate on the former.

TABLE I

Employment Equations (1984-94)

$$\Delta n_{it} = \Delta(\alpha_0 + \alpha_1 \mu_{jt}) n_{(t-1)} + \Delta(1 - \alpha_0 - \alpha_1 \mu_{jt}) \times$$
$$(\alpha_{20}\widetilde{w}_{it} + \alpha_{21}\widetilde{w}_{i(t-1)} + \alpha_{30}k_{it} + \alpha_{31}k_{i,(t-1)} + \alpha_{40}y_{jt} + \alpha_{41}y_{j,(t-1)} + \alpha_5 FP_{i,(t-1)})$$
$$+ \Delta\alpha_t + \Delta\varepsilon_{it}$$

Observations = 4216

	(a)	(b)	(c)	(d)	(e)	(f)
α_0	0.667 (12.0)	0.670 (12.1)	0.596 (13.5)	0.549 (13.9)	0.669 (12.3)	0.647 (11.8)
α_1	0.061 (2.4)	0.064 (2.5)	0.111 (3.3)	0.043 (5.0)	0.072 (2.9)	0.052 (3.2)
α_{20}	0.12 (0.4)	-	0.545 (0.5)	-	-0.102 (0.4)	-
α_{21}	0.33 (1.4)	0.399 (1.7)	0.271 (0.2)	0.262 (1.5)	0.449 (1.9)	0.384 (1.8)
α_{30}	2.10 (6.6)	2.07 (6.5)	0.734 (3.5)	1.03 (5.4)	2.08 (7.2)	1.95 (7.4)
α_{31}	-1.37 (3.8)	-1.35 (3.9)	-	-	-1.31 (4.2)	-1.08 (3.7)
α_{40}	0.39 (2.4)	0.412 (2.5)	0.348 (2.4)	0.267 (2.1)	0.422 (2.7)	0.360 (2.5)
α_{41}	-0.53 (3.3)	-0.544 (3.3)	-0.483 (0.1)	-0.42 (3.8)	-0.570 (3.6)	-0.524 (3.5)
α_5	-	-	-	-	-0.124 (1.6)	-0.121 (1.7)
2nd order serial correlation	-1.238 (0.216)	-1.286 (0.2)	-2.318 (0.02)	-1.483 (0.14)	-1.103 (0.270)	-1.001 (0.317)
Sargan test (Instrument validity)	208.48 (0.038)	210.59 (0.03)	227.0 (0.02)	225.19 (0.03)	249.48 (0.07)	247.95 (0.09)

Notes:

(i) *All equations estimated in first differences using the GMM IV technique due to Arellano and Bond (1991).*

(ii) *Asymptotic absolute t values are in parenthesis and are robust against heteroscedasticity.*

(iii) *All regressions include time dummies*

(iv) *Instruments Used (numbers in brackets (x, y) indicate most recent (x) and oldest (y) lags used (i.e. t-x back to t-y)*

- *(a) & (b) constant, n(2,6), $\mu \bullet n_{(t-1)}$(1,5), w(2,6), k(2,6), y, $y_{(t-1)}$, Time Dummies*
- *(c) & (d) constant, n(2,6), $\mu \bullet n_{(t-1)}$(1,5), w(2,6), k(1,6), y, $y_{(t-1)}$, Time Dummies*
- *(e) & (f) constant, n(2,6), $\mu \bullet n_{(t-1)}$(1,5), w(2,6), k(2,6), FP(2,6), y, $y_{(t-1)}$, Time Dummies*

We can see that there is a statistically significant effect of skill shortages on the dynamics of labour demand. In periods of increased skill shortages, employment adjustment will be more sluggish. This result is fairly robust to the specification of the model, estimates of the coefficient on c_{it} varying between 0.043 and 0.111. In the equations where $k_{i(t-1)}$ is included the coefficient only varies between 0.052 and 0.077. Furthermore, the inclusion of the financial pressure variable $FP_{(t-1)}$ has little effect on the persistence parameter, increasing it in one case and decreasing it in the other.

One general point to make about the results is the relatively weak effect of real wages on employment where one would expect them to have a strong negative effect. One possible reason for this is the quality of our wage term, which is merely the total wage bill divided by the number of employees. This figure contains an hours component, which will undermine the statistical relationship between wages and employment when the latter is measured in terms of numbers of employees. Attempts to use industry-level measures of hourly wages as instruments had little effect on our results.

With the above in mind, and because our inclusion of other lagged explanatory variables were rather *ad hoc*[18], these results lead us to estimate the equations with Δw and Δy terms included estimate the further specifications in Table II. However, these re-specifications do induce some second-order autocorrelation if we continue the iteration up until twenty iterations. Because our non-linear estimation method depends on the convergence of the coefficients only and no other criteria (such as the result of the test for autocorrelation), we therefore report the results of the last iteration with an insignificant value of the test for second-order autocorrelation. In Table II columns (h) and (j) refer to the results after twenty iterations, and columns (g) and (i) refer to those after the last iteration for which the test for second-order autocorrelation is insignificant at the 10% level.

[18] Our discussion of the affect of industry demand on competitiveness did not provide us with an explicit way for industry output to be included. If only the current or lagged value is included it is entirely insignificant.

TABLE II

Employment Equations (1984-94)

$$\Delta n_{it} = \Delta(\alpha_0 + \alpha_1 \mu_{jt}) n_{(t-1)} + \Delta(1 - \alpha_0 - \alpha_1 \mu_{jt}) \times$$
$$(\alpha_2 \Delta \widetilde{w}_{it} + \alpha_3 k_{it} + \alpha_{40} y_{jt} + \alpha_{41} y_{j,(t-1)} + \alpha_{42} \Delta y_{jt} + \alpha_5 FP_{i,(t-1)}) + \Delta \alpha_t + \Delta \varepsilon_{it}$$

Observations = 4216

	(g)	(h)	(i)	(j)
Iterations	5	20	6	20
α_0	0.590 (11.7)	0.604 (11.9)	0.599 (11.8)	0.650 (12.8)
α_1	0.045 (5.3)	0.108 (4.9)	0.102 (5.1)	0.134 (3.4)
α_2	-0.281 (1.8)	-0.278 (1.8)	-0.299 (1.9)	-0.331 (1.7)
α_3	1.044 (5.2)	0.955 (4.8)	0.991 (5.01)	0.674 (3.3)
α_{40}	0.371 (3.2)	0.396 (3.3)	-	-
α_{41}	-0.506 (4.2)	-0.17 (2.7)	-	-
α_{42}	-	-	0.457 (4.3)	0.568 (2.7)
α_5	-0.164 (2.7)	-0.17 (2.7)	-0.173 (2.8)	-0.208 (2.7)
2nd order serial correlation	-1.469 (0.142)	-2.048 (0.041)	-1.603 (0.109)	-2.419 (0.016)
Sargan test (Instrument validity)	250.10 (0.080)	249.74 (0.082)	249.71 (0.082)	227.0 (0.02)

Notes:

(i) *See notes for Table 1*

(ii) *Instruments Used (numbers in brackets (x, y) indicate most recent (x) and oldest (y) lags used (i.e. t-x back to t-y)*

- *(g) & (h)* *constant, n(2,6), skn(t -1)(1,5), w(2,6), k(1,6), y, y(t - 1), Time Dummies*
- *(i) & (j)* *constant, n(2,6), skn(t -1)(1,5), w(2,6), k(2,6), FP(2,6), Δy, Time Dummies*

4.1 Effects of Skill Shortages on the Employment Adjustment Parameter

We can show graphically the effect of skill shortages on employment adjustment. Figure 4 shows how λ_t varies over the time period in three industries, depending on which specification we use. The straight line in the diagram shows the value of the constant adjustment parameter α_0, in the standard specification (column (a) in Table I), for comparison.

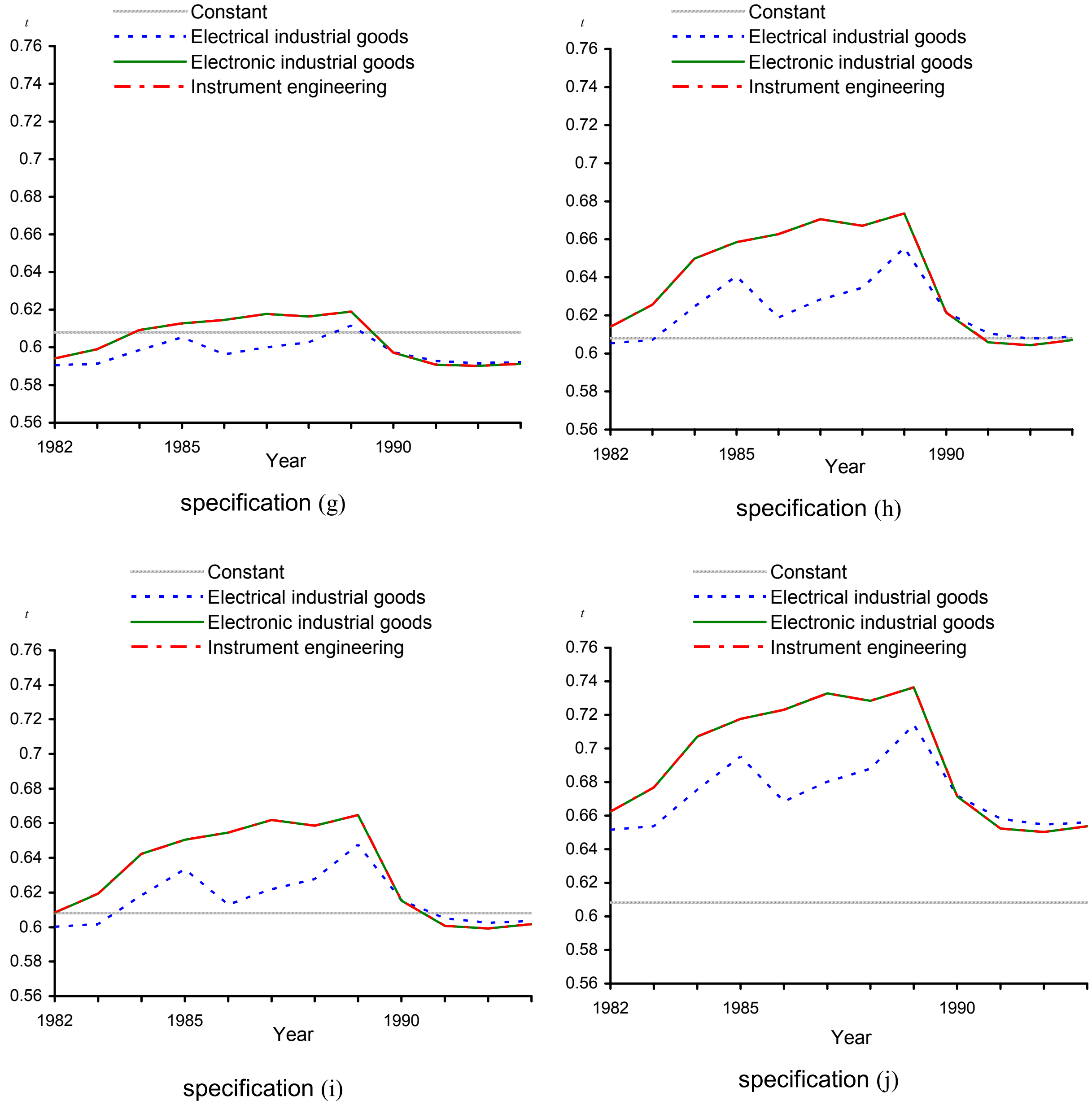

Figure 4 Variation of Net Employment Adjustment Coefficient

As can be seen from Figure 4, the conclusions one draws regarding the effects of skill shortages on the dynamics of employment behaviour depend upon whether one uses the specification with or without second-order autocorrelation in the residuals. According to our estimation, employment adjustment in these industries was less sluggish during 1982/3 and 1990-3: periods when unemployment was increasing in the economy as a whole. In these periods, the standard, time-invariant, dynamic labour demand model presented in column (a) of Table I understates the speed of employment adjustment. However, whether it would overstate it during the other years of our study depends very much upon which specification one uses. Both of the earlier iterations (i.e. those without evidence of second-order autocorrelation) give much lower estimates of the value of the coefficient on *skill·n*. However, this is to be expected because the convergence on the parameter approaches its final value from below.

Although there is a statistically significant impact of skill shortages on the employment dynamics, this effect is much smaller than one would expect, particularly when one bears in mind the fact that the three industries presented in the diagram were the industries which reported some of the highest skill shortages of all the industries examined.

5 Conclusion

In this paper we have undertaken an investigation into the impact on firms' employment behaviour of shortages of skilled labour. We have found that firms' employment adjustment will be slower in periods where there are shortages of skilled labour. Even when we take into account firms' financial status, this result remains robust. At first glance, these results support the theory that an increase in employment during an economic expansion is likely to be restricted by a shortage of skilled labour. However, the size of the effects is rather small and the net effect on employment adjustment is relatively modest.

One reason why one might expect to find a smaller level of asymmetry in employment adjustment at the micro level than at the macro level is the influence of the creation and destruction of jobs themselves. In our firm level data we can only observe changes in employment levels *within the firm*. Another source of changes in employment at the macro level is the birth and death of firms. We only measure the changes of employment levels in existing firms, although some of these may have been set up or may have closed within the time period our sample encompasses. Therefore, we do not examine the increase in employment when a new firm is born and the decrease when a firm dies, and the asymmetries between these two. There is no reason to believe that the mechanisms whereby firms are set up and close down are symmetric, indeed there are likely to be considerable fixed costs that prevent an increase in demand in an industry bringing new firms into being, whereas a collapse in demand can make firms insolvent with deadly rapidity. Moreover, a job that is destroyed due to a firm's closure is likely to remain so longer than a one that is created by the birth of a firm.

To put this discussion in perspective, Davis *et al* (1997) found that in the United States between 1973 and 1988, 15.5% of annual job creation was due to business start-ups. This compares with shutdowns, which account for 22.9% of annual job destruction. If the same is true for the UK, the asymmetry in employment adjustment would be even greater than that estimated in this paper.

In conclusion, we have found that firms' employment adjustment will be slower in the upward than in the downward direction. It will be faster when the firm expects sales to fall and when the labour market is tight and slower in periods when they expect it to expand or when there are shortages of skilled labour. However, the size of the effects themselves is small and the net effect on employment adjustment is modest.

Data Appendix

The sample is an unbalanced panel of 610 firms from the EXSTAT/EXTEL company database for the period 1982-1994. The distribution of the number of firms by the number of consecutive years for which they are present is

Years	Firms
4	20
5	56
6	72
7	69
8	52
9	123
10	43
11	23
12	21
13	131

Data Descriptions

- Employment (N_{it})

  Domestic employment (EXSTAT item C15)

- Wages (W_{it})

  The nominal wage rate is given by total remuneration (EXSTAT item C16) divided by total employment. This is converted into a real wage by deflating it by the 3-digit industry producer price index.

- Capital Stock (K_{it})

  See Wadhwani and Wall (1986) (EXSTAT item C57).

- Industry Output (Y_{it})

  This is the level of output in the industry to which the firm belongs deflated by the 3-digit industry producer price index (Monthly Digest of Statistics).

- Financial Pressure (FP_{it})

  This is defined as $\dfrac{I_i}{\pi_i + D_i + I_i}$

  where I_i = interest payments (EXSTAT item C57), π_i = profits before tax (EXSTAT item C34) and D_i = depreciation (EXSTAT item C52).

- Skill Shortages

  The proportion of firms in industry *j* who report that a shortage of skilled labour is likely to limit their output in the future. (CBI *Industrial Trends Survey*). The question asked is 'What factors are likely to limit your output over the next four months? The factors are: orders or sales, skilled labour, other labour, plant capacity, credit or finance, materials and components, and other. The choices are not mutually exclusive and there are no restrictions on the number of factors that may be considered.

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