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Teamwork, monitoring and absence

John S. Heywood[a,b,*], Uwe Jirjahn[c], Xiangdong Wei[d,b]

[a] Department of Economics, University of Wisconsin-Milwaukee, Milwaukee, WI 53201, USA
[b] Labor and Industrial Economics Group, Birmingham Business School, University of Birmingham, UK
[c] Department of Economics, Institute for Labor Economics, University of Hanover, Germany
[d] Department of Economics, Lingnan University, Hong Kong, China

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ABSTRACT

We present a model showing that firms with interdependent worker productivity (team production) have a higher cost of absence and as a consequence will spend additional resources on monitoring absence. As a result, firms with team production should have lower absence rates, all else equal. Using the Workplace Employment Relations Survey (UK), we are the first to estimate each of these related associations showing that absence has a greater cost in the face of team production, that firms with team production engage in greater monitoring and that firms with team production have reduced absence.

1. Introduction

The economic costs of absenteeism are enormous and while absenteeism has been of concern to economists, it has not generated the attention that such costs would dictate.[1] Economists most commonly view absence from work as a dimension of labor supply, yet if contractual hours are not defined by the employment relationship, the very concept of absenteeism would not exist. Thus, Brown and Sessions (1996, p. 38) call for an "explanation for the determination of hours constraints," suggesting that economists should place more emphasis on the role of labor demand in determining contractual hours and hence absence.

Several recent studies respond to this call by isolating the role of firm side variables in determining minimum contractual hours and their enforcement. Barmby (2002) and Barmby et al. (1994) show that the structure of the labor contract is critical in determining the daily cost of absence and thus its incidence. This follows earlier work in which Barmby et al. (1991) show that the structure of the sickness pay scheme influences absence, contending that managers structure such schemes based on the underlying cost of absence to the firm. Coles and Treble (1996) build on Weiss (1985) to argue that interdependent

* Corresponding author at: Department of Economics, University of Wisconsin-Milwaukee, P.O. Box 413, Milwaukee, WI 53201, USA. Tel.: +1 414 229 4310; fax: +1 414 229 5915.
E-mail address: heywood@uwm.edu (J.S. Heywood).

[1] Estimates for the United Kingdom in 1980s put the figure at 6 billion pounds a year (Brown and Sessions, 1996), in the United States a figure of 24 billion dollars a year has been offered (Dunn and Youngblood, 1986), and more recent figures from Germany put the figure at 62 billion DM or nearly 2 percent of German GDP (IWD, 1997).

production (teamwork) is critical in determining this underlying cost to the firm, while Coles et al. (2007) make a related point arguing that "just in time" inventory technology (a proxy for teamwork) increases the cost of absence and causes firms to invest more in reducing absence. Barmby and Stephan (2000) show that larger firms with teamwork can profitably conserve on buffer-stock workers, reduce monitoring of absence and thus allow absence rates to increase. Heywood and Jirjahn (2004) use German data to show that workplace teams, a proxy for teamwork, reduce the absence of blue-collar workers.[2]

The typical theoretical presentation in this literature relies on three relationships. First, workplaces characterized by teamwork have a higher cost of absence. Second, this higher cost leads to greater expenditures, usually on monitoring, by the firm to reduce absence. Third, the increased expenditures on monitoring reduce the rate of absence of firms with teamwork below that of firms without teamwork. Our theoretical motivation presents a representative model isolating each of these relationships. To date none of the studies on the subject have estimated all three of these relationships, leaving more open than necessary the possibility that the hypothesized relationship between teamwork and absence may flow from causation other than that typically claimed.

Using data from the 1998 Workplace Employment Relations Survey (WERS), we estimate the determinants of absence rates, confirming that a series of proxies for teamwork are associated with significantly reduced absence. This result persists even as many traditional results from the empirical absence literature are confirmed. Importantly, we move behind this relationship to show that absence rates have a larger cost in the presence of teamwork and that firm monitoring is greater in the presence of teamwork. While the finding of a relationship between teamwork and absence in the UK is important, these two additional and novel findings are critical for supporting the causation often outlined in the literature.

In what follows, Section 2 explains the connection between teamwork and absence. Section 3 describes our data and provides descriptive statistics. Section 4 presents the empirical estimations, and Section 5 concludes.

2. Teamwork and absence

Deardorff and Stafford (1976) consider technologies that require the simultaneous presence of an entire shift of workers, showing that the profitability of the firm depends on its ability to coordinate essentially identical hours for each worker. Duncan and Stafford (1980) pick up on this by contrasting two extremes. The first, illustrated with a typing pool, has no teamwork. The output lost by a single worker's absence is only his or her own increment, the typing of that worker. The second, illustrated with an assembly line, has complete teamwork as the finished product depends on each worker completing his or her step along the line. Here the output lost by a single worker's absence is, in the extreme, the entire output of the shift. Weiss argues more formally that low rates of absenteeism are highly valued when production involves teamwork. He imagines a critical number of workers necessary for production. Excess workers add nothing to output and if the number of workers present drops below the critical value, output drops to zero. Recent theory represents this extreme with the 'o-ring' production function (Kremer, 1993).

The empirical literature usually does not directly observe teamwork. Proxies for the threat of dismissal or the cost of job loss are typically used as independent variables thought to reduce absence.[3] While such variables may play a role, they are endogenous responses to the underlying extent of teamwork. Thus, in firms without teamwork the cost of absence is minimal and the need to threaten dismissal or pay efficiency wages is greatly reduced. When teamwork is extensive, the cost of absence is substantial and the firm increases the threat of dismissal, or pays higher wages, in an effort to reduce the probability of worker absence.

2.1. A theoretical illustration

While teamwork makes monitoring of individual effort on the job more difficult, it increases the importance of monitoring absence. Consider N identical workers maximizing expected utility by choosing an absence level, a. Each worker faces a probability $m \in (0, 1)$ of being monitored. A worker monitored and found with an unexcused absence is fired. Otherwise, an absent worker receives full sick pay. Each worker maximizes

$$[1 - a + a(1 - m)]U(W) + amU(R) - C(1 - a), \quad i = 1, \ldots, N \tag{1}$$

where U is the Von Neumann-Morgenstern utility function, W is the current wage and R is the best alternative ($W > R$). The cost of effort depends on a: $C(1 - a)$ with C' and $C'' > 0$, $C(0) = 0$, $C'(0) = 0$ and $C'(1) = \infty$. The resulting interior solution, $a^* \in (0, 1)$, equalizes the expected marginal benefits and costs: $m[U(W) - U(R)] = C'(1 - a^*)$. The worker's optimal absence level is an implicit function of monitoring intensity, $a^* = a(m)$. As monitoring intensity increases, workers reduce absence: $\partial a(m)/\partial m = -[U(W) - U(R)]/C''(1 - a(m)) < 0$.

[2] This progression of research emphasizes that underlying technology (the extent of teamwork) determines the expenditures that firms make on setting and enforcing absence policies. While having a different emphasis, it remains largely consistent with the earlier view that work group norms (reflecting, in part, HRM practices) determine absence (Drago and Wooden, 1992).

[3] See Brown and Sessions (1996) for a review of these studies.

The firm recognizes this and sets intensity to maximize profit. We first consider a firm with teamwork (T). To produce output Q, all N workers must be present. If fewer workers are present, output is zero.[4] Total revenue is $PQ\prod_{i=1}^{N} e_i + V$ where P is the product price, e_i is 1 if worker i is present and 0 if absent, and $V > 0$ is a revenue increment associated with the use of team production. The cost of monitoring a worker, $Z(m_i)$, satisfies $Z'(m_i) > 0$, $Z''(m_i) > 0$, $Z(0) = 0$, $Z'(0) = 0$ and $Z'(1) = \infty$, and total monitoring costs are $\sum_{i=1}^{N} Z(m_i)$. If workers' absence probabilities are identical and independent, the expected profit of a firm with teamwork is

$$\pi^{\mathrm{T}} = PQ\prod_{i=1}^{N}[1 - a_i(m_i)] - W\sum_{i=1}^{N}[1 - a(m_i)m_i] - \sum_{i=1}^{N} Z(m_i) + V = PQ[1 - a(m)]^N - WN[1 - a(m)m] - Z(m)N + V. \quad (2)$$

Imagine a very short run in which the firm can alter its monitoring intensity but not its number of employees. This yields a first order condition determining monitoring:

$$-PQ[1 - a(m^{\mathrm{T}})]^{N-1}\frac{\partial a(m^{\mathrm{T}})}{\partial m} + W\left[a(m^{\mathrm{T}}) + m^{\mathrm{T}}\frac{\partial a(m^{\mathrm{T}})}{\partial m}\right] = Z'(m^{\mathrm{T}}) \quad (3)$$

where m^{T} denotes the optimal monitoring level under teamwork. Now consider a firm without teamwork (NT) in which each worker's contribution to profit is independent of that of other workers: $(1/N)PQ\sum_{i=1}^{N} e_i$. If all workers are present, output remains Q. If fewer than N workers are present, output is merely reduced in proportion to those absent. The expected profit of the firm without teamwork is

$$\pi^{\mathrm{NT}} = \left(\frac{1}{N}\right)PQ\sum_{i=1}^{N}[1 - a_i(m_i)] - W\sum_{i=1}^{N}[1 - a(m_i)m_i] - \sum_{i=1}^{N} Z(m_i) = [1 - a(m)]PQ - WN[1 - a(m)m] - Z(m)N. \quad (4)$$

The first order condition determining monitoring is then

$$-\left(\frac{1}{N}\right)PQ\frac{\partial a(m^{\mathrm{NT}})}{\partial m} + W\left[a(m^{\mathrm{NT}}) + m^{\mathrm{NT}}\frac{\partial a(m^{\mathrm{NT}})}{\partial m}\right] = Z'(m^{\mathrm{NT}}) \quad (5)$$

where m^{NT} is the optimal monitoring level of a firm without teamwork. The fundamental result follows from (3) and (5) and can be evaluated by comparing the marginal gains of monitoring for a given monitoring level. If $N > 1$, the firm with teamwork has a higher marginal gain of monitoring than the firm without teamwork when $-PQ[1 - a(m)]^{N-1}(\partial a(m)/\partial m) > -(1/N)PQ(\partial a(m)/\partial m)$.[5] This implies that $m^{\mathrm{T}} > m^{\mathrm{NT}}$ and reflects that the firm with teamwork loses the entire output by a single worker's absence whereas the firm without teamwork loses only that worker's own increment. Since both types of firms have the same marginal cost of monitoring function, the higher marginal gain under teamwork implies that the profit maximizing level of monitoring is higher in the firm with teamwork. This fundamental result, together with worker behavior, implies that $a(m^{\mathrm{T}}) < a(m^{\mathrm{NT}})$.

In summary, our representative model highlights the three relationships we seek to test. The difference in the technology makes absence more costly in terms of lost revenue for the firm with teamwork. As a result, the firm with teamwork will monitor more than the firm without teamwork. As a consequence, absence will be lower for the firm with teamwork.

2.2. Teams and teamwork

Following Heywood and Jirjahn (2004), our empirical work uses teams and their characteristics as proxies for underlying team production. Management has increasingly viewed the organization of workers in teams as a tool to increase productivity (Spreitzer et al., 1999) yet it is apparent that teams succeed only in certain circumstances. In particular, there is a close, albeit imperfect, tie between teams and underlying team production. In equilibrium, the use of teams will reflect the underlying production technology that is largely given by the type of product and, to a lesser extent, by market strategy. Theoretical work illustrates the connection between teams and underlying technology with interdependent worker productivity. Teams facilitate communication and information sharing among team members. Aoki (1990) and Carter (1995) emphasize that this communication is much more important when there are gains associated with coordinating workers' actions and allocating their tasks. Such coordination and allocation is the essence of team production, suggesting that teams will be far more likely where worker productivity is interdependent.

This theoretical work is complemented by empirical evidence. If there is a tie between teams and team production, teams imply that the identification of workers' individual contributions to production is difficult (Alchian and Demsetz, 1972). Accordingly, teams should be associated with a reduced use of individual based incentives and an increased use of group based incentives. Heywood and Jirjahn (2002) demonstrate that teams are positively related to the presence of group

[4] Note there is no loss of generality when compared with a model in which $k < N$ workers are required to produce Q and any workers beyond k are redundant, adding nothing to output.

[5] This condition implies $(1 - a)^{N-1} > 1/N$ and hence $a < 1 - e^{[-\ln N/(N-1)]}$. In general, it holds for reasonable initial absence rates. For example, in a firm of 50 workers the condition holds for any absence rate below 7.7 percent.

payment schemes. Brown et al. (2007) use Australian data to demonstrate the link between indicators of team production and the use of teams. Clearly, this does not mean that interdependent worker productivity need be completely absent without teams. Rather it shows that interdependencies are likely to be far smaller in firms without teams.

Our theoretical analysis suggests that workplaces with teams, as a proxy for a greater degree of interdependent worker productivity, should report lower absence due to increased expenditures on monitoring. Despite our emphasis on teams as a reflection of underlying technology, some might argue that teams as a tool of human resource management might reduce absence independent of team production and increased monitoring expenditures. Teams increase the social interaction among workers, perhaps causing them to acquire sentiment for each other and giving rise to pro-social motivation, high effort and reduced absence (Akerlof, 1982). Moreover, workers might enjoy increased job satisfaction through the greater autonomy associated with teams, and this might also reduce absence.

However, research has not established these supposed direct influences of teams. While Kandel and Lazear (1992) argue that worker involvement through teams may generate mutual monitoring and increased peer pressure, Barron and Gjerde (1997) demonstrate the possibility that excessive peer pressure can harm both employees and the firm. Similarly, while Batt and Appelbaum (1995) find that the greater autonomy associated with teams increases job satisfaction, they show that the higher stress and work-load associated with teams lowers job satisfaction. Similarly, Bauer (2004) examines which elements of the high performance workplace actually increase job satisfaction. He finds that improved communication and job autonomy increase satisfaction, but that working in teams does not increase satisfaction. Indeed, Godard (2001) finds that the use of high performance work practices (including teams) is typically associated with reduced job satisfaction. Finally, Hamilton et al. (2003) show that high-productivity workers prefer to work in teams, but that low productivity workers prefer not to work in teams. Low-productivity workers may experience reduced utility from working in teams even as self-selection of higher productivity workers might contribute to some degree to the productivity (and perhaps the absence) effect of teams.

In summary, teams do not automatically increase firm performance or worker satisfaction. Instead, teams are likely to arise as a reflection of underlying teamwork, and firms must invest in measures that induce the optimal level of pro-social motivation, mutual monitoring and/or peer pressure. In a broad sense this investment can be seen as part of the resources spent on monitoring performance in general and absence in particular. Jones and Kato (2004) support this view, finding that the screening of team members by management rather than self-selection plays the crucial role in the performance effects of teams. To the extent that screening requires additional monitoring (in order to know which workers to select), these results boost our claim of a connection between teams and monitoring.

More generally, the use of teams as a proxy for team production will be implicitly tested not only by our examination of the association of teams with absence rates, but also by our examination of the prediction that absence is more costly in establishments using teams. Neither the job satisfaction hypothesis nor the peer pressure hypothesis yields the prediction that absence should be more costly for firms using teams.

Another notion from human resource management is that teams allow "cross-training" which reduces the cost of absence (Capelli and Rogovsky, 1994; Morita, 2005). A negative link between teams and absence is not at odds with this notion. Indeed, the very concept of cross-training recognizes that team production exists and that the absence of a particular worker reduces output of the entire team. It is this recognition that leads to training other workers to perform the tasks associated with the absent worker. Put somewhat differently, the need to cross-train arises only with team production, and it is unlikely that cross-training completely eliminates the increased cost of absence associated with team production.

Despite this line of argument, the study of complementary bundles of human resource management practices remains of central interest (Ichniowski et al., 1997; Kato and Morishima, 2002; Black and Lynch, 2004) and demands that our testing attempts to isolate the interaction between teams and cross-training, a potentially related part of a typical bundle. We will confirm that accounting for this does not eliminate the direct role of teams in reducing absence.

2.3. Additional determinants of absence

While focusing on the teams as a determinant of absence, we will control for a wide variety of other determinants. Variables for the work schedule are included in the estimates. As pointed out by Deardorff and Stafford, shift work is characterized by a synchronization of working hours for the workers of an entire shift. This synchronization is particularly important if production technology is characterized by interdependent worker productivity. Thus, shift work may be seen, in part, as an alternative indicator of teamwork (Marris, 1964, p. 8), yet the use of shifts may imply greater flexibility for employers in that workers from one shift may be able to fill in for absent workers from another shift or be asked to work a double shift. In this way, the use of shifts may indicate an employer with a lower cost of absence, all else equal. This might result in reduced monitoring and greater absence. Moreover, shifts are associated with less flexibility on the part of employees, and night shifts, in particular, often interfere with the biological and social rhythms of employees (Finn, 1981). Workers are, therefore, likely to take increased absence to avoid the physical and mental burden of shift work. In contrast, measures of working time flexibility for employees might be associated with reduced absence. If an employer has flexible starting or finishing times, the constraint of contractual attendance is less binding (Brown and Sessions, 1996). On the other hand, a firm that can easily provide flexibility to its workers may find absence less costly, and thus absence may actually be higher. Similarly, the option of part-time employment may reduce the mismatch between contractual and desired hours (Drago and Wooden, 1992). However, a high proportion of part-time workers may also provide enhanced flexibility for the firm in the event of absence that reduces the need to monitor absence and, hence, results in higher absence (Brown et al., 1999).

Several variables capture the structure of the workforce. Women are generally recognized as having greater absence rates (Leigh, 1983; Drago and Wooden, 1992; Bridges and Mumford, 2001), and we control for the share of women in the establishment. Disabled workers may also have a greater incidence of absence. Further, an indicator of the percentage of older workers is included. On the one hand, older workers may have a shorter expected employment until retirement, lowering the cost of job loss. On the other, it is also possible that if earnings profiles are heavily backloaded, older workers may have larger quasi-rents, increasing their cost of job loss and, hence, reducing the incentive to take absence.

We also control for the size of the establishment and its age. While larger size increases absence (Barmby and Stephan, 2000), we anticipate that older workplaces will be associated with reduced absence. Older established workplaces will be more successful in using backloading as an incentive device (Lazear, 1979), and the resulting greater cost of job loss will reduce absence.

Greater earnings loss associated with absence should reduce its incidence (Allen, 1984; Weiss, 1985; Treble, 2001). We include a measure of the share of the workplace's employees who earn more than 16,000 GBP in 1998. In addition, we include a profit sharing indicator as it has been identified as a determinant of absence rates (Brown et al., 1999). Profit sharing implies that each worker has a financial stake in the effort and absenteeism of other workers. This creates peer pressure that may change work group norms and reduce absence.

The character of industrial relations often has an influence on absence. Examinations with North American data typically find a positive correlation between unionization and absenteeism (Allen, 1984; Chaudhury and Ng, 1992). Evidence from Germany shows no link between collective bargaining coverage and absence but a positive association between works councils and absence (Heywood and Jirjahn, 2004). In order to capture several dimensions of industrial relations, we include variables for union recognition, the presence of joint consultative committees and a control for the quality of employment relations. To the extent that quality measures cooperative and trustful relations (with or without formal employee representation), it should indicate that management considers employees' interests to a larger degree (Jirjahn and Smith, 2006) reducing the incentive to take absence.

Working conditions and human resource management practices should have an impact on absence, too. We anticipate that workers take absence to avoid unpleasant working conditions. If the variety of tasks is associated with increased stress, it will therefore result in greater absence. Further, we control for the percentage of manual workers who are more likely to suffer from unpleasant working conditions or workplace hazards. In contrast, control over the pace of their work for employees and discretion over how they do their work indicate a more pleasant work environment.

In addition, we capture further dimensions of human resource management by including whether or not the management holds routine meetings with workers, whether or not layoffs are used, and the extent of cross-training. Meetings in the form of briefings or quality circles may be part of improving work group norms and worker satisfaction and, we anticipate, may be associated with reduced absence. Continuity in the workforce, the absence of layoffs, is often taken as essential for the development of peer pressure (Kandel and Lazear, 1992) and should also be associated with reduced absence. Alternatively, layoffs may protect a core group of workers for whom incentives such as backloading may be more successful, thereby reducing overall absence rates. Cross-training may lower the cost of absence as multi-skilled workers are able to fill in for absent colleagues and to perform their tasks, which may lead to reduced monitoring and higher absence. On the other hand, employers can more easily transfer employees with health problems (e.g. back pain) to other work if the employees are cross-trained. This may result in lower absence. Altogether, the inclusion of various variables for human resource management helps to identify the role of teams as a reflection of exogenous team production rather than as an element of an endogenously adopted HRM cluster of practices.

Finally, we include dummies to account for industrial groupings, recognizing that the nature of production and the type of work varies dramatically with the product or service being produced.

2.4. Further testing of the model

After testing the prediction that teamwork is associated with reduced absence, we next test the two logical associations upon which that prediction rests. As made clear in our theoretical illustration, the reduced absence rests on the monitoring choice of the firm. The cost of absence with teamwork exceeds that in which worker productivity is not interdependent. As a consequence, the firm with teamwork production will have a larger optimal level of monitoring in an effort to reduce absence further. Thus, we use the data to test the anticipated correlation between teamwork and monitoring. Using several indicators of monitoring that revolve around the use of appraisal and the intensity of supervision, the evidence shows that teamwork generally is associated with increased monitoring. Discussion of the controls and specification will be saved for later.

Finally, the relationship between monitoring and teamwork is based on the assumption that the cost of absence is greater for establishments with team production. Our final series of estimates divides the sample by whether or not the establishment has teamwork and then tests for the relative cost of absence. Again, discussion will be saved for later.

3. Data and descriptive statistics

The data are drawn from the 1998 Workplace Employee Relations Survey that contains detailed information on the presence of teams. The establishments in the survey are a representative sample of those in Britain (see Cully et al., 1999).

After eliminating public sector observations, the sample size is 1230. Definitions and descriptive statistics are presented in Table 1. The critical dependent variable is the absence rate. The establishments report the percentage of workdays missed due to absence over the previous 12 months. As shown, the average proportion is .043 or 4.3 percent. The exact question on absence in WERS98 is "over the last 12 months what percentage of work days was lost through employee sickness or absence at this establishment? Please exclude authorized leave of absence, employees away on secondment or courses, or days lost through industrial action."[6]

Estimating the determinants of this proportion across establishments requires a transformed dependent variable in which the proportion, θ, becomes $\ln[(\theta+.5/N)/(1-\theta+.5/N)]$. This log-odds or logistic transformation insures that predictions of θ remain within the zero to one range while the transformed variable ranges from minus infinity to positive infinity. The transformed absence rate can then become a linear function of the explanatory variables including the extent of workplace teams and the quality of those teams. As usual, it is important to correct the logistic transformation of heteroscedasticity (Allen, 1981). Since the variance of the dependent variable equals $[(1+1/N)(1+2/N)/(\theta+1)(1-\theta+1/N)]$, weighted least squares regressions are performed:

$$\omega \ln\left[\frac{\theta+.5/N}{1-\theta+.5/N}\right] = \boldsymbol{\beta}'\boldsymbol{X}\omega+\varepsilon \tag{6}$$

where $\omega=[(1+1/N)(1+2/N)/(\theta+1)(1-\theta+1/N)]^{-1/2}$, N represents the number of workers in the establishment, $\boldsymbol{\beta}$ is the vector of coefficients, and $\boldsymbol{X}$ is the vector of independent variables. To calculate the marginal influence of x on θ requires multiplying its coefficient, β, by the mean proportion and its inverse:

$$\Delta\theta = \left[\frac{(\bar{\theta}+.5/N)(1-\bar{\theta}+.5/N)}{1+.5/N}\right]\beta\Delta x. \tag{7}$$

The survey questions attempt to identify meaningful teams by associating teams with expanded decision-making and responsibility. The basic question asks for a categorical response to the share of workers in the largest occupational group that work in teams. Three follow-up questions ask whether or not these teams require working together, joint decision making, and responsibility for specific products or processes. The mean response to the basic question on the extent of teams corresponds to the category of 40–59 percent. As the results in Table 2 show, the raw data show no consistent pattern between the extent of teamwork and absence rates. The only large deviation is the lower absence rate of 3.49 for establishments with the next to highest extent of teamwork. The seven categories of team usage are used as an independent variable taking values of zero to six.[7]

The follow-up questions indicate that nearly 70 percent of workplaces describe that their teams depends on team members "working together," while only 45 percent of workplaces have team members "jointly deciding how the work is to be done" and 60 percent of workplaces giving teams "responsibility for specific products or services." We take these to be measures of the quality or depth of the teams in use by the workplace. The underlying dichotomous variables behind these follow-up questions can take a value of zero either if the workplace makes no use of teams or if the teams it does use do not match the survey description. Such detailed measures on the nature of teams were not used in the study with German data (Heywood and Jirjahn, 2004) that only measures the share of workers in teams. The presence of these detailed measures is important as it allows us to refine the proxy to more nearly match the concept of teamwork. Knowing that the teams work together and make decisions jointly makes it more likely that the underlying technology involves the interdependent productivities associated with teamwork.

4. Teams and absence

Table 3 presents the initial results. Column one shows the log-odds estimation. Many of the coefficients emerge with the expected sign. Larger establishments report greater absence. While union recognition does not significantly increase absence, both poorer relations between workers and managers and JCCs increase absence. Older establishments have reduced absence. Flex-time and shift work emerge as positive determinants while the extent of control over the job is a negative determinant. Profit sharing, which binds together the fortunes of the establishment's workers, is associated with reduced absence. Firms paying higher wages have reduced absence.[8] Interestingly, once all the other controls are included, the indicator of cross-training plays no role, a point to which we will return.

Of primary importance, establishments using teams have lower absence rates. Approximating the marginal effect of teams with Eq. (7) for an average sized firm of 584, the change in the probability equals $(-.029)(.044)(.958)/1.001$ or $-.001$. This is a modest influence. Given the mean absence rate of .043, the increase in team usage associated with a one standard deviation movement up the categorical ranking equal (roughly an increase of 2.5 in the ranking) results in a reduction in the absence rate of .0025 or about 6 percent.

[6] Despite the detailed nature of this question, we recognize there may be variations in what constitutes an "unauthorized" absence across firms.

[7] Substituting the midpoint from within the category does not meaningfully change any of the results we present.

[8] As a robustness check we adopted the next higher breakpoint that measures the share of worker in the firm earning more that 22,000 BPS. That measure retains a negative and significant coefficient and does not change the patterns of statistical significance presented throughout Table 3.

Table 1
Variable descriptive statistics and explanation.

Variables	Mean	Std. Dev.	Explanation
Absence	.0434	.0725	Proportion of annual working days lost due to absence[a]
Log-odds	−4.1628	2.3095	ln(absence + .5/N)/(1 − absence + .5/N)
Team coverage	3.2670	2.4697	Percentage of employees in the largest occupational group working in a designated team (0 = 0 percent; 1 = 1–19 percent; 2 = 20–39 percent; 3 = 40–59 percent; 4 = 60–79 percent; 5 = 80–99 percent; 6 = 100 percent)
Team 1	.6921	.4618	Dummy = 1 if team working depends on team members working together
Team 2	.4453	.4972	Dummy = 1 if team members jointly decide how the work is to be done
Team 3	.6029	.4895	Dummy = 1 if teams are given responsibility for specific products or services
Financial performance	2.6656	.8500	Indicator of cross-establishment financial performance comparison for establishments in the same industry (0 = a lot below than the average; 1 = a little below than the average; 2 = about the average; 3 = a little better than the average; 4 = a lot better than the average
Productivity	2.6050	.7830	Indicator of cross-establishment productivity comparison for establishments in the same industry (0 = a lot below than the average; 1 = a little below than the average; 2 = about the average; 3 = a little better than the average; 4 = a lot better than the average
$P_{appraisal}$	3.4971	2.7153	Percentage of employees covered by formal job appraisal schemes (0 = 0 percent; 1 = 1–19 percent; 2 = 20–39 percent; 3 = 40–59 percent; 4 = 60–79 percent; 5 = 80–99 percent; 6 = 100 percent)
$P_{supervisor}$	1.4215	1.2386	Percentage of non-managerial supervisors/line-managers (0 = 0 percent; 1 = 1–19 percent; 2 = 20–39 percent; 3 = 40–59 percent; 4 = 60–79 percent; 5 = 80–99 percent; 6 = 100 percent)
P_{nmsup_tr}	1.5387	2.1206	Percentage of non-managerial supervisors/line-managers trained for people management (0 = 0 percent; 1 = 1–19 percent; 2 = 20–39 percent; 3 = 40–59 percent; 4 = 60–79 percent; 5 = 80–99 percent; 6 = 100 percent)
Appraisal	.4505	.4977	Dummy = 1 if non-managerial supervisors/line-managers carry out formal job appraisals
Size	.0584	.2130	Establishment size/1000
Percent female	49.0562	29.9651	Percentage of female employees in the establishment
Percent part-time	28.9240	31.0112	Percentage of part-time employees in the establishment
Percent manual	36.0577	33.4565	Percentage of manual workers in the establishment
Percent over age 50	15.0357	12.5185	Percentage of employees over 50 years old in the establishment
Percent disabled	.7508	2.2050	Percentage of employees with disability in the establishment
High pay	25.6032	27.4244	Percentage of employees paid 16,000 pounds or above a year (one of six break points used in a series of similar questions)
Union	.2004	.4005	Dummy = 1 if establishment recognizes at least one union for collective bargaining
Good relations	3.2771	.7604	Indicator of management and employee relations (0 = very poor; 1 = poor; 2 = neither good nor bad; 3 = good; 4 = very good)
Briefing	.3016	.4591	Dummy = 1 if the establishment has a system of briefings for a work group/section/team
Flextime	.1374	.3445	Dummy = 1 if the establishment has flexible working time arrangement for its non-managerial employees
Work home	.1096	.3125	Dummy = 1 if able to work at or from home during normal working hours
Parent leave	.2457	.4307	Dummy = 1 if parental leave is available
Job share	.1451	.3524	Dummy = 1 if able to share a full-time job with someone else
$F_{chdcare}$	.0301	.1710	Dummy = 1 if help with the cost of childcare is available from the establishment
Nursery	.0160	.1255	Dummy = 1 if a workplace nursery is available
Shift	.2968	.4570	Dummy = 1 if the establishment has shift working arrangement for its non-managerial employees
$P_{profit\ sharing}$	.4012	.4903	Dummy = 1 if the establishment uses a profit related pay or bonus system
Percent performance pay	1.4495	2.3887	Percentage of non-managerial employees covered by performance-related pay (0 = 0 percent; 1 = 1–19 percent; 2 = 20–39 percent; 3 = 40–59 percent; 4 = 60–79 percent; 5 = 80–99 percent; 6 = 100 percent)
Establishment age	29.0368	47.2150	Age of the establishment
JCC	.1833	.3871	Dummy = 1 if the establishment has a joint managers and employee consultative committee that primarily concerns with consultation rather than negotiation
Quality circle	.3029	.4597	Dummy = 1 for having quality circles or problem solving groups
Layoff	.0868	.2816	Dummy = 1 for using compulsory redundancy during the last 12 months
Cross-training	2.2471	2.1805	Percentage of employees formally trained to be able to do jobs other than their own (the same categories as in the Teamwork variable)
Job variety	2.2533	.7850	Indicator of variety of work for employees in the largest occupational group (0 = none; 1 = a little; 2 = some; 3 = a lot)
Job discretion	1.9352	.9309	Indicator of discretion over how they do their work for employees in the largest occupational group (the same categories as J variety)
Job control	1.8289	.9271	Indicator of control over the pace of their work for employees in the largest occupational group (then same categories as J variety)
Single	.4367	.4962	Dummy = 1 for firms with single establishment
Owner change	.1720	.3775	Dummy = 1 if an establishment experienced change of ownership during the past 5 years

Table 1 (*Continued*)

Variables	Mean	Std. Dev.	Explanation
Techch	.6575	.4747	Dummy = 1 if an establishment introduced new technology over the past 5 years
Prodch	.4643	.4989	Dummy = 1 if an establishment introduced changes in work techniques or procedures over the past 5 years
Orgach	.5260	.4995	Dummy = 1 if an establishment introduced changes in organization of work over the past 5 years
Secmanuf[**]	.1889	.3915	Dummy = 1 for manufacturing industry
Secelect	.0029	.0539	Dummy = 1 for energy and water industry
Secconst	.0472	.2123	Dummy = 1 for construction industry
Secwhole	.2368	.4253	Dummy = 1 for whole sale and retail industry
Sechotel	.0991	.2989	Dummy = 1 for hotel and restaurant industry
Sectrans	.0494	.2169	Dummy = 1 for transport and communication industry
Secfinan	.0297	.1699	Dummy = 1 for finance and business service industry
Secothbu	.1315	.3381	Dummy = 1 for other business services industry
Seceduca	.0370	.1887	Dummy = 1 for education industry
Sechealt	.1281	.3344	Dummy = 1 for health and social work industry

Sample: all establishments in the private sector (size: 1230).

[a] The exact question on absence in WERS98 is "over the last 12 months what percentage of work days was lost through employee sickness or absence at this establishment? Please exclude authorized leave of absence, employees away on secondment or courses, or days lost through industrial action."

[**] The industry dummies follow the 1992 Standard Industry Classification. The omitted industry is unclassified others group.

As an expansion of the specification in column 1, more detailed indicators of the nature of the teams are included. Column 2 shows that the same pattern of the controls emerges but with the indicator of teams having a greater role. The use of teams is now an indicator of whether or not the team members actually work together. This indicator helps to identify whether or not the teams used by the firm are actually an indicator of teamwork. Also included is an interaction of this dichotomous variable with the extent of teamwork within the firm. The new specification shows that while the interaction plays no role, the presence of teams with members working together emerges with a large coefficient of nearly −.38. The same type of projection as used originally indicates a substantial influence of −.016. Thus, the use of teams with members working together reduces absence by 37 percent (−.016/.043). Again, this comparison with the results in the first column is important as we take the requirement that employees work together to be closely associated with underlying teamwork production.

The other two indicators of team quality also reveal a greater influence on absence than the measure of the simple extent of teams in the workplace. The indicator of whether the workers have joint decision making authority emerges with a coefficient of about −.26 but with an also statistically significant influence of the interaction. Thus, whether or not there exist teams that have such authority reduces absence, and when the extent of teams with such authority grows within the firm, absence is further reduced.

A similar pattern is repeated in column four. The presence of teams with responsibilities for specific products or services emerges as a powerful negative determinant of absence. The interaction measuring the extent of teams with such responsibilities also has strong negative effect on absence. The projections are dramatic as the presence of teams with responsibilities with specific products or services reduces absence rates by .018 while a movement in usage categories of 2.5 reduces absence rates by an additional .007. Thus, if a workplace originally had no teams but then established teams with such responsibilities that covered 36 percent of the employees (roughly 2.5 categories out of 7), the absence rate would be .025 smaller, a decline of more than half the mean absence rate.

The results across all the columns show the same pattern of size and significance for the coefficients on the control variables. The indicators of teams also show a very consistent pattern. Despite the inclusion of a large variety of relevant controls, the use of teams emerges as a negative determinant of absence. The use of these controls help to separate the real influence of teams on absence from those associated with a broader package of HRM practices. In this fashion, we use teams as a proxy for underlying team production. Indeed, when the quality of the team is used to identify its presence, the results are larger. The use of teams with responsibility and decision making is associated with substantially lower absence rates.

Table 2
Teamwork and absence.

Percentage of workers in teams	Proportion of sample (sample size)	Absence rate
0	.141 (173)	4.53
1–19	.067 (83)	4.49
20–39	.087 (107)	4.09
40–59	.054 (66)	4.47
60–79	.126 (155)	4.26
80–99	.190 (234)	3.49
100	.335 (412)	4.27

Table 3
The influence of teamwork on absence.

	(1)	(2)	(3)	(4)	(5)
Constant	−2.672 (11.32)**	−2.487 (10.40)**	−2.627 (11.04)**	−2.468 (10.36)**	−2.478 (10.25)**
Team coverage	−.0287 (2.31)**				−.0694 (4.03)**
Team 1		−.3775 (5.09)**			
Team 1 × Team coverage		−.0273 (.85)			
Team 2			−.2592 (3.59)**		
Team 2 × Team coverage			−.0314 (2.14)**		
Team 3				−.4171 (5.63)**	
Team 3 × Team coverage				−.0653 (3.35)**	
Cross-training	−.0126 (.92)	−.0044 (.32)	−.0128 (.94)	−.0022 (.16)	−.0935 (3.40)**
Team coverage × Cross-training					.0199 (3.39)**
Size	.0235 (2.08)**	.0231 (2.07)**	.0221 (1.95)*	.0260 (2.32)**	.0224 (1.99)**
Percent female	.0017 (1.17)	.0022 (1.54)	.0017 (1.20)	.0023 (1.64)	.0017 (1.18)
Percent part-time	.0024 (1.80)*	.0023 (1.70)*	.0025 (1.83)*	.0021 (1.57)	.0021 (1.52)
Percent manual	.0015 (1.56)	.0012 (1.28)	.0015 (1.50)	.0011 (1.19)	.0014 (1.44)
Percent over age 50	−.0048 (2.03)**	−.0056 (2.36)**	−.0053 (2.24)**	−.0057 (2.41)**	−.0048 (2.03)**
Percent disabled	.0048 (.53)	.0059 (.70)	.0067 (.78)	.0079 (.93)	.0058 (.68)
Unionization	−.0630 (1.07)	−.0518 (.89)	−.0513 (.88)	−.0552 (.95)	−.0630 (1.08)
Good relations	−.1251 (3.66)**	−.1346 (3.97)**	−.1276 (3.71)**	−.1134 (3.95)**	−.1289 (3.79)**
JCC	.2127 (3.96)**	.2208 (4.15)**	.2157 (4.03)**	.2359 (4.43)**	.2029 (3.79)**
Briefing	−.0774 (1.55)	−.0469 (.94)	−.0809 (1.62)	−.0477 (.96)	−.0616 (1.23)
High pay	−.0044 (3.65)**	−.0044 (3.73)**	−.0044 (3.71)**	−.0041 (3.44)**	−.0043 (3.57)**
Profit sharing	−.3052 (6.02)**	−.3071 (6.11)**	−.3872 (5.65)**	−.2949 (5.88)**	−.3096 (6.13)**
Establishment age	−.0020 (3.38)**	−.0018 (3.15)**	−.0020 (3.39)**	−.0019 (3.28)**	−.0020 (3.43)**
Shift	.1698 (3.04)**	.1830 (3.32)**	.1618 (2.91)**	.1865 (3.39)**	.1733 (3.13)**
Flextime	.1843 (2.82)**	.2038 (3.14)**	.1974 (3.02)**	.2147 (3.30)**	.2054 (3.14)**
Quality circles	−.1559 (2.88)**	−.1321 (2.46)**	−.1431 (2.64)**	−.1279 (2.38)**	−.1404 (2.59)**
Layoffs	−.1815 (2.46)**	−.1671 (2.28)**	−.1789 (2.42)**	−.1802 (2.46)**	−.1874 (2.55)**
Job variety	.0935 (2.70)**	.0797 (2.32)**	.0862 (2.50)**	.0796 (2.32)**	.0797 (2.30)**
Job discretion	−.0182 (.55)	−.0114 (.35)	.0108 (.33)	−.0185 (.57)	−.0155 (.47)
Job control	−.0662 (2.32)**	−.0664 (2.35)**	−.0560 (1.95)*	−.0694 (2.46)**	−.0703 (2.48)**
Industrial controls (11)	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	.176	.191	.181	.194	.183
N	1191	1191	1191	1191	1191

* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.

This is important as it makes more precise the earlier use of teams as a proxy for teamwork. When teams are defined to more nearly coincide with the characteristics of teamwork, the influence on absence is larger than when a loose definition is applied.

Several additional estimations continue to suggest a robust relationship between teams and reduced absence. First, removal of the interactions between the indicators of team quality and team coverage simply increases the absolute size of the coefficients on the team quality indicators, and they remain highly significant. Second, we examine the relative strength of the various team indicators in a specification that included all three quality indicators and the team coverage variable. The remaining controls are identical to those in Table 3. Despite the obvious co-linearity, two of the four variables emerged with coefficients significant at the five percent level: whether or not the team members must work together (Team 1) and whether or not the team has responsibilities for specific products or services (Team 3). These coefficients remained large with that for Team 1 at −.333 and that for Team 3 at −.154. Again, the particular importance of teams that require actually working together emphasizes the teamwork aspect of teams.

As a third robustness test, we added Team Coverage to the specifications in columns 2, 3 and 4. It never changed the statistically negative coefficients on Team 1, Team 2 and Team 3. The interactions with Team Coverage retained their negative sign, but that in column 4 lost its statistical significance. The Team Coverage variable itself took an insignificant coefficient in columns 2 and 3, but a paradoxical positive coefficient in column 4, although one matched by a largely increased negative coefficient on the interaction. The sum of these robustness checks indicated a durable pattern of teamwork as a negative determinant of absence.

As a fourth robustness check we returned to the idea that while team work may reflect technology, the adoption of teams can be part of a bundle of human resource management practices that includes cross-training. As mentioned cross-training has not emerged as an important control, but to examine this in more detail we enter an additional interaction of cross-training and teamwork. The results of doing so in the most basic equation, that from column 1, are presented in column 5. First, the size of the coefficient on teamwork remains negative and significant and more than doubles in size. Second, the coefficient on cross-training becomes negative and statistically significant for the first time, indicating that cross-training is associated with reduced absence as cross-trained workers with health problems can be more easily transferred to other jobs. Third, the interaction takes a significant positive coefficient, hinting that cross-training lowers the firm's need to monitor

Table 4
Teamwork and monitoring.

Percent of workers in teams	Percent of supervisors	Percent of supervisors trained in HRM	Supervisor does performance appraisal	Percentage subject to performance appraisal
0	19.0	25.7	.296	41.2
1–19	13.8	13.1	.407	50.9
20–39	16.2	23.9	.415	37.0
40–59	19.8	28.2	.637	52.2
60–79	25.6	23.9	.433	55.9
80–99	24.8	36.0	.730	67.6
100	19.7	36.6	.575	68.7

workers in the presence of team production. Overall, this pattern suggests that cross-training and teamwork actually off-set each other to an extent when both are present.[9]

Finally, the influence of teams may reflect peer pressure rather than technology. If so, we anticipate that this peer pressure would increase in the presence of profit sharing that ties the workers together financially. Specifically, the team variable indicating working together might best indicate circumstances in which peer monitoring would exist. We interact this team variable with that for profit sharing and add it to the specification. While the team variable retains a significantly negative coefficient that increased in size, the interaction of teams with profit sharing is significantly associated with increased absence. Interacting the team variables indicating joint decisions and responsibility for specific products with profit sharing yields similar results. While the estimations are available from the authors, they suggest that the influence of teams does not merely reflect increased peer pressure.

Despite the robustness checks, we recognize that at this stage reverse causality remains a possibility. Specifically, if management has the ability to adopt team production technology, they may be especially likely to do so if they have, for whatever reason, low absence rates. Nonetheless, we will suggest that the full set of associations we confirm makes this far less likely, while not making this impossible.

5. Teams and monitoring

A prerequisite for teamwork to reduce absence in our model is that establishments with teamwork do more extensive monitoring. Again, more extensive monitoring results because the costs of absence are greater under teamwork as individual absence reduces the productivity of other workers. The firm responds to the greater costs of absence with a higher optimal level of monitoring intensity designed to reduce absence.

We now examine the relationship between monitoring and teamwork production. We continue to use the team variables as a proxy for teamwork and examine their influence on four indicators of monitoring. The first indicator is the extent of line supervisors as a share of production workers while the second modifies that by measuring the extent of line supervisors trained in people management (HRM) as a share of production workers. Using such an indicator follows Goldin (1986), among others, who take the supervisory ratio as indicator of the intensity of monitoring. The third indicator identifies whether or not the line supervisors do performance appraisals of production workers, while the fourth indicates the share of workers who are subject to performance appraisals.

We assume that these indicators of monitoring reflect, in part, increased monitoring of absence. This assumption follows from the importance of absence as a strategic management variable. Absence reports and statistics from line mangers help to identify absence patterns and strategic responses (Dunn and Wilkinson, 2002). Such patterns include increased absence (shirking) during the days around major sporting events or around an employee's birthday (Skogman Thoursie, 2004, 2007). More immediately, superiors may contact employees to confirm their reason for being absent. Also, "return-to-work interviews" between superiors and employees following sickness appear to be very effective in detecting the true reasons for absence and in reducing the absence rate (Backes-Gellner et al., 2001). Clearly, all of these forms of monitoring absence require a higher share of supervisors and specific training of superiors. Trained HRM professionals may be able to communicate more effectively and more easily change the extent of absence. Finally, performance appraisals are a central element in monitoring workers, and the extent of absences often influences the quality of a worker's appraisal which in turn influences the future employment prospect, career and remuneration of the worker within the firm (Brown and Heywood, 2005).

Table 4 shows the raw association between the extent of teams and the four indicators of monitoring. All of the indicators are ordered categorical variables with the exception of the whether or not the supervisor conducts performance appraisals. In the table, the midpoint of the relevant category is substituted for each observation for the ordered categorical variables. The means are then presented for the various extents of teamwork. There appears to be a tendency for establishments with greater teamwork to have greater monitoring, but it is much weaker for the managerial intensity indicators.

[9] Adding the interaction to other estimates in Table 3 provides broadly similar results. The team indicator remains routinely negative and significant, the cross-training coefficient is always negative and is significant in two of the three cases, and the interaction coefficient is positive but significant in only one of the estimations.

Table 5
Teamwork and monitoring: summary of regressions.

	Percentage of supervisors (ordered probit)	Percentage of supervisors trained in HRM (ordered probit)	Supervisor does performance appraisal (probit)	Percentage subject to performance appraisal (ordered probit)
Team coverage	.0204 (1.55)	.0439 (2.86)**	.0830 (4.77)**	.1051 (6.34)**
Team 1	.0860 (1.10)	.2443 (2.59)**	.3168 (3.27)**	.4292 (4.72)**
Team 1 × Team coverage	.0428 (.88)	−.1357 (1.63)	.1059 (1.76)*	.0222 (.36)
Team 2	−.0232 (.29)	.1054 (1.19)	.3121 (3.14)**	.5551 (5.88)**
Team 2 × Team coverage	.0332 (1.87)*	.0515 (2.66)**	.0946 (4.25)**	.1081 (5.12)**
Team 3	.1083 (1.37)	.2165 (2.48)**	.4311 (4.42)**	.4681 (5.09)**
Team 3 × Team coverage	−.0255 (1.05)	−.0034 (.13)	−.0118 (.39)	.0587 (2.08)**

Note: The table reflects 16 underlying estimates and the controls are described in the text.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.

We use the indicators of monitoring as dependent variables in a series of multivariate specifications designed to identify the independent influence of teamwork. As indicated in Table 1, the ordered categories proceed from lower monitoring intensity to higher monitoring intensity. The resulting specifications thus include three ordered probit estimations and one simple probit estimation.

In each specification the controls are the same as those used in Table 3 but with the addition of variables that we anticipate influence monitoring but not absence. Ultimately these additional variables will be used as identifying variables in an instrumental variable estimation. In the meantime, we emphasize that we have experimented with them as controls when estimating absence and they are not typically significant determinants. Moreover, their inclusion in no way changes the role of the team work indicators as determinants of absence rates as presented in Table 3.

The additional variables include dummy indicators of change in organization, technology change, production and ownership, and a series of variables indicating the provision of benefits (job sharing, childcare and nurseries at work and share ownership schemes) as well as an indicator of whether the plant is a single establishment or part of a multi-establishment firm. The latter is presumed to be a proxy for longer chains of command and imply more monitoring, a result confirmed in all estimations. The change variables are included on the assumption that change requires additional monitoring as learning by workers is required and as new performance measures emerge, a result modestly confirmed with several positive and significant partial correlations: organizational change in two specifications, and production change and technical change each in one specification using the team coverage variable. Finally, the fringe benefit indicators may identify jobs that are more valuable, making the consequences of job loss greater and reducing the extent of monitoring all else equal. Alternatively, fringe benefit provision may be greater in establishments with more developed systems of human resource management, and thus may be positively correlated with other indicators of such development including monitoring schemes. This latter pattern is more nearly supported by the data with only one significant negative partial correlation but with seven significant positive partial correlations across the four specifications using the team coverage variable.

In total we estimated 16 specifications arising from four indicators of monitoring and four indicators of teams. As before, we include the interactions of team quality with team coverage. The results are summarized in Table 5 with the full results available from the authors upon request. While not uniform across all specifications, the pattern is very convincing.[10] For example, across the four indicators of monitoring, the basic team coverage variable takes a positive coefficient for each with the three statistically significant coefficients averaging *t*-statistics of 4.7 and the insignificant coefficient (in estimating the determinants of the percent of supervisors) still taking a *t*-statistic of 1.5. Using the alternative measures of team quality does not alter this pattern. Indeed, for the indicators of appraisal, it is often the case that both the indicator and its interaction with the extent of teamwork simultaneously take significantly positive coefficients. The general pattern shows teamwork strongly associated with greater monitoring with the pattern remaining somewhat stronger for the appraisal indicators than for the supervisory intensity indicators.

Further alterations of the specification reveal the same basic pattern. We removed several of the independent variables that were used in the initial determinants of absence from the estimation of the determinants of monitoring with no substantial influence. A second important point is that the marginal effects for the indicator of a team that must work together is routinely and usually substantially larger than those for the simple team coverage indicator. This fits our earlier result that the team must work together indicator had a larger influence on absence than did the simple coverage variable.[11]

6. Teamwork and the cost of absence

The association of teamwork with greater monitoring is theoretically derived from the assumption that the cost of absence is greater in establishments with teamwork. We now turn to an examination of whether or not this assumption appears

[10] A variety of statistically significant controls emerge, and in every case the hypothesis of no explanatory power is routinely rejected.
[11] The marginal effects are calculated holding all other variables at their sample means. For the ordered probit estimations it is the average marginal effect across the relevant categories.

Table 6
Teamwork and performance.

	Financial performance	Productivity	Productivity growth
Team coverage			
Yes	2.68	2.63	3.05
No	2.59	2.52	3.06
Team 1			
Yes	2.69	2.64	3.05
No	2.59	2.51	3.04
Team 2			
Yes	2.68	2.68	3.06
No	2.64	2.54	3.04
Team 3			
Yes	2.67	2.64	3.07
No	2.64	2.53	3.06

consistent with the data available in the WERS. The examination proceeds by estimating the determinants of three available measures of workplace performance. These are ordered categorical measures of the establishment's financial performance compared with other establishments in its industry, of the establishment's productivity compared with others in its industry, and of the establishment's recent productivity growth. For each measure we divide the sample by the dichotomous indicators of the presence of teams. While each of the team quality indicators are already dichotomous, we divide the categorical coverage variable into simply those establishments that report any positive coverage by teams and those that report no coverage. In each case, the assumption being tested is that the negative influence of absence on performance should be larger for establishments using teams than for those not using teams. This, in turn, suggests that absence imposes a larger cost to firms using teams.

Table 6 provides the mean values of the performance indicators separately for those establishments using teams and those not using teams. This separation is shown for each of the four team variables. While the differences are not large, eleven of the twelve comparisons exhibit a larger mean performance for the establishments using teams. At issue is whether or not within this apparent pattern we can isolate different influences for absence.

As in the earlier section, this requires a long series of estimations with 3 performance measures divided into samples of establishments with and without teamwork as measured by 4 teams variables ($3 \times 2 \times 4 = 24$). We also vary the specification. We use the variables underlying the estimates in Table 5 but add in turn each of the monitoring variables. The monitoring variable most likely to be a statistically significant determinant of performance is the percent of workers subject to performance appraisals, which generally takes a positive coefficient. The results of the ordered probit estimations using this monitoring variable are summarized in Table 7 and present a dramatic pattern. Using the basic team coverage variable, higher absence is associated with both significantly lower financial performance and lower productivity relative to industry peers. When the establishment does not use teams, no significant relationship exists between absence and performance. This is more than simply imprecision in the estimates. Frequently, the coefficient for absence actually is positive. More generally, the absence variable takes a negative coefficient for all twelve estimates for establishments involving teamwork, and that coefficient is statistically significant in nine cases. The absence variable takes seven positive and five negative coefficients and

Table 7
Teamwork and the cost of absence: summary of regressions.

	Financial performance	Productivity	Productivity growth
Team coverage			
Yes	−2.8207 (2.95)**	−1.6479 (1.79)*	−1.4195 (1.58)
No	1.5263 (1.39)	.8415 (.58)	−4.0416 (1.00)
Team 1			
Yes	−3.6024 (3.53)*	−2.2396 (2.16)**	−1.8102 (1.80)*
No	1.6639 (1.66)*	.6930 (.57)	−1.7219 (.71)
Team 2			
Yes	−6.2171 (3.97)**	−2.4346 (1.52)	−2.7420 (1.70)*
No	−.0291 (.05)	−.5294 (.79)	−2.5784 (2.23)**
Team 3			
Yes	−1.5921 (1.54)	−1.7960 (1.70)*	−2.2662 (2.19)**
No	.7231 (.92)	.0364 (.04)	.2117 (.11)

The estimated coefficients and their corresponding *t*-statistics (in parentheses) for the absence ratio variable are reported in the table. *Note*: This summarizes 24 underlying estimations as described in the text.

* Statistically significant at the 10 percent level.

** Statistically significant at the 5 percent level.

Table 8
The endogeneity of monitoring.

	Log-odds of absence rate	Log-odds of absence rate	Log-odds of absence rate	IV estimation of supervisor does appraisal
Team coverage	−.0302 (2.29)**	−.0218 (1.80)*	−.0151 (1.15)	
Supervisor does performance appraisal		−.2966 (5.49)**		
IV for supervisor does appraisal			−.5332 (3.45)**	
Team coverage (in the IV estimation)				.0561 (2.61)**
ρ			.1954* (1.71)	
Adjusted R^2	.164	.185		
N	1103	1103	1103	

Column 3 summarizes the results of the dummy endogenous estimation. The specifications of the absence and the monitoring equation follow those in Tables 3 and 5.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

obtains statistical significance only once in each direction for establishments without teamwork. Even that one significantly negative coefficient it is smaller in size than that for firms with teamwork.

The pattern lends further credence to the use of teams as an indicator of underlying technology that involves teamwork. In the complete absence of teamwork, a worker might be paid a piece rate when present and paid nothing when absent without excuse. While we did not formally model the possibility of no sick pay, the cost of a worker's absence in this circumstance can be expected to be small and difficult to detect, as confirmed in the empirical estimates.

The results might be criticized for including measures of monitoring (as it may be considered endogenous) when estimating the determinants of performance. Excluding the monitoring variables causes a modest increase of the size of the coefficients on absence that merely reinforces the pattern that the costs of absence are greater in the establishments using teams.

6.1. Relationships between critical variables

We note that we have presented only reduced form estimates of the three critical relationships. The theory makes clear that the presence of teamwork increases the cost of absence that increases monitoring which, in turn, reduces absence. We undertake a series of estimations suggesting how to test jointly some of the relationships between our critical variables.

We return to the initial determinants of absence as estimated in Table 3. There we showed that establishments using teamwork had reduced absence. Our theory presumed that this followed from the increased monitoring done by firms with teamwork as confirmed in Table 5. Yet, it may well be argued that monitoring itself should be included among the determinants of absence while recognizing that monitoring is endogenous. In Table 8 we summarize a series of estimations designed to test this line of thinking.[12] The first column reproduces the central result showing the influence of teamwork on absence from the first column of Table 3. The second column adds the dichotomous variable indicating whether or not supervisors conduct performance appraisals. The coefficient on this monitoring variable is large, negative and highly significant, indicating that increased monitoring does reduce absence. Importantly it causes the influence of teamwork to attenuate. The size of the coefficient falls by approximately one-quarter. Such a reduction would be anticipated if teamwork has its influence largely through increasing the optimal extent of monitoring.

Pursuing this line further, we develop the contention that monitoring is endogenous. Thus, we treat the monitoring variable as a dummy endogenous model. An instrumental variable is estimated for monitoring using the specification underlying Table 5 (see Section 5 for our discussion of the identifying variables). In this specification teamwork is a very important determinant of performance appraisal. As shown in columns 3 and 4, when using the dummy endogenous framework, the MLE estimate shows that teamwork positively influences monitoring (column 4) and that monitoring has a large negative influence on absence rates (column 3).[13] The resulting instrumental variable for performance appraisal emerges with a negative coefficient about twice its size in column 2. Importantly, the statistically significant ρ indicates that the likelihood ratio test rejects the hypothesis that the equations for the instrument and for absence rate are independent. Taking into account the endogeneity of monitoring, teamwork is no longer significant as a direct determinant of absence. The significant influence of teamwork is indirectly through its effect on monitoring and the effect of monitoring, in turn, on absence rates. This is precisely the pattern of causation illustrated in our theoretical model. Nonetheless, we recognize the difficulty of finding reliable instruments, and while the results are supportive, we do not want to overplay them.

[12] The smaller sample sizes in Table 8 (compared to Table 3) reflect missing data on the monitoring variables.

[13] Additional tests using the alternative measures of monitoring support those already shown. We took each of the remaining categorical monitoring variables and transformed them into dichotomous variable in order to estimate the dummy endogenous variable model. In each case the monitoring variable played a role in determining absence after accounting for the endogeneity.

7. Conclusions

The estimates in this paper rest on the assumption that work place teams reflect, in part, underlying team production. The worker interdependencies associated with such production generate the need for teams and their value. We argue that absence is more expensive for establishments with team production and lowering these costs provides an added incentive to monitor workers. The additional monitoring results in lower absence rates.

Estimations using British establishment data reveal the presence of teams to be among the strongest determinants of absence rates. Moreover, we also show that establishments using teams engage in greater monitoring, as would be expected if such establishments have a higher cost of absence. Finally, the estimations show that, indeed, the cost of absence is greater in those establishments using teams. In summary, the three critical building block relationships of the theory receive empirical support. The confluence of these results gives added impetus to continue the search for demand side, product based explanations for the variation in absence rates. Finally, our attempt to incorporate some of the endogeneity in our testing served to support further our hypothesized chain of causation.

While we do not claim to have tested a final structural form, we emphasize that no previous research has made as concerted an effort to test each of the assumptions and relationships critical to prediction that teamwork is associated with reduced absence. We also note that it might be tempting to suggest that increased use of teams will further reduce absence. This would be a misunderstanding of the relationships explored in this paper. Teams are taken to be a logical response to those technologies that have underlying teamwork production. It is this production that increases the cost of absence and thus the monitoring. Firms without teamwork and thus without the increased cost of absence have little to gain by simply putting workers into teams.

As a final caveat, we note that there may be unmeasured heterogeneity across establishments. We do not have the ability to estimate a fixed effects model that would hold these effects constant. Instead we must rely upon our unusually large set of controls to attempt to hold constant the many determinants of our key dependent variables. Our many robustness checks and our effort to endogenize key variables also helps to provide confidence. Nonetheless, fixed effects could be of concern if, for example, management ability differs by firms such that better managed firms have both lower absence rates, do more monitoring, and use teams. While we have some oblique proxies for managerial quality such as the quality of management and employee relations, longitudinal data would be required to control fully for such managerial fixed effects.

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