# Technology, Wages and Skill Shortages: Evidence from UK Micro Data[*]

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Abstract: Why have skill shortages continue to persist despite increases in training and the skill levels of the workforce? We argue that technical progress has raised the demand for skilled labour to mach the observed increase in supply. We provide econometric evidence in support of this hypothesis, showing that skill shortages are higher for establishments that use advanced technology in the production process. We also provide econometric evidence that hiring difficulties are inversely related to the relative wage, as theory would suggest. Our results have clear implications for policy. If technological progress continues to be skill biased, policies that address skills deficiencies will only be successful if they produce a continual, rather than a temporary, increase in levels of skills among the workforce.

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1) Introduction

Skill shortages seem an endemic feature of the UK economy. The 1997 Skill Needs in Britain Survey (DfEE, 1997), for example, indicates that 18% of employers "felt there was a significant gap between the level of skills their current employees had and those they needed to meet their current business objectives"; this compares with 20% in 1996 and 12% in 1994. Also, 55% of firms in the 1996 survey felt employees were deficient in key computer literacy skills, compared with figures of 64% in 1996 and 53% in 1994. Time series data from the British Chambers of Commerce supports this impression: levels of skill shortages at the 1997 cyclical peak were similar to those at the 1988 peak[1].

These data highlight an important question concerning skill shortages. The amount of training provided by firms and the levels of qualifications held by the workforce have increased in recent years (DfEE, 1997, Robinson and Manacorda, 1997)[2]. Why has this increase in the supply of skilled labour not led to a secular reduction in skill shortages? One explanation for this persistence of skill shortages is the speed of technical change. If technological progress increases the demand for skilled labour, so the increase in supply we have observed has been matched by an increase in demand, skill shortages will continue. This hypothesis is consistent with evidence that technical change has increased the relative demand for skilled labour (Haskel and Heden, 1998, Machin, 1996). It is also consistent with data from the Skill Needs in Britain Survey (DfEE, 1997) which indicates 69% of employers in 1997 and 74% in 1996 felt the required level of employee skills is increasing.

This paper presents the first formal evidence of a link between skill shortages and technology. We use data from the 1991 Employee Manpower and Skills Practices Survey (EMSPS), a survey of 1600 individual establishments, providing the first comprehensive, nationally representative data source on skill shortages, hiring, turnover, training and other issues. We also use data from the 1990 Workplace Employee Relations Survey (WERS), since every establishment surveyed in EMSPS also appears in WERS. Combining these data sets allows us to investigate the links between technology and skill shortages, controlling for factors such as wages, the composition of employment, training and labour market flexibility[3].

We begin in the next section by discussing our data and presenting descriptive statistics. Overall, 35% of establishments report skill shortages. We also have evidence on other aspects of the skills problem. In our sample, 57% of establishments that recruited workers in the 12 months before the survey reported difficulty in hiring. We also find that 18% of

[1] Source: Bank of England Inflation Report, May 1999, chart 3.13. CBI Industrial Trends Survey data show a fall from 43% to 25% when comparing the peaks of 1988 and 1997. However, the CBI data is derived from a survey asking whether shortages of labour will limit output, whereas the BCC survey asks if employers are having difficulty in finding skilled labour. The BCC question seems a more direct measure of shortages.

[2] But see Green et al (1995) who dispute that effective training has risen significantly.

[3] 1990/1 were recession years where real GDP fell. Skill shortages therefore fell, but since output fell in all sectors this should not unduly

establishments reported they currently had vacancies that were proving hard-to-fill. These measures are closely related: establishments with skill shortages are significantly more likely to have hard-to-fill vacancies and to have experienced difficulties in hiring workers.

Estimates of econometric models to explain skill shortages, hiring difficulties and hard-to-fill vacancies are presented in section 3. The determinants of these variables are broadly similar, which leads us to regard them as different symptoms of the same underlying process. Our most important finding is that "high-tech" establishments (i.e. those where a new product has used "microprocessors or other microelectronic components" or "new materials such as advanced alloys or engineering plastics" in the production process) are more likely to suffer skill shortages. This finding supports the argument that the persistence of skill shortages can be explained by technical change. In addition, establishments that use word processing were more likely to have found hiring difficult and to experience hard-to-fill vacancies.

We also present econometric evidence of a systematic negative link between the relative wage and our measures of skill shortages and hiring difficulties[4]. We find little evidence of a link between skill shortages and labour market flexibility and no evidence of a link between skill shortages and training.

Our results have clear implications for policy. If technological progress continues to be skill biased (as it has been in the past, Gregg and Manning, 1997), the demand for skilled labour will continue to rise and there will be continual pressure for skill shortages to rise. In order to offset this, the supply of suitably skilled labour must also rise, to keep pace with demand. As a result, policies that are intended to address skills deficiencies will only be successful if they produce a continual, rather than a temporary, increase in levels of skills among the workforce.

## 2) Data

Although widespread interest in the skills issue has lead to a vigorous public policy debate, empirical evidence is surprisingly scarce. Data on skill shortages are available at aggregate or industry level data, largely derived from the CBI Industrial Trends Survey (CBI, 1998), supplemented by other occasional surveys (Hart, 1992)[5]. Our data on skill shortages at the establishment level is complementary to these data, since they allow us to investigate variations in skill shortages between workplaces.

Our measures of skill shortages, hiring difficulties and hard-to-fill vacancies are constructed as follows:

### *i) Skill shortages*

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distort the cross-section variation in shortages that we analyse in this paper.

4 Other evidence is set out in Thomas and Deaton (1977), Doeringer and Piore (1971), Bosworth (1990,1993), Bosworth at el (1992) and Bishop (1993).

5 These data typically show significant shortages of skilled workers but low unskilled shortages. Skill shortages are also highly procyclical and are concentrated in certain industries, especially the engineering sector (Bosworth et al, 1992). Regionally, skill shortages are lower in regions of higher unemployment (Campbell and Baldwin, 1993).

Managers are asked:

> *Would you say that this establishment has experienced a "skill shortage" in the last 12 months, or not?*

The first row of Table 1 summarises these data. Overall, 35% of firms report skill shortages. 44% of establishments in manufacturing report skill shortages (similar to the level in 1984 WIRS data). On average, 34% of non-manufacturing workplaces report skill shortages. Although these figures are heavily influenced by construction, this evidence shows that skill shortages are a problem for the whole economy; they do not just affect manufacturing.

*ii) Hiring difficulties*

For each of nine distinct occupational groups, managers are asked:

> *How easily have you been able to fill vacancies in each of the following occupational groups in the last 12 months?*

Responses are on a 1-5 scale (where a response of 1 indicates no difficulty was experienced). We define an establishment as facing a *hiring difficulty* if there is a response in the range 3-5 for any occupational group[6]. Table 1, row 2, summarises these data. 57% of our establishments experienced a hiring difficulty on the 12 months prior to the survey. Hiring difficulties are greatest in heavy manufacturing and lowest in the transport and communications sector.

The only other systematic data on hiring difficulties in the UK is contained in the 1984 Workplace Industrial Relations Survey (Millward et al, 1992). These data were analysed by Haskel and Martin (1993), who found hiring difficulties were related to firm-specific factors related to size and workplace organisation, and to conditions in the local labour market. Perhaps surprisingly, they found no evidence that hiring difficulties were systematically related to the wage. As we shall see, we do find a wage effect in this paper.

*iii) Hard-to-fill vacancies*

Data on this come from managers' responses to the question:

> *Do you currently have vacancies which are proving hard to fill?*

Responses are summarised in row 3 of table 1. We see that 18.2% of establishments had hard-

[6] This is consistent with usage in the survey: establishments whose response is between 3 and 5 are asked subsequent questions about the effects of having a hiring difficulty.

to-fill vacancies at the time of survey[7]. The sectoral distribution of hard-to-fill vacancies is similar to that of skill shortages.

The interpretation of skill shortages is a controversial topic, discussed in a number of papers. Skill shortages could reflect either difficulties in hiring new workers or perceived skill deficiencies in the existing workforce (cf. Green and Ashton, 1992, Green et al, 1998). Hiring difficulties and hard-to-fill vacancies are probably best thought of in terms of the probability of filling vacancies (Haskel and Martin, 1993a). Table 2a presents correlations between our measures; these are all positive and significant. However they are somewhat low, lying between 0.3-0.4. This shows that the three aspects of shortages considered here are, although related, not synonymous. Table 2b documents the means of hard-to-fill vacancies and hiring difficulties according to whether establishments have a skills shortage. We observe that the means of hard-to-fill vacancies and hiring difficulties are higher when the establishment has a skill shortage and that these differences are significant. Taking the evidence of table 2 as a whole, it seems that our measures are related, so establishments with a skills shortage are more likely also to have experienced a hiring difficulty and to have hard-to-fill vacancies[8].

In the remainder of this section we relate our measures of skill shortage and hiring difficulties to some establishment characteristics[9]. Beginning with technology, we have information on both the type of output produced and the technology used to produce it. We use the variable *high-tech* to indicate establishments whose production process uses "microprocessors or other microelectronic components" or "new materials such as advanced alloys or engineering plastics". If the hypothesis that technological change creates skill shortages were correct, we would expect to find a positive relationship between this variable and skill shortages. As table 3 shows, these establishments are indeed significantly more likely to experience skill shortages and hiring difficulties. We also have measures of the type of technology used at the establishment, in particular we have information on whether the establishment has any of the following: (i) computer-aided design, (ii) word processing, (iii) computer testing or quality control, (iv) automated storage and (v) computerised control over the production process[10]. As table 3 shows, these measures of technology affect our measures in different ways: thus word processing has little effect on skill shortages but is associated with more hard-to-fill vacancies and hiring difficulties, and automated storage is associated with higher skill shortages but fewer hiring difficulties. However there is again a clear relationship between skill shortages and hiring difficulties and these measures of technology. Although we should always be careful in interpreting simple partial correlations, this evidence does suggest there is a link between technology and skill shortages.

Our next characteristic is the relative wage. We constructed this as follows. To

[7] We would expect lower levels of hard-to-fill vacancies than skill shortages and hiring difficulties since establishments are asked about current vacancies, while the other questions refer to any shortage or difficulty encountered in the previous year

[8] For a more detailed analysis of this issue, see Green et al (1995).

[9] Descriptive statistics for these explanatory variables are presented in the data appendix; also see footnote 10.

[10] 4.3% of establishments are "high-tech", 15.9% have computer-aided design, 61.7% have word processing, 3.5% have computer testing or quality control, 3.7% have automated storage and 4.3% have some form of computerised control over the production process.

measure the wage at the establishment we used WERS data on weekly earnings, observed in the summer of 1990. Earnings data is available for each of five distinct occupational groups[11], in those establishments where workers in that group are employed. To measure the alternative wage for each occupational group, we calculated average weekly earnings in our sample for workers in the same group and in the same geographical region[12]. The relative wage for each occupational group was then calculated as the establishment wage for that group divided by the alternative wage for that group. In the tabulations and econometric estimates presented below, we use the relative wage of clerical workers to measure the relative wage at the establishment. We also report (see footnote 15, below) estimates that use relative wages of the other groups; our results are not overly sensitive to using different measures of the relative wage[13]. We also experimented with other measures of the relative wage, for example using average industry wages to measure the alternative wage and adjusting for differences in weekly hours of work or in establishment size. In no case were the results greatly different from those reported here.

Table 3 presents the means of our measures for establishments whose relative wage is in the upper quartile or the lowest quartile of the relative wage distribution. We see that few high-wage establishments suffer skill shortages or problems in hiring while low-wage establishments are more likely to experience these problems. Hiring difficulties appear more sensitive to the wage than skill shortages; we will comment further on this below.

We also consider the effects of labour market flexibility. To measure this we used the proportion of workers who are part-time and an indicator that management can organise work as it chooses, without opposition from its workforce (Beatson, 1995, and Haskel et al, 1997, discuss flexibility in more detail). As table 3 shows, hard-to-fill vacancies and hiring difficulties are lower when more of the workforce are part-time. Finally, we consider the effects of training. We use a simple measure, indicating that workers "who have done similar tasks before" receive training before commencing work. As table 3 shows, training status is not associated with more skill shortages or hiring difficulties.

## 3) Econometric results

In this section we explore the determinants of skill shortages, hard-to-fill vacancies and hiring difficulties using our establishment-level cross-section micro data. As with all studies that use cross-section data, several issues merit discussion. First, our results may reflect reverse causation. We discuss this in detail below, where we argue this is unlikely to be a significant problem. Second, our results may be affected by a host of establishment-specific factors that affect the probability of facing a skills shortage or hiring difficulty. We attempt to control for

[11] These are unskilled manual, semi-skilled manual, skilled manual, clerical and supervisory workers.

[12] Establishments are in 1 of 11 regions. Thus the alternative wage for an unskilled manual worker in Wales is measured as the average of all reported weekly earnings of unskilled manual workers in Wales in our sample.

[13] We use the relative wage of clerical workers as this yields the largest sample. As an alternative procedure, we could have combined our measures into a composite measure of the relative wage facing the "average" worker. We did not do this because variations in this variable would reflect differences in the composition of employment across establishments as well as differences in wages.

heterogeneity by including a large number of explanatory variables and arguing that estimates on our main variables of interest are unaffected by the inclusion of different sets of controls. The robustness of our results suggests we can have confidence in our main findings. Third, our estimates may be biased by the absence of measures of the supply of skilled labour. We argue below that this is unlikely to be a serious problem.

Our empirical model is very simple. We suppose that the propensity of establishment *i* to have skill shortages, hard-to-fill vacancies or hiring difficulties for each of our N establishments can be expressed as

1) $$Y^*_i = X_i \beta + u_i$$

were Y* refers to the propensity to have skills shortages, hard-to-fill vacancies or hiring difficulties as appropriate, *i* indexes the establishment, $X_i$ is a (1xm) vector of observations on *m* explanatory variables at establishment *i*, β is an (mx1) parameter vector and *u* is an error term. Since our observed shortage measures are binary, we further assume that

2) $$Y_i = 0 \text{ if } Y^*_i < 0$$
$$Y_i = 1 \text{ if } Y^*_i \geq 0$$

We can then estimate the β parameters in (1) using probit or logit techniques.

For each of our dependent variables we estimate a general model that includes our measures of technology, the relative wage, flexibility and training as well as the unemployment rate in the local labour market, the proportions of the workforce that are unionised, skilled, manual and female, and also the number of employees, as explanatory variables. These models are then simplified by dropping insignificant measures of technology, training and labour market flexibility. We present estimates of probit models: the pattern of estimates from logit was very similar.

Table 4 presents our estimates. We obtain a number of interesting results. First, there is a clear relationship between the type of technology used in the production process and our various measures of shortage. Skill shortages are significantly higher for “high-tech” establishments, that is, those where a new product has used “microprocessors or other microelectronic components” or “new materials such as advanced alloys or engineering plastics” in the production process. This is our most important finding. It provides econometric evidence to support the hypothesis that skill shortages are affected by technical progress. We also find that hard-to-fill vacancies and hiring difficulties are both significantly higher where establishments use word processing[14].

Second, we also observe a negative effect of the wage for each of our variables, which

[14] It is perhaps surprising that word-processing is significant when more obvious measures of technology are not. This is an issue that deserves further investigation using different data”

is either significant or nearly so[15]. The finding of a systematic negative econometric link between wages, skill shortages and hiring difficulties is especially interesting, as this link was not detected in previous studies[16]. It is also worth noting that the estimate on hiring difficulties is more significant than that on skill shortages (this is consistent with the partial correlations reported in table 3). This is plausible, since hiring difficulties refer to hiring of new workers while skill shortages refer to problems with the whole workforce, most of whom are incumbent.

We find some weak evidence that training can reduce skill shortages, although the estimate falls short of significance; there is no evidence that training affects hard-to-fill vacancies and hiring difficulties[17]. As for labour market flexibility, the only significant relationship we detect is that hiring difficulties are lower where more of the workforce are part-time. Finally, considering our controls, we find that labour shortages are lower when more of the workforce is unionised, higher where more of the workforce is skilled and also higher in larger establishments (these results are all consistent with earlier findings).

We now consider endogeneity of our explanatory variables and the possibility of reverse causation, focussing on the relative wage and technology. Our wage data and technology measures were collected as part of the WERS3 survey in the summer of 1990 and are thus predetermined with respect to data derived from the 1991 EMSPS survey[18]. As for reverse causation, skill shortages and hiring difficulties presumably increase the marginal cost of operating technology and thus we would expect a negative relationship between technology and skill shortages if there is reverse causation. The fact that we have estimated a positive relationship therefore suggests that reverse causation is not a problem; in anything, our results may in fact underestimate the positive effect of technology on shortages. A similar logic holds for wages. If skill shortages and hiring difficulties create pressure for higher wages, reverse causation would predict the opposite sign to those we have obtained.

Assessing the impact of omitting measures of the supply of skilled labour is more difficult. Since increased supply will presumably reduce skill shortages, it seems clear that the estimate on any included explanatory variable that is positively related to the supply of skilled labour will be biased downwards. Thus, for example, if high-tech establishments are more likely to operate in areas with a good supply of skilled labour, then the estimate in the effects of this variable will be biased down. In other words, the effects of technology might be stronger than our estimates would suggest. Also, if wages are higher in areas where the supply of skilled labour is greater, reflecting variations in human capital, then the impact of

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15 Similar results were obtained using other measures of the wage: the coefficient on the log relative wage in the skill shortage model is estimated to be –0.21 (t=2.27) when using the relative wage of unskilled workers and estimated to be –0.40 (2.26), -0.75 (2.87) and –0.35 (2.01) using the relative wages of semi-skilled manuals, skilled manuals and supervisors respectively.

16 Previous work (eg Haskel and Martin, 1993) estimated models for hiring difficulties for skilled manual workers, using a much smaller sample and a more restricted set of establishment-specific controls.

17 We also have information on whether training is on-the-job or off-the-job, whether incumbent workers continue to receive training, whether the results of training are assessed or certified, whether inexperienced workers receive training and whether training is associated with the introduction of new technology. Using these alternative measures produced no significant estimates. This may suggest that the effect of training is not robust.

18 The sole exception is our measure of whether the establishment produces high-tech products; this is derived from EMSPS.

the relative wage may also be biased down[19].

The effect of changes in the explanatory variables on the probability of observing a skills shortage, hard-to-fill vacancy or hiring difficulty is provided by the marginal effects, which are presented in table 5 for our main variables of interest. For continuous explanatory variables, we calculate a semi-elasticity measure: the change in the probability of observing any of our shortage measures value induced by a 1% increase in the relative wage (and a 1% increase in the proportion of workers who are part-time in the case of hiring difficulties). Our estimated semi-elasticities are rather small: a 1% increase in the relative wage reduces the probability of experiencing a shortage by around 0.1 percentage points. Thus, the relative wage effect, although present, is weak. For dummy explanatory variables, we calculate marginal effects in a different way: we calculate the change in the probability of observing a shortage induced by a change in the explanatory variable from zero to unity. The estimated marginal effect for high-tech products is 0.22 in the case of skill shortages; this means that the probability of observing a skills shortage is 0.22 higher, ceteris paribus, in establishments that produce high-tech products. The probability of experiencing hard-to-fill vacancies is 0.15 and 0.09 higher respectively for establishments with word-processing, while establishments which train have a probability of experiencing a skill shortage that is 0.08 lower. These findings suggest that the impact on skill shortages of being in the high-tech sector is greater than that of having word processing on hiring difficulties.

Marginal effects for some industry dummies are also large. Relative to the excluded case of the personal and public services sector, establishments in manufacturing have a probability of facing a skills shortage that is lower by 0.15-0.24 while the probability for those in the distribution, hotels and catering sector is lower by 0.40[20]. Overall these marginal effects suggest that the relative wage, technology and industrial sector have the largest impact on the probability of experiencing skill shortages, hard-to-fill vacancies and hiring difficulties.

## 4) Conclusions and Policy implications

This paper has addressed the question of why skill shortages continue to persist despite increases in training and the skill levels of the workforce. We have considered the hypothesis that technological progress has lead to continual increases in the demand for skilled labour, so the increase in the supply of skilled labour has been matched by an increase

[19] Of course, these arguments are highly speculative. Wages could also be higher in areas of low supply of skilled labour, as wages are bid up to attract scarce skills. In that case the impact of the wage in our estimates will be biased up. Note that our regional dummies should control for this to some extent.

[20] Marginal effects for hard-to-fill vacancies and hiring difficulties are somewhat lower than this.

in demand. We have provided econometric evidence that supports this hypothesis, showing that skill shortages are higher for firms in the high-tech sector of the economy and that establishments that use word processing find it harder to recruit staff. We have also provided the first evidence that skill shortages are inversely related to the relative wage, as theory would suggest.

The policy implications of our results are clear. Assuming that skill-biased technical progress continues, our results suggest that this will lead to ever-higher levels of skills shortages unless there is a matching continual increase in the supply of skilled labour. If skill shortages are considered a problem, policy measures should therefore be designed to produce a continual increase in the skill levels of the workforce. Policies that create a one-off increase in the level of skills, in an attempt to eliminate the "skill deficit" can at best lead to a temporary reduction in skill shortages.

# Data Appendix

**a) dependant variable:**

i) **skill shortages**: we use responses to the question:

*Would you say that this establishment has experienced a "skill shortage" in the last 12 months, or not?*

source: question A28 of EMSPS

ii) **hiring difficulties**: :for each of nine distinct occupational groups, managers are asked:

*How easily have you been able to fill vacancies in each of the following occupational groups in the last 12 months?*

Responses are on a 1-5 scale (where a response of 1 indicates no difficulty was experienced). We define an establishment as facing a *hiring difficulty* if there is a response in the range 3-5 for any occupational group

source: question C16 of EMSPS

iii) **hard-to-fill vacancies**: we use managers' responses to the question:

*Do you currently have vacancies which are proving hard to fill?*

source: question C16 of EMSPS

**b) explanatory variables**

*log wage*: the log of the wage reported for the typical worker in the group indicated
source: question K15 of the Managers Questionnaire of WIRS (mean=-0.163, standard deviation=0.369).

*High-tech:* a dummy variable indicating establishments where any new product has used "microprocessors or other microelectronic components" or "new materials such as advanced alloys or engineering plastics" in the production process.
source: questions G14 and G15 of EMSPS (mean=0.124, standard deviation=0.323).

*Computer-aided design*: a dummy variable indicating establishments where "the establishment uses microelectornics in design"
source: question A26 of the Managers Questionnaire of WIRS (mean=0.374, standard deviation=0.483).

*Word processing*: a dummy variable indicating establishments where "the establishment uses microelectornics in word-processing"
source: question A26 of the Managers Questionnaire of WIRS (mean=0.877, standard deviation=0.328).

*Computer testing/Quality control*: a dummy variable indicating establishments where "the establishment uses microelectornics in testing or quality control"
source: question A26 of the Managers Questionnaire of WIRS (mean=0.216, standard deviation=0.412).

*Automated storage*: a dummy variable indicating establishments where "the establishment uses microelectornics in automated storage"
source: question A26 of the Managers Questionnaire of WIRS (mean=0.062, standard deviation=0.214).

*Compute control of production*: a dummy variable indicating establishments where "the establishment uses microelectornics in control of production"
source: question A26 of the Managers Questionnaire of WIRS (mean=0.465, standard deviation=0.499).

*%part-timers*: the % of employees who are part-timers.
source: question 1 of the Basic Workforce Data Sheet of WIRS (mean=0.144, standard deviation=0.209).

*Management organises work as it wishes:* :we use responses to the question
"*In practice, is management here able to organise work as it wishes...or are their limits to the way it can organise work?*"
and define the variable to be 1 if the response indicates managers are able to organise work as it wishes, and equal to 0 otherwise
source: question N19 of the Managers Questionnaire of WIRS (mean=0.625, standard deviation=0.485).

*training*: a dummy variable indicating newly hired workers who have done similar work before are offered training
source: question D4 of EMSPS (mean=0.839, standard deviation=0.368).

*Local unemployment rate*: the unemployment rate in the travel-to-work area in 1990
source: 1990 WIRS, extra information (mean=0.6.855, standard deviation=0.3.379).

*% unionised*: the % of the workforce in unions
source: question C1 of the Managers Questionnaire of WIRS (mean=0.492, standard deviation=0.375).

*% skilled*: the % of employees who are skilled.

source: question 3 of the Basic Workforce Data Sheet of WIRS (mean=0.114, standard deviation=0.174).

*% manuals*: the % of employees who are manual.
source: question 1 of the Basic Workforce Data Sheet of WIRS (mean=0.404, standard deviation=0.314).

*% female*: the % of employees who are female.
source: question 1 of the Basic Workforce Data Sheet of WIRS (mean=0.288, standard deviation=0.192).

*employment*: the log of the number of full-time employees reported in WIRS
source: question 1 of the Basic Workforce Data Sheet of WIRS (mean=5.633, standard deviation=1.311).

# Table 1

## Skill shortages, hard-to-fill vacancies and recruitment difficulty by broad occupational group

| | | | manufacturing | | | | services | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **All** | **Energy/water** | **metals, minerals chemicals** | **metal goods, engineering, vehicles** | **other manufacturing** | **construction** | **distribution, hotels, catering** | **transport and communication** | **banking and finance** | **public admin, med personal and dom services** |
| **Skill Shortage** | 35.2 | 45.6 | 38.0 | 45.4 | 41.6 | 43.8 | 30.4 | 7.2 | 31.2 | 38.8 |
| **Hiring Difficulty** | 57.4 | 62.5 | 74.7 | 70.5 | 57.4 | 64.6 | 62.3 | 26.4 | 54.7 | 55.3 |
| **Hard-to-fill vacancy** | 18.2 | 14.9 | 20.2 | 28.4 | 14.0 | 28.2 | 11.6 | 6.2 | 18.3 | 21.7 |

notes:

1) row 1 presents responses to the question "*would you say that this establishment has experienced a 'skill shortage' in the last 12 months?*"; row 2 presents responses to the question "*do you currently have vacancies which are proving hard to fill?*"; row 3 presents responses derived from the question "*how easily have you been able to fill vacancies... in the last 12 months?*"

2) responses are weighted to correct for the deliberate over-sampling of large establishments (see Millward et al, 1992).

**Table 2**
**The relationship between skill shortages, hard-to-fill vacancies and recruitment difficulties**

## a) Correlation Matrix

| | 1) | 2) | 3) |
|---|---|---|---|
| 1) skill shortages | 1 | | |
| 2) hard-to-fill vacancies | 0.34* | 1 | |
| 3) hiring difficulties | 0.39* | 0.31* | 1 |

notes:
1) responses are weighted to correct for the deliberate over-sampling of large establishments
2) * denotes correlation signficant at 5% level.

## b) Means of hard-to-fill vacancies and hiring difficulties by incidence of skill shortages

| | *Skill shortages?* | | |
|---|---|---|---|
| *mean of* | *Yes* | *no* | *$H_0$: means equal* |
| hard-to-fill vacancies | 0.46 | 0.15 | -14.49* |
| hiring difficulties | 0.90 | 0.52 | -16.98* |

notes:
1) table presents means of skill shortage measure according to whether there are hard-to-fill vacancies or not, similarly for hiring difficulties
2) the final column presents a test of the hypothesis that the means in each row are the same.
3) * denotes a test statistic significant at the 5% level.
4) means are weighted to correct for the deliberate over-sampling of large establishments

# Table 3

## Skill shortages, hard-to-fill vacancies and recruitment difficulties by establishment characteristics

| | | *technology* | | | | | |
|---|---|---|---|---|---|---|---|
| | All | high-tech | computer-aided design | word processing | computer testing/ quality control | automated storage | computer control of production |
| Skill Shortage | 35.2 | 54.9 (*) | 47.5 (*) | 35.9 | 36.1 | 40.3 (*) | 36.6 |
| Hard-to-fill vacancy | 18.2 | 35.4 (*) | 30.6 (*) | 22.6 (*) | 22.2 (*) | 22.0 (*) | 19.0 |
| Hiring difficulty | 57.4 | 64.9 (*) | 65.9 (*) | 59.2 | 64.8 (*) | 44.7 (*) | 57.0 |

| | wages | | flexibility | | Training |
|---|---|---|---|---|---|
| | wages: lower quartile | wages: upper quartile | ≥ 50% part-time | Management organises work without opposition | Training? |
| Skill Shortage | 36.6 | 34.8 | 35.7 | 34.2 | 37.6 |
| Hard-to-fill vacancy | 25.0 (*) | 15.4 | 14.6 (*) | 17.1 | 19.4 |
| Hiring difficulty | 62.4 (*) | 55.6 | 49.8 (*) | 59.6 | 56.6 |

notes:
1) means are weighted to correct for the deliberate over-sampling of large establishments.
2) see the data appendix for full definitions and sources of variables used.
3) (*) indicates a mean that is significantly different from the national average at the 5% level.

## Table 4
## Econometric estimates

| | *dependent variable* | | | | | |
|---|---|---|---|---|---|---|
| | (1) skill shortages | (2) skill shortages | (3) hard-to-fill vacancies | (4) hard-to-fill vacancies | (5) hiring difficulty | (6) hiring difficulty |
| log relative regional wage | -0.26 (0.16) | -0.27 (0.16) | -0.24 (0.18) | -0.32 (0.17) | -0.38 (0.18) (*) | -0.36 (0.18) (*) |
| High-tech | 0.56 (0.18) (*) | 0.56 (0.18) (*) | 0.07 (0.20) | | 0.15 (0.21) | |
| CAD | 0.03 (0.13) | | 0.03 (0.14) | | -0.13 (0.14) | |
| word processing | 0.04 (0.17) | | 0.59 (0.22) (*) | 0.51 (0.21) (*) | 0.29 (0.18) | 0.26 (0.17) |
| Computer testing or quality control | 0.09 (0.13) | | 0.03 (0.14) | | -0.13 (0.14) | |
| automated storage | -0.05 (0.23) | | 0.46 (0.24) | | 0.03 (0.26) | |
| computerised control of production | 0.06 (0.13) | | -0.12 (0.14) | | 0.02 (0.14) | |
| % part-time | -0.01 (0.32) | | 0.55 (0.35) | | -0.61 (0.34) | -0.59 (0.33) |
| managerial freeedom | -0.07 (0.11) | | 0.09 (0.12) | | 0.10 (0.12) | |
| training | -0.22 (0.14) | -0.22 (0.14) | 0.18 (0.16) | | -0.05 (0.15) | |
| log local unemployment rate | 0.01 (0.02) | -0.01 (0.02) | 0.00 (0.02) | 0.01 (0.02) | -0.02 (0.02) | -0.02 (0.02) |
| % unionised | -0.17 (0.17) | -0.35 (0.19) | -0.15 (0.17) | -0.42 (0.19) (*) | -0.49 (0.19) (*) | -0.51 (0.18) (*) |
| % skilled | 0.59 (0.37) | 0.59 (0.36) | 1.49 (0.41) (*) | 1.34 (0.39) (*) | 0.39 (0.41) | 0.35 (0.41) |
| % manual | 0.06 (0.24) | 0.05 (0.23) | -0.67 (0.27) (*) | -0.59 (0.26) (*) | -0.19 (0.25) | -0.15 (0.25) |
| % female | 0.08 (0.29) | 0.08 (0.29) | 0.48 (0.32) | 0.47 (0.31) | 0.01 (0.31) | 0.01 (0.31) |
| log employment | 0.09 (0.05) | 0.10 (0.04) (*) | 0.18 (0.05) (*) | 0.20 (0.05) (*) | 0.31 (0.05) (*) | 0.29 (0.05) (*) |
| industry dummies | Yes | Yes | yes | yes | yes | Yes |
| Regional dummies | yes | Yes | yes | yes | yes | Yes |
| Sample | 677 | 677 | 656 | 656 | 653 | 653 |
| log L | -426.58 | -427.30 | -349.48 | -352.89 | -364.11 | -365.52 |
| $R^2$ | 0.06 | 0.07 | 0.12 | 0.12 | 0.09 | 0.09 |

notes:
1) estimates obtained by Probit estimation using Stata 5.0; standard errors are in parentheses.
2) see the data appendix for full definitions and sources of variables used.
3) High-tech denotes establishments that use "microprocessors or other microelectronic components" or "new materials such as advanced alloys or engineering plastics" in the production process.
4) a * indicate an estimate significantly different from zero at the 95% level.

## Table 5
## Marginal Effects for Selected Variables

| | (1) | (2) | (3) |
|---|---|---|---|
| | skill shortages | Hard-to-fill vacancies | hiring difficulty |
| log relative regional wage | -0.096 (0.012) | -0.095 (0.003) | -0.102 (0.023) |
| high tech (d) | 0.221 (0.070) | | |
| word processing (d) | | 0.147 (0.049) | 0.094 (0.065) |
| % part-time | | | -0.190 (0.043) |
| Training (d) | -0.084 (0.017) | | |

notes:
1) estimates obtained by Probit estimation using Stata 5.0
2) see the data appendix for full definitions and sources of variables used.
3) a "d" in parentheses indicates the variable is a dummy
4) row 1 of the table shows the change in the probability of observing a positive value of the dependent variable induced by a 1% increase in the relative wage; row 4 shows the effects in terms of percentage points of a 1% increase in the proportion of workers who are part-time (source authors calculations using Stata5.0). Standard deviations are in parentheses. For rows 2,3 and 5, where we have dummy explanatory variables, the table shows the change in terms of percentage points the probability of observing a shortage induced by a change in the explanatory variable from zero to unity (source: Stata 5.0). Standard errors are in parentheses.

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