No innovation without representation?

An analysis of participation, representation, R&D and innovation

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1. Introduction¹

Does it pay for firms to involve their workforce, or is such participation an expensive luxury? For those who would like to see increased employee participation and representation, this is a key issue. What, though, would be the mechanisms through which such practices would pay? One possibility lies in the relationship between participation and representation on the one hand, and labour 'flexibility' on the other. It has become fashionable to argue that to achieve economic success, whether at the corporate or national level, flexibility is of key importance. While this term 'flexibility' is often used, it is rarely defined. In related work (Michie and Sheehan, 1999) we have made a distinction between the positive and negative types of policies and practices that are encompassed within the overall term 'flexibility'. In this paper we look specifically at the role of worker participation and representation in the workplace. To do so we use the UK's 1990 Workplace and Industrial Relations Survey (WIRS3). We investigate the relationship between firms' human resource management practices - with a particular focus on employee participation and representation mechanisms - on the one hand and the firms' levels of research and development (R&D) expenditure and the probability of their introducing innovative investment on the other.

Section 2 below sets our work within the context of the existing literature linking human resource management and work practices, including employee participation and representation schemes, on the one hand, to firm performance - and in particular, to firms' innovative activities - on the other. Section 3 describes the data and explains our estimation procedures. Section 4 presents our empirical results, testing whether there is indeed a correlation between participation and representation on the one hand, and firms' innovative activities on the other. Section 5 concludes, arguing that while cost cutting strategies and work intensification can bolster profitability in the short term, in the longer term developing participatory and representative mechanisms will prove increasingly important to those firms that wish to compete using new products and processes.

2. Participation, Representation, and Corporate Behaviour

The effect that employee participation and representation has on economic performance – at the level of the firm, and nationally – has of course been the subject of economic analysis for some time, having spawned a large number of related literatures.² For a discussion of the potential benefits of participation at work as far as corporate performance goes, see for example Kandel and Lazear (1992), Katz, Kochan and Weber (1985), and Robinson (1998). Huselid (1995) finds systems of High Performance Work Practices to have an economically and statistically significant impact on both intermediate employee outcomes (turnover and productivity) and short- and long-term measures of corporate financial performance.

On participation, contingent pay and performance, see Fernie and Metcalf (1995) and Pendleton (1997). Both these latter papers use WIRS3 to examine the effects of such work practices on corporate 'performance', where this latter is estimated by variables such as the change in labour productivity, relative labour productivity, and relative financial performance. Patterson et al (1997) find that whether performance is

measured in terms of productivity or profitability, people management practices have a powerful impact on corporate performance.

On the adoption of 'high performance' or 'high involvement' work systems, see for example Pil and MacDuffie (1996) and the various papers authored and co-authored by Ichniowski, referred to below. Black and Lynch (1997) find that 'simply introducing high performance workplace practices is not enough to increase establishment productivity'; in line with out findings below, they find that increased employee voice is a necessary condition to making such practices actually effective. In their study almost three-quarters of all establishments had some form of Total Quality Management (TQM) system, but by itself these were not associated with higher productivity. The percentage of workers involved in regular decision making meeting was, though, positively associated to labour productivity.

On the importance of work organisation in particular, see Lam (1996), Milgrom and Roberts (1990, 1995) and Steedman and Wagner (1989). And on the specific link with innovation and R&D, see Kleinknecht (1998), Machin and Wadhwani (1991), Michie and Prendergast (1998), Nickell and Nicolitsas (1997), Redding (1996) and Roper *et al.* (1996).³

The present paper aims to contribute to this literature – or rather, these literatures by testing empirically some additional hypotheses. To do so, we bundle various types of participatory and representative practices, along with other human resource management techniques,⁴ along the lines described in the various papers authored and co-authored by Ichniowski.⁵ It is this sort of bundling approach that we use in our estimations described and discussed below (in Sections 3 and 4 respectively).

One way that the current paper contributes to the existing literature is as follow. We examine not only employee participation and representation mechanisms, including contingent pay schemes, but we also include an analysis of the relation between these practices on the one hand and on the other, firstly, flexible job assignment and secondly, the relation of all this to the firm's innovative activity. The paper also examines the relation between clusters or systems of such 'complementary' participatory practices and innovation.

While it is widely recognised that 'flexible' employees are important for firms' competitiveness, such practices, if not complemented with adequate reward systems⁶ and increased training,⁷ can result simply in an increased intensification of work. In order to test for the effect of such flexibility when it is properly combined with other 'high road' practices, we include 'flexible job assignment' (no 4 in Table 1) as part of a bundle of employee participation practices.

3. The Data and Estimation Procedures

3.1 The Data

The data used in the analysis are derived from the third (1990) UK Workplace Industrial Relations Survey (hereafter WIRS3).³ This is the largest interview-based

³ The data from the fourth (1998) survey – the renamed Workplace Employee Relations Survey (WERS) - is only now (April 1999) being released, and we will be using this new dataset in the Leverhulme Trust and ESRC funded projects referred to above, which run to 2001. Further details are

survey of industrial relations practices in the world.⁸ The survey was sponsored by the UK Government's Employment Department, the Economic and Social Research Council, the Policy Studies Institute (with funds form the Leverhulme Trust) and the Advisory, Conciliation and Arbitration Service. The WIRS3 database contains information on 2061 establishments with 25 or more employees in the manufacturing and service industries and the public and private sectors:⁹

...the surveys cover around 70 per cent of employees in Great Britain. The surveys consist of large, nationally representative samples of workplaces. The design incorporates rigorous statistical sampling and there is no clustering in the sample selection, since this might lead to under-representation of particular types of workplace... (Millward, 1994, p. 5)

Fernie and Metcalf state that 'There is unanimity among industrial relations specialists that WIRS provides the most authoritative picture of employee-management relations available' (Fernie and Metcalf, 1995, p. 391).

The analysis in this paper is limited to establishments in the 'trading sector' (establishments in central and local governments, the national health service, local enterprise agencies, quangos and non-trading public corporations are excluded from the analysis), which account for 73 per cent of the total sample. Amongst the establishments in the trading sector the survey design required that specialist financial and product market information be obtained. At establishments where the main

available from <u>http://www.bbk.ac.uk/Departments/Management</u> where subsequent papers using these new data will be posted. Some initial results are reported in Guest, Michie and Sheehan (1999).

manager identified him/herself as a specialist in either personnel or 'human or manpower resources' or 'industrial, employee or staff relations' - i.e., a personnel specialist - separate questionnaires were administered to the 'personnel specialist' and to the 'financial manager'. Airey *et al.* describe the rationale for the two questionnaires:

It was thought probable that when such a personnel specialist was present there would be a different manager at the establishment best placed to answer financial and product market questions (Airey *et al.*, 1992, p. 38).

The total number of completed financial manager questionnaires in the dataset is 489. The R&D question, used in our estimations (described in detail below), was asked only to the financial manager. It was not asked in the personnel specialist/main management questionnaire. The analysis of R&D expenditure is therefore restricted to the subset of establishments (489) where the financial manager was interviewed.¹⁰ The main difference between these firms compared to all firms in the traded sector was in relation to establishment size. Not surprisingly, average employment was larger in firms where a financial manager was present. In addition, only 274 companies answered both the questions on the introduction of advanced technological change (AC) and R&D expenditure. The lower response reflects, in part, the fact that only companies which had been operating for more than three years were eligible to answer the question on AC. With the exception of age and size no other bias is present in the sub-set of firms used in the analysis. Approximately 45 per cent of these establishments carried out R&D activities; 38.6 per cent had introduced AC in the past three years but had no R&D expenditure; 8.2 per cent of firms had R&D expenditure but did not introduce any

AC; and 16.4 per cent of companies had neither carried out R&D expenditure nor introduced AC.

While the WIRS3 survey is comprehensive in terms of its coverage of British workplaces and the database contains literally hundreds of variables about each workplace, the data are limited in terms of both HRM and innovation information. In the case of the latter, there are no direct questions asked on whether the company introduced either a product or process innovation or had obtained a patent licence. As discussed earlier, questions are asked to financial managers about the firms' R&D activities. Whilst caution must be placed on assuming that firms that engage in R&D will necessarily innovate (see for example, Freeman, 1994 and Winter, 1987 for further discussion), there does appear to be a significant and positive correlation between the two activities. WIRS3 also asks whether the firm had 'introduced new plant, machinery or equipment, that includes the use of new micro-electronics technology'. In their investigation into the effects of unions on investment and innovation, Machin and Wadhwani (1991) classify this as 'advanced technical change' (AC) and note that, 'It is likely that much of AC is also innovation, although, undoubtedly, some is not' (Machin and Wadhwani, 1991, p. 31).

Thus, while neither R&D expenditure nor AC are exact measures of innovation, it is reasonable to assume that they can serve as proxies for the likelihood of a firm introducing an innovation, especially when analysed together.

Investigating HRM from the WIRS3 data is also problematic. Sisson (1993) examines in detail the types of HRM practices asked in the WIRS3 and notes that:

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...it is extremely surprising to find how little the WIRS studies have to say on the matter... The cynic would say that this is not surprising. WIRS inherited the Donovan equation of industrial relations with management-trade union relations; the individual aspects of the employment relationship, as McCarthy (1992) has recently pointed out were not to be deemed what industrial relations was about and were to be left to those interested in personnel management (Sisson, 1993, p. 202).

While there are surprising gaps in WIRS3 about training and recruitment practices, the survey's lack of HRM questions is perhaps less of a problem than suggested by Sisson. Indeed, as illustrated below, WIRS3 does provide a sufficient number of variables to enable participatory practices and employee representation variables to be grouped into three 'systems'. Moreover, WIRS3 provides enough information to create the variable 'flexibility' - which examines the relation between firms' use of greater employee flexibility and decreased job demarcation, on the one hand and 'innovation' activities on the other.

In relation to more interpretative work practice questions, both the management and the employee representative were asked, for example, about the influence of the Joint Consultative Committee (JCC) on management's decisions. In order to include responses from employees at the various establishments, the response of the employee representative is used in the derivation of the employee involvement variables.

Much quantitative work which utilises cross-section data is bedevilled by problems concerning the direction of causation (see Fernie and Metcalf, 1995 for a detailed discussion on the problem of causation in WIRS3; also Pendleton, 1997). Firstly, there may be reverse causation whereby it is not because a firm has a high percentage of workers on short-term contracts that there is little innovative activity but rather that firms which are not innovating may have a high percentage of employees on short-term contracts simply because managers fear that in the future they would have to reduce their workforce as the firm is getting less and less competitive. Secondly, there may be simultaneous causation with firms introducing advanced technological machinery at the same time that they introduce new work practices.

Since the data are cross-sectional, lagged values of explanatory variables cannot be used as instrumental variables. We therefore attempted to find instruments which, for example, affected the use of flexible labour or profit sharing but did not affect expenditure on R&D or the introduction of technological change. For the majority of the explanatory variables there were no appropriate instruments. It is important to stress therefore that what we are investigating here is the possible correlation between the use of flexible work practices on the one hand, and the firms' innovativeness on the other. We are not arguing that there is a simple, one-way causation. Indeed, we would expect any correlation we found to be the result of two-way causal relationship between symbiotic practices.

The variables used in the estimations are described in Table 1.

[Table 1 here]

'Ichniowski *et al.* (1997) group the individual practices into four 'HRM systems' which map out a hierarchy from 'traditional' to 'most innovative'. Since the primary

objective of our analysis is to examine the relation between employee participation and representation and flexible job assignment on the one hand and innovation on the other, we group individual participation practices into three 'Systems of Participation', ranging from 'no employee participation schemes' to 'highly participatory'. Our groupings are as follows:

- 'Participation System 3' contains no participatory practices. This system is characterised by non-performance related pay, no profit sharing, no formal job appraisals; no efforts to increase employee involvement over the past three years and limited consultation with employees; no employee representation either through trade union or JCC recognition; and no increased flexibility in employees' job assignments. 12.5% of firms were in this category.
- 'Participation System 2' uses participatory practices in at least two areas: innovative pay schemes; employee involvement or consultation schemes; employee representation; and/or has increased job assignment flexibility. 72.5% of establishments were in this category.
- 'Participation System 1' incorporates at least one component from each of the participation schemes listed above. Such systems have innovative incentive pay plans; employee involvement and consultation schemes; employee representation; and has increased job assignment flexibility. Such firms could be categorised as using 'highly participatory' work practices. Approximately 15% of establishments were in this category.

3.2 The Econometric Model

We first test for any correlation between, on the one hand individual participatory practices, with on the other hand the probability of innovating. The following generalised reduced form equation is estimated:

(1)
$$Y_i^* = B'X_i + \Psi'dPay_i + \Omega'dEI_i + \rho'dRep_i + \phi dFlex_i + \varepsilon_i$$

where:

- Y_i denotes the probability of 'innovating' using combinations of the innovation proxy variables described above (with Y_i^{*} = 1 if Y_i^{*} > 0, and = 0 otherwise);
- X_i, is a vector of firm characteristics that are likely to influence R&D expenditure and the introduction of AC. These include: the number of employees in the establishment (SIZE); whether the firm is foreign owned (dFOREIGN); and industry dummies. Given the debate over whether innovative activities are 'demand pull' or 'technology push' (see Freeman, 1994 for a discussion), the variable dRISE was included which measures perceptions about product demand (= 1 if the demand for an establishment's product had been rising in the preceding 12 months; dFALL is defined symmetrically). Financial performance is also likely to influence innovative activities. The manager's perception of the establishment's financial performance dABOVE is included (dABOVE = 1 if the manager regards financial performance to be above average - dBELOW is defined in a symmetric fashion).

The other explanatory variables are derived from Table 1:

- dPay_i contains a vector of dummy variables on contingent pay;
- dEI_i contains a vector of dummy variables on employee involvement schemes including efforts by management to increase employee involvement, information sharing and consultation;
- dRep_i indicates whether employees are represented by either a trade union or a JCC; and
- dFlex_i indicates whether there has been an increase in the flexibility of job assignments either through reduced job demarcation and/or a redistribution of tasks amongst manual employees; and
- ϵ_i is a normally distributed error term.

We also test for any correlation between, on the one hand systems of participatory practices (as outlined above), with on the other hand the probability of innovating, the following generalised reduced form equation is estimated:

(la)
$$Y_i = B'X_i + \Phi'PartSys_i + \varepsilon_i$$

where:

- X_i, is the same vector of firm characteristics as used in equation (1);
- PartSys_i includes dummy variables for the systems of participation (PartSys 1-3; see above for details); and
- ε_i is a normally distributed error term.

4. Results

Our results are reported in Tables 2 and 3. All estimates were done in Limdep 6.0. We report only the marginal effects which were calculated as the derivative of the conditional expectation of the observed dependent variable and evaluated at the sample means, following the procedure in Limdep (Greene, 1995).

[Table 2 here]

The results for the determinants of R&D expenditure and the introduction of AC, reported in Table 2, indicate that the standard explanatory variables contained in the X_i vector have the expected signs. Foreign ownership and good financial performance are positively correlated with the probability of 'innovating'. Producing in the service sector is negatively correlated with the probability of 'innovating'. While the dummy variables for a 'rise' and a 'fall' in product demand have the expected signs, neither is significant. The effect of establishment size monotonically increases in relation to R&D but is non-monotonic when both variables are estimated together. Machin and Wadwhani (1991) find a similar pattern in relation to establishment size and investment. All of the variables in the X_i vector follow the same patterns as described here in Table 3.

The results reported in Tables 2 and 3 show the following:

• Contingent pay variables were not significant.

- With increased Employee Involvement over the previous 3 years, the sharing of information and consultation with employees about change proved significant.
- While JCC representation was not itself significant, TU recognition was significant.
- dFlex_i whether there has been an increase in the flexibility of job assignments either through reduced job demarcation and/or a redistribution of tasks amongst manual employees - is also significant.

While it is difficult to measure goodness of fit in such qualitative response models, the adjusted R-squared results range between 0.216 (Table 2) to 0.250 (Table 3) and the null hypothesis that the slopes of the explanatory variables are zero is strongly rejected by the likelihood ratio tests. This is also the case for the estimations reported in Table 3.

[Table 3 here]

Table 3 reports on the correlation between systems of participatory practices and 'innovation'. The results indicate that the use of participatory practices are positively correlated with the probability of 'innovating'. For example, firms that meet the criteria of Participation System 1 - which means that they incorporate at least one component of *each* of the participation, representation and flexibility policy areas identified in Table 1 - are more likely to 'innovate' than are firms that have no participatory practices. Ichniowski *et al.* (1997) report similar results regarding the effect of HRM systems on firm productivity, and Michie and Sheehan (1998) report similar results regarding the effect of 'progressive' HRM systems on innovation.¹¹

5. Conclusions

The literature referred to in Section 2 above has generally recognised that the way people are treated at work will have effects on factors such as productivity and profitability. This paper has attempted to contribute to this literature by analysing how these effects actually work through, both by looking at specific firm behaviour such as investment in R&D and new technology, and also by analysing firms' human resource management practices in 'bundles' of such practices. We have focussed in this paper particularly on issues of participation and representation.

It is widely argued that in the economy of the future, continual innovation will be key to building and maintaining competitive advantage. We find that the likelihood of firms innovating is positively correlated with employee representation at work. It is true of course that firms can profit in the short term from cost cutting strategies and work intensification. But over the longer term it appears likely that developing such participatory and representative mechanisms will prove increasingly important to those firms that wish to compete on the high road of innovation.

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| Variable name | Dummy Variable description |
|--|---|
| Contingent Pay Workplace/company profit sharing or ESOS (58.2) Individual Merit Pay (34.1) | Whether manual and non-manual employees are eligible to participate in share ownership/profit-sharing/value added schemes? Pay by result (PBR)? Merit pay or pay related |
| | to individual performance? |
| 2. Employee Involvement (EI) | |
| (Response of Employee Representative) | |
| a. Efforts to increase EI (45.2) | Has management attempted to increase employee involvement in last 3 years? |
| b. Communication Methods (91.1) | |
| i. Information sharingii. Meet Union (where present) | Regular meetings (at least once a month) among work-groups or teams to discuss aspects of performance, such as 'quality circles' and other problem solving groups? Regular meetings between junior managers/supervisors and all the workers for whom they are responsible - known also as 'briefing groups' or 'team briefings'? Regular meetings between senior managers and all sections of the work-force? Suggestion Schemes? Do union representatives and managers meet |
| in most offish (where present) | often to discuss concerns and co-operate in finding solutions to issues? |
| iii. Consultation about Change | Whether employee representatives were consulted about introduction of new plant/equipment or changes to work organisation? |
| 3. Representation: a. | Trade union recognition? (42.4) |
| b. | Whether any Joint Consultative Committees (JCCs)? (23.6). |
| 4. Flexible job assignment: | |
| a. | Whether management has promoted greater flexibility of working or reduced job demarcation? (24.4) Redistribution of tasks amongst manual |
| 0. | employees |

 Table 1. Descriptions of Variables and their Sample Means (%)

| Dependent Variable | R&D | Both R&D and AC | |
|---|--|---|--|
| | (1) | (2) | |
| Constant Log(SIZE) log(SIZE) ² dFOREIGN dRISE | -0.652 (3.117)*** ¹ 0.351 (2.965)*** ² 0.091 (1.823) * ³ 0.225 (2.178)* 0.150 (1.366) | -0.723 (3.867)*** 0.384 (3.227)*** ² -0.106 (1.930) * ³ 0.281 (2.422)** 0.193 (1.601) | |
| dFALL dABOVE dBELOW | -0.116 (1.234) 0.264 (2.794)** -0.072 (1.319) | -0.125 (1.316) 0.271 (2.911)*** -0.095 (1.769) | |
| Industry Dummies: dMecheng dEleceng dOtrmanuf dServ | 0.063 (1.085) 0.045 (1.128) 0.114 (1.365) -0.141 (1.993)* | 0.070 (1.102) 0.037 (1.204) -0.119 (1.428) -0.160 (2.017)* | |
| <u>DPay (Contingent Pay):</u> dProfit dMerit | 0.161 (1.652) -0.044 (1.200) | 0.172 (1.720) 0.169 (1.625) | |
| <u>dEI (Employee Involvement):</u> dIncreased EI dInforShare dMeetUnion dConsult | 0.206 (1.987)* 0.324 (2.523)** 0.172 (1.705) 0.287 (2.127)* | 0.219 (2.027)* 0.341 (2.772)** 0.189 (1.629) 0.300 (2.365)** | |
| dRep (Representation) dTU recognition dJCCs | 0.190 (1.912)* 0.165 (1.654) | 0.209 (2.116)* 0.172 (1.726) | |
| dFlex (Flexibility): | 0.223 (2.185)* | 0.259 (2.561)* | |
| Log-likelihood (Log L) Restricted LogL ⁴ Likelihood ratio test ⁵ Adjusted R ² N ⁶ | -236.0 -321.7 171.4 0.239 441 ⁶ | -310.6 -415.9 210.6 0.216 258 ⁷ | |

 Table 2. Marginal Effect Estimates of Participation and 'Innovation'

Note 1: t-statistics are in parentheses and ***, ** and * denote significance at the 1-percent, 5-percent, and 10-percent level, respectively.

Note 2: denotes a coefficient and its standard error have been scaled up by 10^3 .

Note 3: denotes a coefficient and its standard error have been scaled up by 10^7 .

Note 4: The coefficients are restricted to slopes equal to zero.

Note 5: The likelihood ratio test has 20 degrees of freedom.

- *Note 6:* As described in Section 3, 489 financial managers were interviewed, or which 487 answered the question on R&D. Due to missing values in various companies for some of the explanatory variables, an additional 46 establishments are excluded from the estimations. The final number of establishments used in the estimations of R&D expenditure is 441.
- *Note 7:* As described in Section 3, 274 establishments answered both the question on R&D expenditure and AC. Due to missing values in relation to various explanatory values, the final number of establishments used in the estimations is 258.

| Table 3. | . Partici | patory | Systems | and | 'Innovation' |
|----------|-----------|--------|---------|-----|--------------|
|----------|-----------|--------|---------|-----|--------------|

| Dependent Variable | R&D | Both R&D and AC |
|------------------------------------|------------------------|-------------------------------|
| | (1) | (2) |
| | | |
| Constant | -0.592 (3.103)***1 | -0.619 (3.715)*** |
| log(SIZE) | $0.339(2.882)^{***^2}$ | $0.361 (3.007)^{***^2}$ |
| $\log(SIZE)^2$ | $0.101(1.856)^{*3}$ | -0.112 (1.934) * ³ |
| dFOREIGN | 0.221 (2.175)* | 0.284 (2.420)** |
| dRISE | 0.151 (1.368) | 0.194 (1.602) |
| dFALL | -0.120 (1.240) | -0.129 (1.328) |
| dABOVE | 0.261 (2.791)** | 0.276 (2.929)*** |
| dBELOW | -0.080 (1.322) | -0.098 (1.761) |
| | | |
| Industry Dummies: | | |
| dMecheng | 0.060 (1.077) | 0.071 (1.105) |
| dEleceng | 0.047 (1.131) | 0.036 (1.202) |
| dOtrmanuf | 0.115 (1.364) | -0.117 (1.429) |
| dServ | -0.149 (2.016)* | -0.175 (2.178)* |
| | | |
| Participation Systems | | |
| PartSys1 | 0.326 (2.815)* | 0.367 (2.987)*** |
| PartSys2 | 0.192 (2.113) | 0.201 (2.221)** |
| | | |
| Log-likelihood (Log L) | -249.9 | -346.5 |
| Restricted LogL ⁴ | -350.4 | -448.2 |
| Likelihood ratio test ⁵ | 201.0 | 203.4 |
| Adjusted R ² | 0.250 | 0.241 |
| N^6 | 436 | 251 |
| | | |

Notes 1,2,3,4: See Table 2

Note 5: The likelihood ratio test has 13 degrees of freedom.

Note 6: Due to missing values for some of the explanatory variables when creating the 'PartSys' variables, the final number of establishments used in the estimations is 436 and 251 respectively.

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² See for example the brief overview by Bartlett et al (1998). See also Huselid (1995), McCarthy (1992), Millward, Stevens, Smart and Hawes (1992), Millward (1994), Pagano and Rowthorn (1996), and Winter (1987).

³ On the related issue of technology adoption, see Stoneman and Kwon (1994, 1996).

⁴ For a discussion of which, see Sisson (1993), Storey (ed.)(1995), Torrington and Hall (1987) and Tyson and Fell (1986).

⁵ See for example Ichniowski (1990) and Ichniowski et al. (1996, 1997).

⁶ On which, see Michie and Wilkinson (1995).

⁷ On which, see Keep and Mayhew (1996), Lam and Marsden (1992), and Lynch and Black (1997).

⁸ See Milward *et al.* (1992) for full details of the third survey and information on the previous WIRS conducted in 1980 and 1984. See also the special issue of the *British Journal of Industrial Relation*, June 1993.

⁹ The sampling frame for WIRS3 was the Employment Department's 1987 Census of Employment (CoE). A 'census unit' is an establishment based measure of individual places of employment at a single address, covering all employees of the identified employer at that address. The CoE file contains data on just over 142,000 establishments and was broadly representative of the population of manufacturing and service sector, and public and private sector establishments in Britain in 1987. To ensure a high response rate to WIRS, larger establishments were deliberately over-sampled but it is a straightforward matter to make WIRS3 into a nationally representative sample of workplaces in Britain by using a set of weighting factors. Such weights were applied to the data used in our analysis.

¹⁰ Of the 489 financial managers interviewed, 487 answered the R&D question.

¹¹ Pfeffer (1998) also argues that the 'people practices' that distinguish successful organisations include job security, team working and systematic sharing of information.