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ABSTRACT

Job Anxiety, Work-Related Psychological Illness and Workplace Performance*

This paper uses matched employee-employer data from the British Workplace Employment Relations Survey (WERS) 2004 to examine the determinants of employee job anxiety and work-related psychological illness. Job anxiety is found to be strongly related to the demands of the job as measured by factors such as occupation, education and hours of work. Average levels of employee job anxiety, in turn, are positively associated with work-related psychological illness among the workforce as reported by managers. The paper goes on to consider the relationship between psychological illness and workplace performance as measured by absence, turnover and labour productivity. Work-related psychological illness is found to be negatively associated with several measures of workplace performance.

JEL Classification: I0, J28, J81, J20

Keywords: job anxiety, stress, absence, labour productivity

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1. Introduction

Economists have long been interested in how working conditions can affect health, the focus of this literature having been on the incidence of workplace accidents and injuries and, particularly, their relationship with earnings (for a survey see Viscusi and Aldy, 2003). However, partly as a consequence of structural change, workplace accidents and injuries have declined over time, with authors highlighting that current risks to health may instead stem from the 'intensification of work' associated with increased job demands and job strain (Green and Whitfield, 2009). Contemporary analysis of work-related health risks therefore needs to consider employee psychological as well as physical health, something recognised for some time by psychologists and epidemiologists, but which has received less attention from economists.[1]

Recent contributions to the economic literature focus on the relationship between working conditions - especially contractual arrangements and job demands - and psychological health (Robone *et al*., 2008 and Cottini and Lucifora, 2010) while others have extended the traditional, compensating wage differential analysis to consider work-related stress (French and Dunlap, 1998 and Groot and Maassen van de Brink, 1999).

Organisations have also been keen to highlight the business case for improving employee psychological health, emphasising sickness absence, employee turnover and presenteeism (being at work, but working at less than full capacity) as mechanisms through which psychological health may influence firm performance (see, for example, Sainsbury Centre for Mental Health, 2007). It is, however, surprising that virtually none of the evidence used to support these arguments is written by economists. Broadly speaking, the methodology underlying this evidence relies on estimating work time 'lost' as a result of psychological ill-health using responses from employees and multiplying it by an estimate of the value of work, often measured using hourly wage rates to convert to an aggregate economic or monetary cost (see, for example, Stewart *et al*., 2003 and Goetzel *et al*., 2004). Importantly, these studies compare the costs resulting from absence to those

[1] The obvious exception to this is the related literature on job satisfaction.

relating to presenteeism and, for mental health problems, the latter is found to be particularly important (see also, Dewa and Lin, 2000). These studies, do not however, attempt to distinguish between the costs of psychological ill-health and *work-related* psychological ill-health specifically, the latter potentially within an employer's more direct control. One of the few economic contributions to this literature by Leontaridi and Ward (2002) is an exception to this. Using data on OECD countries from the 1997 International Social Surveys Program (ISSP) they examine the relationship between employee psychological well-being and behaviour at work finding a significant positive relationship between self-reported work-related stress, individual quit intentions and absence. Buhai *et al*. (2008) are, however, among the first to utilise matched employee-employer, albeit focusing on the influence of workplace conditions on workplace performance, rather than psychological health specifically. While they find that resolving negative physical aspects of work, such as those relating to 'internal climate' and 'repetitive and strenuous work', positively impact on firm productivity there is no influence of psycho-social factors.

This study attempts to contribute to the literature in several ways. First, using a large scale nationally representative dataset of workplaces in both the public and private sector within Britain (the Workplace Employment Relations Survey (WERS)) we provide a comprehensive analysis of the determinants and effects of employee psychological health. Second, focusing on work-related psychological health rather than psychological health more generally, we examine an aspect over which employers have more control and where modifications of work practices may have more influence.[2] Third, we have an extensive set of controls for the influence of job characteristics and the workplace on psychological health, including measures of co-worker psychological health. Fourth, unlike most of the literature, the matched nature of our data facilitates examination of the relationship between psychological health reported by employees and workforce psychological health and performance reported by the manager. We utilise measures of

[2] We acknowledge it is often difficult to isolate the cause of psychological illness and that employers can facilitate access to work for employees with non-work-related health problems. Work may even act to amplify or moderate existing health problems. However, our focus throughout is on work-related psychological health. We provide more specific definitions below.

absence, quits and labour productivity in an attempt to identify the channels through which such effects may operate. Finally, we exploit the 1998-2004 panel element of WERS to examine the causality of the relationship between employee psychological health and workplace performance.

2. Background

Consistent with the focus of the earlier literature, previous versions of WERS were restricted to consider the prevalence of accidents and injuries at work rather than work-related *illness* (see, for example, Reilly *et al*., 1995 and Nichols *et al*., 2004). Fenn and Ashby (2004) were among the first to consider workplace illnesses using data from WERS 1998, where they explored the influence of unions and health and safety committees on workplace accidents and illnesses. This broader consideration of workplace health also featured in later contributions by Robinson and Smallman (2006) using the same data, and Brammer and Pavelin (2006) who use WERS 2004. The results of this type of analysis, which have focused on modelling the number of injuries or illnesses as a function of workplace characteristics, have highlighted the role of features such as workplace size and unionisation on employee health and safety. These studies, however, tend to form an aggregate measure of workplace illness or injury and, as such, ignore the heterogeneity of conditions that comprise each group. This may be particularly problematic when aggregating across physical and psychological health problems whose determinants may differ considerably.[3]

Questions relating to job anxiety were introduced into the employee questionnaire for the first time in WERS 2004. This information has been used to examine the determinants of employee well-being (Wood, 2008) and the relationship between earnings and job anxiety (Bryson *et al*., 2010). Wood (2008) examines the influence of job characteristics, including job control and job demands, and employee voice on well-being captured using measures of job satisfaction and job anxiety. Consistent with the Karasek (1979) model

[3] Workplace measures of ill-health have also been matched onto employee level data. For example, Wei (2007) examines compensating wage differentials associated with workplace ill-health and finds evidence of a significant wage premium connected to establishment level job-related illness.

developed in the psychology literature, he finds evidence of greater anxiety in more demanding jobs with lower levels of employee control.[4] He also finds evidence that perceived levels of support from, and consultation with, management reduce anxiety levels. In contrast, Bryson *et al*. (2010) focus on the influence of employee earnings on job satisfaction and job anxiety in the private sector. They find evidence of a positive relationship between earnings and job anxiety which is robust to detailed controls for the nature of work, effort and workplace characteristics. In contrast, they find no influence of co-workers' wages on job anxiety.

Other studies relating to employee psychological health have often used broader measures than job anxiety, although precise measures have largely been data determined. Robone *et al*. (2008) use data from the British Household Panel Survey (BHPS) to examine the influence of contractual arrangements and working conditions on self-assessed health and psychological well-being measured using the General Household Questionnaire (GHQ). Cottini and Lucifora (2010) instead focus on work-related mental health measured using self-reported responses to questions on whether work affects stress, sleeping problems, anxiety and irritability in the European Working Condition Survey (EWCS). They find evidence that certain job characteristics (particularly shift work and repetitiveness) and demands (complexity and intensity of tasks) are positively associated with mental health problems. In a similar manner to Bryson *et al*. (2010), several studies have focused on the relationship between earnings and psychological health. French and Dunlap (1998) and Groot and Maassen van de Brink (1999) both find evidence of a compensating wage differential associated with workplace stress.

To our knowledge this study is however, the first to link information on job anxiety collected from employees to broader information on workforce psychological ill-health reported by the manager. However, it is the information on workplace performance provided in WERS that provides an opportunity to explore the wider implications of

[4] Reviewing the literature on factors associated with risk of psychological ill-health (particularly among healthcare staff) Michie and Williams (2003) also find evidence to support the demand-control framework. They highlight long hours, high demands of work and lack of control over work or decision making as important risk factors.

workforce psychological ill-health. In this respect the paper contributes to a well established literature on workplace performance (see, for example, Machin and Stewart, 1990). Recent contributions to this literature, for example Brown *et al*. (2007), have noted the potential of subjective employee-level information, finding that employee loyalty is an important determinant of workplace performance.[5]

3. Data and Methodology

WERS 2004 is a stratified random sample of 2,295 establishments with more than 5 employees taken from the Inter-Departmental Business Register maintained by the Office for National Statistics. Information on workplace health and safety is provided as part of the main (face to face) Management Interview. In addition, a random sample of up to 25 employees are asked to complete an employee questionnaire which contains information about their personal characteristics, the nature of their employment, their job demands and job anxiety. In terms of the last, information is collected on Warr's (1990) measure of anxiety-contentment (see Wood, 2008 for a more detailed discussion). More specifically, workers are asked *'Thinking of the past few weeks, how much of the time has your job made you feel each of the following?'* where the 6 states are *'tense'*, *'calm'*, *'relaxed'*, *'worried'*, *'uneasy'* and *'content'*. For each, responses are recorded on a 5 point scale from *'never'* to *'all of the time'* (see Table 1) and (re)coded so that higher numerical values (1-5) reflect increased intensity. Consistent with previous evidence, we find a Cronbach's alpha of 0.85 indicating strong reliability and, following Wood (2008) and Bryson *et al*. (2010), we combine these items into a single subjective measure which we refer to as *job anxiety*. In constructing our index, values for *calm*, *relaxed* and *content* are negatively coded such that job anxiety increases with the aggregate index, which, averaged across the six items lies within the interval -2 to +2 for each employee.[6]

[5] While broader than our analysis of worker psychological health, there has been increasing interest in how worker well-being influences behaviour. Oswald *et al*. (2009) use two experiments (one laboratory controlled and the other a natural experiment) and find that a general measure of happiness increases effort and thus productivity in a piece rate system.

[6] We constrain the index to be available only for individuals who respond to all six items, which results in 565 employees being dropped from our analysis.

Information is available on 21,796 employees from 1,733 workplaces and the weighted mean value is -0.20.

Firstly, we estimate the relationship between job anxiety and employee, employment and workplace characteristics using OLS.[7]

$$JA_{ij} = X_{ij}\beta + Z_j\gamma + \varepsilon_{ij} \quad (1)$$

where X_{ij} refer to personal and employment related characteristics of employee *i* in workplace *j* and include age, gender, ethnicity, disability, highest academic qualification, part-time employment, temporary employment, occupation, supervisory responsibilities, whether individuals perceive themselves to be over-skilled or under-skilled and whether they are a trade union member. Workplace level controls (Z_j) include industry, log of workplace size, region, presence of an appraisal system within the employee's occupation and the composition of the workforce (female, age, temporary, full-time). We also control for organizational change (reported by the manager), performance related pay, the prevalence of team working and receipt of training. Alongside these more standard controls, it is also possible to include an indicator of co-worker job anxiety which has not been utilized in previous studies, but could capture common unobserved workplace effects and spillover effects between workers, the latter of which are noted by Cottini and Lucifora (2010).

Consistent with the theoretical model of Karasek (1979), Wood (2008) highlights the importance of job demands and the amount of control an employee has as important determinants of job anxiety. In all specifications we include occupation, supervisory responsibilities and overtime as controls for job demands but, in an additional

[7] Green (2008), Wood (2008) and Bryson *et al*. (2010) all use OLS to estimate models where the dependent variable is an index value. We test the sensitivity of the results by using a two-sided tobit model and, rounding the responses and estimating an ordered probit model. The main results are robust to these alternative estimation methods.

specification, we use self-reported information on worker effort and control.[8] Wood (2008) further argues that support from management can act as a moderator of the relationship between work and job anxiety and we similarly control for an index of perceived support.[9] We additionally include a measure of the employee perception of the security of employment since job insecurity may be one mechanism through which anxiety is generated. However, using subjective self-reported information as an explanatory variable in a model of self-reported job anxiety may be problematic, since both may be influenced by unobserved individual factors or what Green (2008) refers to as common method bias. We also estimate both specifications with workplace fixed effects (excluding workplace level variables) to control for unobserved workplace heterogeneity such as the influence of workplace culture. If these unobserved workplace influences are correlated with the explanatory variables in the above specifications, failure to account for fixed effects will produce biased results.

Employee Job Anxiety and Manager-reported Workforce Stress

As noted above, information is collected from the Management Questionnaire on both injuries sustained at work and illness caused or made worse by work. In each case a list of specific injuries (or illnesses) is provided and, therefore, the measures are restricted to cover certain types of injuries/illnesses. In terms of illnesses, the manager is asked '*In the last 12 months, have any employees suffered from any of the following illnesses, disabilities or other physical problems that were caused or made worse by their work?1) Bone, joint or muscle problems (including back problems and RSI), 2) Breathing or lung problems (including asthma), 3) Skin problems, 4) Hearing problems, 5) Stress, depression or anxiety, 6) Eye strain, 7) Heart disease/attack, or other circulatory problem, 8) Infectious disease (virus, bacteria), 9) None of these'*. As with all measures

[8] Following Wood (2008) two self-reported measures are used to create the effort index, namely, the extent of agreement with '*my job requires I work very hard*' and '*I never seem to have enough time to get my work done*'. An index of control relates to responses about the extent to which employees influence *'what tasks you do in your job'*, '*the pace at which you work'*, *'how you do your work'*, '*the order in which you carry out tasks'* and *'the time you start and finish your working day'*.

[9] The index of managerial support captures the extent to which employees feel managers '*can be relied upon to keep their promises*', '*are sincere in attempting to understand employees' views*', '*deal with employees honestly*', '*understand about employees having to meet responsibilities outside work*', '*encourage people to develop their skills*' and '*treat employees fairly*'.

of this type, responses are subject to recall bias. However, there is an additional complication in focusing on work-related ill-health rather than injuries, in that it is often more difficult for the manager to correctly to identify the cause of the illness (Robinson and Smallman, 2006).[10] As noted above, most previous studies using the illness data in WERS do not utilize the information on type of illness reported. This distinction is critical to our analysis and we focus on psychological health problems relating to *stress, depression or anxiety*, which are reported by 14.8% of workplaces or 57.2% of all workplaces reporting any health problem (see Table 2).[11,12] Confirming the earlier discussion, work-related health problems affect a greater proportion of workplaces (25.8%) than injuries (7.5%).

In analyzing incidence we form a binary stress indicator (S_j), equal to 1 if the manager indicates that employees have been affected by *stress, depression or anxiety* caused or made worse by their work in workplace *j* and 0 otherwise.[13] The underlying latent stress variable is assumed to be determined by the set of workplace characteristics, Z_j.[14] The relationship between employee job anxiety and workplace stress is examined by the inclusion of the average level of job anxiety in workplace *j* ($\overline{JA}_j$) within a probit model as follows:[15]

$$S_j^* = \overline{JA}_j\phi + Z_j\gamma + \varepsilon_j \qquad (2)$$

[10] There may also be incentives for managers not to disclose the prevalence of work-related workforce stress leading to underreporting.

[11] It is important to note the broader measure of psychological health utilized by the manager than the employee, where the latter focuses only on job anxiety.

[12] Managers who respond positively to any of items 1-8 (above) are then asked, '*How many employees have been absent owing to these problems over the last 12 months?'*. This information cannot, however, be directly related to *stress, depression or anxiety* unless this is the only work-related illness reported (which only applies to 262 workplaces out of the 816 that report workforce stress). It is therefore not utilized here.

[13] We cannot link this information to an individual employee, but know only that at least one employee at the workplace was affected. Individual level data from the Labour Force Survey indicates that about 1.5% of workers report suffering from work-related stress, depression or anxiety.

[14] We enhance the workplace characteristics slightly in this specification and include controls for the composition of the workforce in terms of ethnicity, trade union membership and disability for which we have employee level controls in the previous analysis. We also examined the role of some personal characteristics of the manager (for example, gender and length of service) but these were not significant and so are excluded from our final specification.

[15] The average is created over all employees within the workplace with a valid measure of job anxiety. We restrict the analysis to workplaces with a minimum of 3 valid job anxiety observations.

One would anticipate that the higher the level of job anxiety expressed by employees the greater the probability of the manager reporting workplace stress $(\phi > 0)$. The relationship may, however, not be linear, in that there may be a critical point at which levels of anxiety induce stress of a sufficient level to be recognized by the manager. In an alternative specification, we therefore replace the average level of job anxiety with a series of dummy variables indicating that the workplace lies in a particular quartile in the distribution of average workplace job anxiety.[16]

Work-related Psychological Health and Workplace Performance

Finally, we examine the relationship between employee job anxiety, work-related stress, and workplace performance. Consistent with the potential channels through which psychological health could affect workplace performance, we explore three measures of workplace performance, namely absence, quits and labour productivity. The manager is asked a general question on absence, namely, *Over the last 12 months what percentage of work days was lost through employee sickness or absence at this establishment?*, and are asked to exclude authorized leave of absence, employees away on secondment or courses, or days lost through industrial action. The average absence rate across workplaces is 4.5%, and is slightly higher in the public than private sector.

In addition, managers are asked *In total, how many employees (full and part-time) were on the payroll at this establishment 12 months ago? And how many of these stopped working here because they left or resigned voluntarily?* We define the quit rate as the proportion of those on the payroll one year ago that have left voluntarily. The average quit rate across workplaces is 15.7%, although it is considerably lower in the public sector.[17] Since the absence and quit rate are bounded between 0 and 100 the appropriate

[16] There is one issue in matching this information in that $\overline{JA}_j$ measures employee job anxiety over the last few weeks whereas S_j relates to workforce stress over the last year.

[17] WERS also collects information on those who have left employment '*for some other reason*'. This may include retirement due to ill health. The results, however, are similar if an aggregate measure of the quit rate due to voluntary reasons or other is used.

model is a tobit model.[18] The workplace absence and quit rates are both measured over the preceding 12 months, the same period as manager-reported *stress*. Employee job anxiety however, is measured over a shorter and more recent period, the last few weeks.

The other main channel through which employee psychological health may affect workplace performance is through preesenteeism, or reduced labour productivity without absence. In WERS managers are asked *Compared with other establishments within the same industry how would you assess your workplace's labour productivity?* Responses are ranked on a 5 point scale from (1) *A lot below average* to (5) *A lot better than average*.[19] Following previous studies we merge the lowest 2 categories given the small number of workplaces that report *A lot below average*. Despite the concentration of workplaces reporting above average performance, this subjective measure has been used extensively in the literature (see, for example, Brown *et al*., 2007) and has been found to produce informative results. There may, however, be differences in how workplace performance is measured across sectors and studies tend to constrain their analysis to the private sector. Given the importance of psychological health problems in the public sector, we consider all workplaces, although we separate our analysis by sector given the measurement issues that may be involved.[20] Note however, that while job anxiety and stress may negatively affect labour productivity, a moderate amount of pressure on employees may enhance workplace performance and job anxiety. As such, there may be an optimal amount of workplace anxiety; in all specifications we examine quartiles of the job anxiety distribution as well as average levels to capture these effects.

In 2004 information was also collected in a Financial Performance Questionnaire completed separately from the Management Questionnaire by someone with information about the financial situation of the workplace. The response rate for this element was

[18] The results are similar, if instead, we use OLS. Given the direct reporting of absence rates by the manager (rather than number of days), there is a concentration of responses at whole integers (for example, 1%), an issue not examined further here.

[19] The same question is also asked in relation to *financial performance*. We restrict our attention to the more direct ways in which psychological ill-health may influence workplace performance.

[20] Workplaces are classified as public, private or voluntary sector and we focus on the differences between the first two groups. As a result the sector specific analysis does not utilize information on the 149 workplaces classified as part of the voluntary sector.

about half (1070 workplaces) that of the main Management Questionnaire. However, the key advantage of these data is that objective information on workplace performance is collected. Given our focus on labour productivity we utilise two measures, following Bryson (2007): the log of the total value of sales per employee (full-time equivalent) and the log of value added per employee (full-time equivalent).[21] We trim the top and bottom 1% of values from both measures and estimate the models by OLS so as to consider the sensitivity of the relationship between psychological health and labour productivity between both subjective and objective measures.

In examining the link between workplace performance and employee psychological health, we use measures of $\overline{JA}_j$ and S_j. In terms of subjective labour productivity the models are given as follows:

$$P_j^* = \overline{JA}_j\phi + Z_j\gamma + \varepsilon_j \qquad (3)$$

$$P_j^* = S_j\varphi + Z_j\gamma + \varepsilon_j \qquad (4)$$

where P_j^* is the unobserved latent variable labour productivity and it is related to the observed variable as follows:

$$P_{ij} = \begin{cases} 1 & \text{if } P_{ij}^* \le c_1 \\ 2 & \text{if } c_1 < P_{ij}^* \le c_2 \\ 3 & \text{if } c_2 < P_{ij}^* \le c_3 \\ 4 & \text{if } c_3 < P_{ij}^* \end{cases}$$

where the values of the cut off points are assumed to conform to $c_1 < c_2 < c_3$. An ordered probit model is used to estimate subjective performance, where the variables included

[21] Both measures relate to the last year and are adjusted where not reported for a full calendar year. Value added is measured as total sales minus total purchases and, following Bryson (2007), we add a constant to ensure the distribution lies above zero.

within Z_j have been outlined above (but now also include how long the workplace has been established). Throughout, the analysis is weighted to correct for sampling and response bias using the weights appropriate for the level of analysis.

A problem with cross-sectional analysis of this type is inferring causality. Firstly, there is potentially reverse causality since job anxiety itself may depend on workplace performance. The direction of this effect is not clear: employees in poorly performing workplaces may report anxiety based on their perceived risk of redundancy, whereas growth in high performance workplaces may create additional pressures on employees. Secondly, despite the comprehensive set of workplace controls, there are potentially common unobserved influences on job anxiety and workplace performance, such as, the approach and quality of management. We address these issues in several ways. First, following Bryson (2007), we account for reverse causality, at least in part, by including the percentage of workers made redundant and the employment growth rate to capture elements of the workplace climate over the last year. The positive relationship between job anxiety and absence, and the relationships between psychological illness and labour productivity (using either the subjective or objective sales measure) are robust to the inclusion of these additional controls.[22]

There are two more comprehensive ways of considering the issue of endogeneity of psychological health and workplace performance. The first is to instrument work-related psychological health in the analysis and the second is to utilise the panel element of WERS. In terms of the former we follow Brown *et al*. (2007) and generate a predicted measure of average workplace job anxiety, where the prediction is based on equation (1) and thus incorporates employee characteristics into the analysis. This prediction replaces job anxiety in the workplace performance models. In addition, we simultaneously model subjective labour productivity and manager-reported stress using a semi-ordered bivariate probit model. As with many applications, is it difficult to identify appropriate instruments for workplace stress but, regardless of the precise choice of instruments, the correlation

[22] Interestingly, in the employee-level analysis redundancies and employment growth are not a significant determinant of anxiety once the subjective controls for effort and management support are included. Neither redundancies nor growth are associated with manager reported workforce stress.

between these two equations is never statistically significant and we are unable to reject the null of independence of the two equations.[23]

To investigate this issue further we use the 1998-2004 WERS panel element which follows up a random sample of 956 workplaces from the 1998 WERS. Although job anxiety is not collected in 1998, information is available at the workplace level on work-related ill-health, with *stress* included as one possible response.[24] Since stress is measured in 1998 and workplace performance is measured after this point, we can argue that any relationship is closer to a causal effect. We include a similar set of controls as in analysis of performance in 2004, although in this case all workplace characteristics are measured in 1998.

Unfortunately, the 2004 panel follow up does not contain the same measures of performance as the cross section. We are, therefore, forced to rely on alternative measures of workplace performance to estimate the impact of workplace stress in 1998. In 2004 managers are asked, relative to 1998, *Generally speaking, in establishments in your industry or field has the financial performance improved, stayed the same or deteriorated?* and this is followed up by questions (conditional on their response) which relate performance at the workplace to the industry average. We use this information to generate two measures of performance. Following Brown *et al*. (2007) we measure performance relative to the industry where responses are less than the industry average (1), equal to the industry average (2), and above the industry average (3). An absolute measure of performance is also created, where performance is reported to have improved (3), stayed the same (2) or deteriorated (1).[25] The appropriate model is again an ordered probit. We are also able to consider two additional measures of performance, namely

[23] Our preferred set of instruments relate to health and safety policies and practices at the workplace, which we assume affect employee psychological health but have no direct influence on labour productivity. We include three variables (1) meetings between senior management and the whole workforce on health and safety issues; (2) joint consultative committees which discuss health and safety; and (3) meetings between line managers and employees where health and safety is discussed. In separate analysis these variables are significant determinants of workplace stress but not subjective labour productivity.

[24] The measure in 1998 of *stress* is narrower than *stress, depression or anxiety* utilized in 2004 but is reported at a similar proportion of workplaces (24%).

[25] The two measures are positively correlated (r=0.43) and the absolute measure of performance is more strongly correlated with employment growth (r=0.18).

workplace survival and growth. Information is available for virtually all workplaces in the 1998 sample on whether the workplace has closed and, if the workplace is still operating, on the 2004 level of employment. The former is modelled using a probit model whereas the rate of employment growth between 1998 and 2004 is estimated by OLS.[26]

4. Results.

Job Anxiety

Table 3 presents OLS estimates of the determinants of employee job anxiety. The basic specification presented in column (1) is supplemented with controls for self-reported effort, loyalty, security and manager support in column (2). Overall, the results are largely consistent with the existing literature which finds that psychological ill-health is more strongly related to factors relating to the job than worker characteristics (Groot and Maassen van den Brink, 1999 and Michie and Williams, 2003). In particular, we find strong support that job anxiety is positively associated with job demands, consistent with Wood (2008).

Relative to those with no qualifications, anxiety increases with educational attainment, potentially reflecting increasing job demands. Similarly, anxiety also increases with tenure (although the effect is removed once the variables for effort and control are introduced) and with having supervisory responsibilities. Consistent with this, job anxiety is generally higher among individuals in more skilled occupations, namely managerial, professional and associate professional occupations. Consistent with the influence of effort, hours of work play a prominent role. Part-time workers are significantly less anxious, although the size of the effect is reduced when controlling for self-reported measures of effort and control, and working overtime is positively associated with job anxiety.[27]

[26] Following Bryson and Nurmi (2011) we generate a measure of log employment growth rate per annum and estimate the model by OLS. They are also able to consider sample selection bias generated from focusing on surviving firms which is not considered here.

[27] We have treated the characteristics of employment and the workplace as exogenously determined although as Cottini and Lucifora (2010) note, there may be an endogenous sorting of workers into jobs which may bias the effect of working conditions towards zero.

Interestingly, levels of co-worker job anxiety are positively correlated with own job anxiety, possibly reflecting common (unobserved) workplace characteristics or spill-over effects between workers. It is also important to note that those who report being under-skilled are considerably more anxious than those who are well matched suggesting the balance between job demands and skills is especially important. As expected, self-reported effort is positively associated with job anxiety whereas greater control over how the individual performs their work has the opposite effect. Perceived management support (and also job security) is also negatively associated with anxiety, demonstrating the importance of management policy and practice in attenuating job anxiety. There is a notable increase in the R squared between column 1 and 2, indicating the importance of subjective measures of effort, control and management support.[28] Reassuringly, the key results are robust to the inclusion of workplace fixed effects in columns (3) and (4).[29]

Workforce Stress

Table 4 presents the marginal effects associated with probit models where the dependent variable is work-related stress. In column (1) the specification includes the average level of employee job anxiety, whereas in column (2) the quartile of the job anxiety average is included. The same specifications are also presented separately for public and private sector in columns (3)-(4) and (5)-(6) respectively. Despite the focus on one particular type of health problem, relatively few of the covariates have a significant influence on manager-reported stress among the workforce. Thus, the move from individual to workplace level measures is associated with the outcome being less well determined.[30] There is no consistent significant influence of staff composition in terms of personal characteristics, but there is a negative association between a concentration of employees in skilled trades and process, plant and machine operatives, and workplace stress. Unsurprisingly, given the question relates to all employees, workplace size is important, with increased risk of reporting stress in larger workplaces and single establishment

[28] The direction of the effects are the same although the magnitude of the effects are reduced (and control becomes insignificant), if instead, co-worker effort, control and management support indices are included.
[29] Differences between the public and private sectors are relatively modest and so are not reported here.
[30] The full results for all models are available on request.

status having the opposite effect. Interestingly, manager-reported work-related physical health problems are positively correlated with reporting stress and potentially reflect differences in reporting thresholds among managers, unobserved workplace conditions or a relationship between physical and psychological health problems amongst employees.

Importantly, average levels of employee-reported job anxiety are significant and positive, suggesting that employee reports contain valuable information. A one unit change in the index (which would be equivalent to all employees reporting one rank higher) is associated with a 12 percentage point increase in the probability of manager-reported workplace stress. Further, relative to being in the lowest quartile, workplaces in the highest quartile of employee-reported job anxiety are 9 percentage points more likely to report workplace stress. A positive influence of (average) employee job anxiety is evident in both the public and private sectors, although it is stronger in the former. The results suggest that, in the private sector, only in workplaces with a high level of employee anxiety (above the median workplace) are managers are more likely to report workforce stress.

Workplace Performance

Table 5 considers the relationship between workplace psychological health and two measures of performance, namely absence (in the upper panel) and voluntary quits (in the lower panel). The three measures of psychological health, namely, average job anxiety at the workplace, the quartile of job anxiety and manager-reported stress are presented in columns (1), (2) and (3) respectively. The same results are presented for the public sector and the private sector separately in columns (4)-(6) and (7)-(9) respectively.

Relatively few workplace characteristics significantly affect workplace absence rate. Indeed, we find no relationship between management reported physical health problems and the rate of workplace absence or quits. However, there is evidence of a positive relationship between job anxiety and absence, with a one unit increase in average workplace employee job anxiety associated with a 2.90 percentage point increase in the absence rate. A similar positive effect (2.68 percentage points) is also observed if

manager-reported workplace stress is, instead, used as a measure of employee psychological health.[31] This is unsurprising since one mechanism through which managers identify stress amongst their workforce is through reported absence. Further investigation by sector suggests it is particularly in the private sector where there is a positive relationship between job anxiety and absence. In contrast, in the lower panel of Table 5, we find no evidence of a general effect of job anxiety or stress on the quit rate (columns (1)-(3)), suggesting that this is not a mechanism though which psychological health affects workplace performance.

Table 6 presents the marginal effects from an ordered probit model where workplace performance is measured by a subjective measure of labour productivity ranked from (1) 'below average' to (4) 'a lot better than average'. Similarly to Table 5, we consider the three measures of psychological health and these are presented in Panels A, B and C respectively. There is no influence of either measure of employee job anxiety on labour productivity among all workplaces. However, manager-reported workplace stress increases the probability of reporting performance at or below the industry average, and reduces the probability of reporting superior levels of performance. Further examination by sector indicates that job anxiety and stress play a more important role in the public sector; higher levels of job anxiety are associated with reduced labour productivity and management-reported workforce stress reduces the probability of performance superior to the industry average by 34 percentage points.

It is however, important to try and distinguish the mechanisms through which psychological health impacts on productivity. As such, in an additional specification (results not reported), we include controls for the quit and absence rate. The absence rate is generally negatively associated with labour productivity (although it fails to reach significance in some specifications). In contrast, the results with respect to job anxiety and stress tend to be robust to its inclusion suggesting that presenteeism may be

[31] Interestingly if $\overline{JA}_j$ is simultaneously included with S_j both remain significant and positive, indicating that each contains a separate aspect of psychological health that is correlated with absence.

important, particularly in the public sector. Interestingly, there is never a significant influence of work-related physical illness on labour productivity.

In Table 7 we present the results for the objective, log of sales, measure of productivity. In the overall model job anxiety is negatively associated with sales value, but the negative influence of stress fails to reach significance at conventional levels. Stress is, however, significant in the public sector, whereas particularly high levels of job anxiety seem to be important in the private sector. There is no evidence of a negative relationship between the measures of psychological ill-health and value added (results are not reported), although these models are generally not well determined. Overall, there is thus some evidence from the subjective and objective (sales) measures of labour productivity to suggest a negative association between work-related psychological ill-health and labour productivity. Further, where these relationships do exist they appear to do so over and above the influence of absence and labour turnover.

Sensitivity Analysis

Table 8 provides a summary of the results where average predicted job anxiety replaces average workplace job anxiety in the workplace performance models. In terms of absence, the positive relationship between job anxiety and absence remains, but is only significant in the private sector. In contrast, the relationship between anxiety and labour productivity is strengthened when using predicted values. For both subjective and objective (sales) measures there is evidence of a negative effect of job anxiety on workplace productivity.

In Table 9 workplace performance is measured between 1998-2004 and the measure of psychological health is workforce stress in 1998. The marginal effects relate to relative and absolute subjective financial performance in the upper and lower panels respectively. In short, we find no effect of stress reported by the manager on subsequent relative financial performance but there is evidence that stress is negatively associated with

absolute performance, at least within the public sector.[32] However, we find no significant effect of stress on subsequent employment growth and workplace closure within the private sector (results not reported), where such measures may be more reliably determined by performance and characteristics in 1998.[33] The latter is unsurprising since these measures of workplace performance are less clearly linked to employee psychological health.

5. Conclusions

Using matched employee-employer data for Britain from WERS 2004, this paper contributes to the emerging economic analysis of work-related psychological health. Rather than focusing purely on the determinants of employee job anxiety (Wood, 2008) or work-related stress, we examine the relationship between these measures and, with workplace performance. In this respect we extend the employee-level analysis of Leontaridi and Ward (2002).

Consistent with previous evidence, we find support for the Karasek (1979) framework: employee job anxiety is positively associated with holding a more demanding job as measured by occupation, supervisory responsibility and hours of work. Interestingly, we find employers are able to influence levels of job anxiety amongst their employees by matching job demands to skills, giving employees more discretion or control over how they do their work and providing a working environment that is perceived (by employees) to be supportive and fair. Further, we find evidence that employee reported measures of job anxiety contain valuable information which is correlated with management reports of work-related stress.

The relationship between job anxiety, work-related stress and workplace performance is less clear. In a cross sectional analysis, measures of job anxiety and work-related stress

[32] Managers are asked what they interpret as financial performance and there are dramatic differences between sectors with managers in the public sector more likely to report '*costs or expenditure*' and those in the private sector '*profit or value added*'.

[33] Closure and employment growth in the public sector are likely to be partly determined by political objectives.

are positively correlated with absence, consistent with the employee-level analysis of Leontaridi and Ward (2002). However, there is no evidence of a relationship between our measures of psychological ill-health and the workplace quit rate. Some measures of psychological ill-health are negatively associated with subjective (and some objective measures) of labour productivity. Further, these relationships exist even after controlling for absence and quit rates, suggesting presenteeism may be important. We acknowledge the potential issue of endogeneity, but find the key results are robust to sensitivity analysis based on predicted measures of job anxiety. Further, despite the imperfect measures of workplace performance available in the 1998-2004 panel, there is at least some evidence that workforce stress in 1998 has a negative influence on subsequent financial performance in the public sector.

While we have shown there to be a relationship between work-related psychological health and workplace performance we do not claim to have identified a business case for reducing employee job anxiety. Even if these associations reflect causal relationships, there may be costs associated with reducing job anxiety which employers would need to consider. It is also worth noting that our focus is on work-related psychological health, over which employers are likely to have more direct control, rather than psychological health more generally. The business case for reducing psychological ill-health amongst the workforce more generally is, therefore, not considered here.

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Table 1. Distribution of Domains of Job Anxiety

	Tense	Calm	Relaxed	Worried	Uneasy	Content
All of the time	4.16	3.53	2.93	2.38	2.23	5.17
Most of the time	15.02	30.16	22.82	9.32	7.45	32.89
Some of the time	41.39	29.11	27.59	35.12	27.90	29.86
Occasionally	27.09	26.43	28.73	31.81	32.33	21.18
Never	12.35	10.77	17.93	21.38	30.09	10.90
Mean value	2.72	2.89	2.64	2.40	2.19	3.00

Notes to table: Data are weighted and with the exception of the mean values figures refer to the percentage of employees.

Table 2. Work-related Workforce Health Problems

	Percentage of workplaces	Percentage of employees
Bone, joint or muscle problems	14.42	35.09
Breathing or lung problems	1.54	4.52
Skin problems	2.99	7.98
Hearing problems	0.16	1.60
Stress, depression or anxiety	14.75	37.82
Eye strain	1.87	4.65
Heart disease/attack or other circulatory	0.09	3.53
Infectious disease	1.70	4.40
Any of the above	25.77	51.33

Notes to table: Data are weighted. Managers can report multiple positive responses. The percentage of employees refers to the percentage of employees at workplaces where a manager reports a particular health problem.

Table 3. Employee Analysis: The Determinants of Job Anxiety

	(1)	(2)	(3)	(4)
Constant	-0.616***	0.111	-0.555***	0.096
	(8.34)	(1.35)	(10.95)	(1.51)
Female	0.022	0.022	0.018	0.019
	(1.22)	(1.40)	(1.00)	(1.24)
Age 22-29	0.081**	-0.008	0.053	-0.037
	(2.46)	(0.26)	(1.60)	(1.25)
Age 30-39	0.000	-0.097***	-0.026	-0.115***
	(0.01)	(3.23)	(0.76)	(3.77)
Age 40-49	0.004	-0.109***	-0.016	-0.126***
	(0.12)	(3.48)	(0.46)	(3.97)
Age 50-59	-0.048	-0.166***	-0.069*	-0.184***
	(1.31)	(5.09)	(1.86)	(5.56)
Age 60+	-0.337***	-0.332***	-0.364***	-0.349***
	(7.30)	(7.84)	(7.60)	(8.16)
Other academic qualifications	0.053**	0.027	0.064**	0.035
	(2.14)	(1.20)	(2.45)	(1.49)
GCSE level academic qualifications	0.053**	0.006	0.066***	0.017
	(2.23)	(0.30)	(2.58)	(0.76)
A Level academic qualifications	0.116***	0.073***	0.122***	0.075***
	(4.28)	(3.02)	(4.16)	(2.89)
Degree level academic qualifications	0.129***	0.082***	0.160***	0.103***
	(4.88)	(3.37)	(5.42)	(3.92)
Higher degree level academic qualifications	0.212***	0.129***	0.244***	0.147***
	(5.99)	(4.12)	(6.45)	(4.44)
Tenure 1-2 years	0.079***	0.022	0.102***	0.025
	(3.15)	(0.99)	(4.00)	(1.11)
Tenure 2-5 years	0.108***	0.021	0.142***	0.040**
	(4.88)	(1.11)	(6.39)	(2.01)
Tenure 5-10 years	0.122***	0.024	0.154***	0.042*
	(5.09)	(1.16)	(6.33)	(1.91)
Tenure 10+	0.196***	0.080***	0.233***	0.101***
	(7.97)	(3.73)	(9.22)	(4.47)
Disabled	0.242***	0.147***	0.242***	0.136***
	(7.58)	(4.94)	(7.21)	(4.56)
Trade union member	0.085***	0.012	0.074***	0.004
	(5.47)	(0.91)	(3.97)	(0.27)
Temporary	-0.009	-0.031	0.005	-0.012
	(0.35)	(1.31)	(0.20)	(0.49)
Part time	-0.187***	-0.113***	-0.170***	-0.106***
	(9.36)	(6.66)	(8.23)	(5.74)
Manager or senior official occupations	0.125***	0.175***	0.139***	0.170***
	(3.72)	(5.82)	(3.69)	(4.98)
Professional	0.100***	0.104***	0.122***	0.088**
	(2.92)	(3.30)	(3.19)	(2.49)
Associate professional or technical	0.083***	0.094***	0.100***	0.099***
	(2.59)	(3.20)	(2.79)	(3.10)
Administrative and secretarial	0.050	0.093***	0.055	0.089***
	(1.62)	(3.34)	(1.57)	(2.85)
Skilled trade	-0.050	-0.068**	-0.048	-0.071**
	(1.41)	(2.13)	(1.22)	(2.03)
Personal services	-0.004	0.015	0.008	0.009
	(0.11)	(0.49)	(0.21)	(0.26)
Sales and customer services	0.056	0.062*	0.049	0.053
	(1.57)	(1.91)	(1.10)	(1.37)
Process plant and machine operatives	0.006	-0.015	0.004	-0.035
	(0.16)	(0.48)	(0.10)	(1.00)

Log work place size	-0.003	-0.018***		
	(0.63)	(3.88)		
Single establishment	-0.015	0.057***		
	(1.03)	(3.79)		
Overtime	0.010***	0.004***	0.008***	0.004***
	(8.63)	(3.84)	(6.99)	(3.43)
Supervise	0.092***	0.099***	0.101***	0.109***
	(5.89)	(6.96)	(6.22)	(7.50)
Appraisal	0.031*	0.006	0.010	-0.020
	(1.84)	(0.39)	(0.35)	(0.79)
Coworker JAindex	0.309***	0.125***		
	(10.31)	(4.77)		
Overskilled	0.041***	-0.021*	0.025*	-0.027**
	(3.08)	(1.83)	(1.80)	(2.23)
Underskilled	0.288***	0.151***	0.256***	0.130***
	(9.14)	(5.37)	(7.78)	(4.49)
Organisational change	0.010***	0.008***		
	(3.44)	(2.62)		
Training	-0.055***	0.011	-0.054***	0.014
	(3.62)	(0.86)	(3.38)	(0.97)
Effort index		0.326***		0.319***
		(38.82)		(37.62)
Control index		-0.123***		-0.124***
		(13.16)		(13.10)
Management support index		-0.230***		-0.234***
		(28.55)		(27.11)
Security Index		-0.118***		-0.125***
		(18.09)		(17.26)
Workplace fixed effects	No	No	Yes	Yes
Observations	19163	18292	19206	18335
R-squared	0.12	0.36	0.24	0.45
F test (p-value)	31.16 (0.00)	100.26 (0.00)	25.38 (0.00)	125.83 (0.00)

Notes to table: Data are weighted. T statistics are reported in parenthesis where standard errors are corrected for the complex sample design. *, ** and *** indicate significance at 10, 5 and 1 percent levels respectively. Controls for region of work, industry, workforce composition, gender job concentration are also included but are not reported, as are insignificant controls for performance related pay, teamwork, non-white ethnicity and marital status.

Table 4. Workplace Analysis: The Determinants of Work-related Stress, Depression or Anxiety

	Marginal effects					
	(1)	(2)	(3)	(4)	(5)	(6)
	All		Public		Private	
$\overline{JA}_j$	0.116***		0.197**		0.092***	
	(3.06)		(1.98)		(2.68)	
$\overline{JA}_j$ Quartile 2		0.045		0.152*		-0.005
		(1.48)		(1.66)		(0.17)
$\overline{JA}_j$ Quartile 3		0.073**		0.120		0.055*
		(2.18)		(1.43)		(1.84)
$\overline{JA}_j$ Quartile 4		0.092***		0.088		0.065*
		(2.57)		(0.97)		(1.96)
Observations	1415	1415	376	376	933	933
F-test (p-value)	6.63 (0.00)	6.35 (0.00)	3.08 (0.00)	3.01 (0.00)	6.07 (0.00)	5.99 (0.00)

Notes to table: Data are weighted. T statistics are reported in parenthesis where standard errors are corrected for the complex sample design. *, ** and *** indicate significance at 10, 5 and 1 percent levels respectively. Models also include controls for industry, region, workforce composition (female, full-time, disabled, non-white, temporary, trade union member, age, occupation), workplace size, teamwork, training, organizational change, overtime and manager reported physical health problems which are not reported here.

Table 5. Employee psychological health and work-place performance: absence and quits

Absence rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		All			Public			Private	
$\overline{JA_j}$	2.903**			1.817			4.090***		
	(2.18)			(0.99)			(2.60)		
$\overline{JA_j}$ Quartile 2		0.745			0.136			0.290	
		(1.05)			(0.08)			(0.45)	
$\overline{JA_j}$ Quartile 3		2.473***			5.823**			1.784*	
		(2.78)			(2.52)			(1.96)	
$\overline{JA_j}$ Quartile 4		2.038			-0.489			3.849**	
		(1.62)			(0.29)			(2.54)	
S_j			2.684**			-0.050			2.584*
			(2.53)			(0.03)			(1.94)
Observations	1192	1192	1632	311	311	361	802	802	1180
F-test (p-value)	2.27 (0.00)	2.28 (0.00)	2.14 (0.00)	4.48 (0.00)	3.89 (0.00)	3.02 (0.00)	1.87 (0.00)	1.89 (0.00)	1.85 (0.00)
Quit rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		All			Public			Private	
$\overline{JA_j}$	-0.563			-3.881			-0.271		
	(0.19)			(1.57)			(0.07)		
$\overline{JA_j}$ Quartile 2		-3.288			-1.491			-3.076	
		(0.97)			(0.65)			(0.73)	
$\overline{JA_j}$ Quartile 3		-1.369			-1.533			-1.593	
		(0.52)			(0.67)			(0.49)	
$\overline{JA_j}$ Quartile 4		1.249			-3.666*			1.667	
		(0.39)			(1.71)			(0.42)	
S_j			-0.658			1.545			-0.858
			(0.28)			(1.04)			(0.28)
Observations	1358	1358	1860	360	360	418	903	903	1330
F-test (p-value)	3.82 (0.00)	3.90 (0.00)	4.35 (0.00)	83.62 (0.00)	82.50 (0.00)	7.79 (0.00)	2.87 (0.00)	3.64 (0.00)	3.19 (0.00)

Notes to table: Data are weighted. T statistics are reported in parenthesis where standard errors are corrected for the complex sample design. *, ** and *** indicate significance at 10, 5 and 1 percent levels respectively. Models also include controls for industry, region, workforce composition (full-time, female, disabled, trade union members, non-white, temporary, age and occupation), workplace size, when established, organizational change, teamwork, training, overtime and manager reported physical health problems which are not reported here. Coefficients are from tobit models. The sample sizes for the specifications which include job anxiety are smaller than that for manager reported stress, since each workplace is required to have a minimum of 3 respondents to the employee questionnaire.

Table 6. Employee psychological health and work-place performance: subjective relative labour productivity

	Marginal Effects			
All	*Below average*	*About average*	*Better than average*	*A lot better than average*
Panel A:				
$\overline{JA}_j$	0.004	0.015	-0.012	-0.008
	(0.32)	(0.32)	(0.32)	(0.32)
Observations			1210	
Panel B:				
$\overline{JA}_j$ Quartile 2	-0.004	-0.013	0.010	0.006
	(0.27)	(0.27)	(0.27)	(0.27)
$\overline{JA}_j$ Quartile 3	0.016	0.058	-0.045	-0.029
	(1.16)	(1.19)	(1.17)	(1.19)
$\overline{JA}_j$ Quartile 4	0.006	0.023	-0.018	-0.012
	(0.43)	(0.43)	(0.43)	(0.44)
N			1210	
Panel C:				
S_j	0.029**	0.084***	-0.075**	-0.038***
	(2.02)	(2.60)	(2.29)	(2.72)
Observations			1663	
Public Sector	*Below average*	*About average*	*Better than average*	*A lot better than average*
Panel A:				
$\overline{JA}_j$	0.014	0.368**	-0.335**	-0.047*
	(1.32)	(2.22)	(2.21)	(1.68)
Observations			292	
Panel B:				
$\overline{JA}_j$ Quartile 2	0.010	0.264*	-0.241**	-0.034
	(1.40)	(1.96)	(1.97)	(1.57)
$\overline{JA}_j$ Quartile 3	0.010	0.250**	-0.228**	-0.032*
	(1.35)	(2.08)	(2.07)	(1.66)
$\overline{JA}_j$ Quartile 4	0.012	0.313**	-0.286**	-0.040*
	(1.29)	(2.27)	(2.26)	(1.65)
Observations			292	
Panel C:				
S_j	0.009	0.333***	-0.283***	-0.059**
	(1.50)	(3.54)	(3.35)	(2.52)
Observations			340	
Private Sector	*Below average*	*About average*	*Better than average*	*A lot better than average*
Panel A:				
$\overline{JA}_j$	-0.001	-0.004	0.004	0.002
	(0.08)	(0.08)	(0.08)	(0.08)
Observations			835	
Panel B:				
$\overline{JA}_j$ Quartile 2	-0.015	-0.046	0.038	0.023
	(0.87)	(0.86)	(0.86)	(0.86)
$\overline{JA}_j$ Quartile 3	0.014	0.045	-0.037	-0.022
	(0.78)	(0.80)	(0.79)	(0.80)
$\overline{JA}_j$ Quartile 4	-0.001	-0.004	0.003	0.002
	(0.07)	(0.07)	(0.07)	(0.07)
Observations			835	
Panel C:				
S_j	0.020	0.068	-0.055	-0.034
	(1.53)	(1.56)	(1.55)	(1.55)
Observations			1227	

Notes to table: Data are weighted. '*' '**' '***' denote significance of the marginal effect from zero at the 10%, 5% and 1% level respectively. The same controls are included as in Table 5. Marginal effects are derived from ordered probit models.

Table 7. Employee psychological health and work-place performance: objective labour productivity

Log(sales)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All			Public			Private		
$\overline{JA_j}$	-0.460*			-0.760			-0.333		
	(1.89)			(1.28)			(1.56)		
$\overline{JA_j}$ Quartile 2		-0.171			-0.071			0.011	
		(0.76)			(0.15)			(0.06)	
$\overline{JA_j}$ Quartile 3		-0.430*			-0.358			-0.098	
		(1.68)			(0.63)			(0.47)	
$\overline{JA_j}$ Quartile 4		-0.433*			-0.298			-0.357*	
		(1.87)			(0.52)			(1.70)	
S_j			-0.266			-0.587**			0.008
			(1.41)			(2.10)			(0.05)
F-test (p-value)	4.74 (0.00)	4.75 (0.00)	10.71 (0.00)	74.00 (0.00)	73.04 (0.00)	104.61 (0.00)	7.72 (0.00)	8.34 (0.00)	20.69 (0.00)
Observations	594	594	713	139	139	153	398	398	497

Notes to table: Data are weighted. T statistics are reported in parenthesis where standard errors are corrected for the complex sample design. *, ** and *** indicate significance at 10, 5 and 1 percent levels respectively. The same controls are included as in Table 5. Coefficients are from OLS regressions.

Table 8. Employee psychological health and work-place performance: predicted job anxiety

Absence rate	All	Public	Private
Predicted $\overline{JA}_j$	2.821	-2.583	4.026*
	(1.56)	(0.70)	(1.79)
Observations	1161	306	776
F-test (p-value)	2.25 (0.00)	3.03 (0.00)	1.90 (0.00)
Quit rate	All	Public	Private
Predicted $\overline{JA}_j$	-2.369	-3.826	-3.183
	(0.53)	(1.05)	(0.58)
Observations	1322	355	873
F-test (p-value)	3.78 (0.00)	90.59 (0.00)	2.89 (0.00)
Subjective Productivity		Marginal Effects	
All	*Below average*	*About average*	*Better than average*	*A lot better than average*
Predicted $\overline{JA}_j$	0.043**	0.167**	-0.126**	-0.085**
	(2.27)	(2.32)	(2.32)	(2.28)
Observations		1170		
Public Sector	*Below average*	*About average*	*Better than average*	*A lot better than average*
Predicted $\overline{JA}_j$	0.009	0.563**	-0.478**	-0.095*
	(1.21)	(2.54)	(2.53)	(1.81)
Observations		287		
Private Sector	*Below average*	*About average*	*Better than average*	*A lot better than average*
Predicted $\overline{JA}_j$	0.045*	0.146*	-0.116*	-0.074*
	(1.85)	(1.87)	(1.88)	(1.84)
Observations		801		
Log(sales)	All	Public	Private
Predicted $\overline{JA}_j$	-0.579**	-2.264***	-0.292
	(2.01)	(2.79)	(1.31)
F-test (p-value)	4.83 (0.00)	79.57 (0.00)	5.45 (0.00)
Observations	578	135	387

Notes to table: Data are weighted. T statistics are reported in parenthesis where standard errors are corrected for the complex sample design. *, ** and *** indicate significance at 10, 5 and 1 percent levels respectively. The same controls are included as in Table 5.

Table 9. Employee psychological health and work-place performance: 1998-2004 panel data

	All			Public			Private		
Relative Financial Performance	*Less than industry average*	*At industry average*	*Greater than industry average*	*Less than industry average*	*At industry average*	*Greater than industry average*	*Less than industry average*	*At industry average*	*Greater than industry average*
$S_{1998\,j}$	-0.004	-0.008	0.012	0.003	0.003	-0.005	-0.015	-0.045	0.059
	(0.19)	(0.19)	(0.19)	(0.09)	(0.08)	(0.09)	(0.64)	(0.63)	(0.64)
Observations		695			242			453	
F-test (p-value)		1.92 (0.00)			18.33 (0.00)			2.23 (0.00)	
Absolute Financial Performance	*Deteriorated*	*Stable*	*Improved*	*Deteriorated*	*Stable*	*Improved*	*Deteriorated*	*Stable*	*Improved*
$S_{1998\,j}$	0.051	0.042	-0.094	0.041**	0.164**	-0.205**	-0.019	-0.016	0.035
	(1.40)	(1.54)	(1.49)	(2.12)	(2.55)	(2.77)	(0.40)	(0.39)	(0.39)
Observations		695			242			453	
F-test (p-value)		1.96 (0.00)			21.41 (0.00)			1.95 (0.00)	

Notes to table: Data are weighted. T statistics are reported in parenthesis where standard errors are corrected for the complex sample design. *, ** and *** indicate significance at 10, 5 and 1 percent levels respectively. The same controls are included as in Table 5, although here they relate to 1998 values. Results are marginal effects estimated from an ordered probit model.

Appendix Table 1 Descriptive Statistics- Employee Level

Dependent variable		Average
Job Anxiety Index	Average value of ranked responses to calm, tense, relaxed, worried, uneasy and content. Content, relaxed and calm are negatively coded. See text for more details.	-0.184
Personal characteristics	Dummy variable equals 1 if:	
Female	Female; 0 otherwise	0.535
Single (omitted)	Marital status is single; 0 otherwise	0.222
Married	Marital status is married or living with partner; 0 otherwise	0.679
Separated/Divorced	Marital status is either separated or divorced; 0 otherwise	0.099
Non-white	Non-white ethnic group (mixed, asian, black or chinese); 0 otherwise	0.059
Disabled	Has a work-limiting disability; 0 otherwise	0.045
Age 16-21 (omitted)	Employee is aged between 16 and 21; 0 otherwise	0.059
Age 22-29	Employee is aged between 22 and 29; 0 otherwise	0.155
Age 30-39	Employee is aged between 30 and 39; 0 otherwise	0.251
Age 40-49	Employee is aged between 40 and 49; 0 otherwise	0.268
Age 50-59	Employee is aged between 50 and 59; 0 otherwise	0.221
Age 60+	Employee is aged 60 and over; 0 otherwise	0.047
Tenure <1 year (omitted)	Employee has been working at this workplace for less than 1 year; 0 otherwise	0.158
Tenure 1-2 years	Employee has been working at this workplace for between 1 and 2 years; 0 otherwise	0.128
Tenure 2-5 years	Employee has been working at this workplace for between 2 and 5 years; 0 otherwise	0.268
Tenure 5-10 years	Employee has been working at this workplace for between 5 and 10 years; 0 otherwise	0.186
Tenure 10 years+	Employee has been working at this workplace for more than 10 years; 0 otherwise	0.260
No academic qualifications (omitted)	Employee's highest academic qualification is none; 0 otherwise	0.160
Other academic qualifications	Employee's highest academic qualification is other; 0 otherwise	0.156
GCSE level academic qualifications	Employee's highest academic qualification is GCSE level grade A-C; 0 otherwise	0.261
A level academic qualifications	Employee's highest academic qualification is A level or AS level; 0 otherwise	0.147
Degree level academic qualifications	Employee's highest academic qualification is degree level; 0 otherwise	0.206
Higher degree level qualifications	Employee's highest academic qualification is higher degree level (masters degree or PhD); 0 otherwise	0.069
North East	Workplace is located in the North East; 0 otherwise	0.041
North West	Workplace is located in the North West; 0 otherwise	0.137
Yorkshire and Humberside	Workplace is located in Yorkshire and Humberside; 0	0.094
East Midlands	Workplace is located in the East Midlands; 0 otherwise	0.068
West Midlands	Workplace is located in the West Midlands; 0 otherwise	0.096
East of England	Workplace is located in the East of England; 0 otherwise	0.090
London (omitted)	Workplace is located in London; 0 otherwise	0.104
South East	Workplace is located in the South East; 0 otherwise	0.123

South West	Workplace is located in the South West; 0 otherwise	0.088
Scotland	Workplace is located in Scotland; 0 otherwise	0.112
Wales	Workplace is located in Wales; 0 otherwise	0.048
Employment Characteristics	Dummy variable equals 1 if:	
Manager or senior official	Employee's occupation is manager or senior official; 0 otherwise	0.113
Professional	Employee's occupation is professional; 0 otherwise	0.120
Associate professional and technical	Employee's occupation is associate professional and technical; 0 otherwise	0.167
Administrative and secretarial	Employee's occupation is administrative and secretarial; 0 otherwise	0.190
Skilled trades	Employee's occupation is skilled trades; 0 otherwise	0.067
Personal services	Employee's occupation is personal services; 0 otherwise	0.089
Sales and customer services	Employee's occupation is sales and customer services; 0 otherwise	0.069
Process, plant and machine operatives	Employee's occupation is process, plant and machine operatives; 0 otherwise	0.074
Elementary (omitted)	Employee's occupation is elementary; 0 otherwise	0.112
Manufacturing	Employee works in the manufacturing industry; 0 otherwise	0.148
Electricity, water and gas	Employee works in the electricity, water and gas industry; 0 otherwise	0.018
Construction	Employee works in the construction industry; 0 otherwise	0.047
Wholesale and retail trade	Employee works in the wholesale and retail trade; 0 otherwise	0.098
Hotel and restaurant industry	Employee works in the hotel and restaurant industry; 0 otherwise	0.026
Transport and communication	Employee works in the transport and communication industry; 0 otherwise	0.063
Financial services	Employee works in the financial services industry; 0 otherwise	0.062
Other business services	Employee works in other business services; 0 otherwise	0.114
Public administration	Employee works in public administration; 0 otherwise	0.083
Education	Employee works in education; 0 otherwise	0.120
Health	Employee works in health; 0 otherwise	0.161
Other community services (omitted)	Employee works in other community services; 0 otherwise	0.060
Temporary	Employee is on a temporary or fixed period contract; 0 otherwise	0.079
Part-time	Employee usually works less than 30 hours per week; 0 otherwise	0.220
Trade union member	Employee is a member of a trade union or staff association; 0 otherwise	0.368
Supervise	Employee reports supervising other employees; 0 otherwise	0.346
Training	Employee has received any non-health and safety training organized or paid for by the employer during the last year; 0 otherwise	0.657
Underskilled	Employee states own skills are less than required in their job; 0 otherwise	0.045
Matched (omitted)	Employee states own skills are same as required in their job; 0 otherwise	0.422
Overskilled	Employee states own skills are more than required in their job; 0 otherwise	0.534
Only men	Employee states that the type of work they do is done only by men; 0 otherwise	0.097
Mainly men	Employee states that the type of work they do is done mainly by men; 0 otherwise	0.168
Equally by men and women	Employee states that the type of work they do is done equally by men and women; 0 otherwise	0.376

(omitted)		
Mainly women	Employee states that the type of work they do is done mainly by women; 0 otherwise	0.243
Only women	Employee states that the type of work they do is done only by women; 0 otherwise	0.057
Individual	Employee states that they are the only person doing this type of work; 0 otherwise	0.060
Overtime	Number of hours overtime (paid or unpaid) that employee typically works per week.	3.598
Effort index	Average value of ranked response to 'my job requires I work very hard' and 'I never seem to have enough time to get my work done'.	3.621
Control index	Average value of ranked response to how much influence the employee has over 'what tasks you do in your job', 'the pace at which you work', 'how you do your work', 'the order in which you carry out tasks' and 'the time you start and finish your working day'.	1.985
Management support index	Average value of ranked responses to the extent to which employees feel managers 'can be relied upon to keep their promises', 'are sincere in attempting to understand employees' views', 'deal with employees honestly', 'understand about employees having to meet responsibilities outside work', 'encourage people to develop their skills' and 'treat employees fairly'.	3.403
Secure index	Rank response to 'I feel my job is secure in this workplace'	3.625
Workplace Characteristics		
Single establishment	Dummy variable equals 1 if workplace is a single independent establishment not belonging to another body; 0 otherwise	0.183
Log workplace size	Log of the total number of employees in workplace.	4.767
Established	Number of years for which the organization has been established	47.187
Payment by results	Dummy variable equals 1 if any employees at the establishment receives payment by results; 0 otherwise	0.291
Merit pay	Dummy variable equals 1 if any employees at the establishment receives merit pay; 0 otherwise	0.268
% Female	Proportion of the workforce who are female.	0.514
% Temporary	Proportion of the workforce who hold non-permanent jobs.	0.057
% Full-time	Proportion of the workforce who are employed full-time.	0.749
% Aged over 50	Proportion of the workforce who are aged over 50.	0.220
% Aged less than 21	Proportion of the workforce who are aged between 16-21.	0.071
Appraisal (in occupation)	Dummy variable equals 1 if the manager reports that there is a formal appraisal system in the employees occupational group; 0 otherwise	0.740
Teamwork 100%	Dummy variable equals 1 if 100% of the largest occupational group work in teams; 0 otherwise	0.413
Teamwork 80-100%	Dummy variable equals 1 if 80-100% of the largest occupational group work in teams; 0 otherwise	0.252
Teamwork 0-80% (omitted)	Dummy variable equals 1 if 0-80% of the largest occupational group work in teams; 0 otherwise	0.336
Co-worker job anxiety	Average value of the job anxiety index for all other workers within the same workplace.	-0.184
Index of organizational change	Number of changes to the workplace introduced by management over the last 2 years.	3.934

Notes to table: Data are unweighted. Average over all employees.

Appendix Table 2 Descriptive Statistics- Workplace Level

Dependent variables		Average
Work-related stress (S_j)	Dummy variable equals 1 if manager reports stress, depression or anxiety which is caused or made worse by work among the workforce; 0 otherwise	0.371
Labour Productivity	Manager ranked response relating to workplace labour productivity in comparison to other workplaces within the same industry. Ranked from *below average* (1) to *a lot better than average* (4)	2.494
Absence rate	Percentage of work days lost due to sickness or absence.	5.038
Quit rate	Percentage of employees (measured 1 year ago) who have left voluntarily.	13.270
Employment Characteristics	Dummy variable equals 1 if	
North East	Workplace is located in the North East; 0 otherwise	0.040
North West	Workplace is located in the North West; 0 otherwise	0.120
Yorkshire and Humberside	Workplace is located in Yorkshire and Humberside; 0 otherwise	0.086
East Midlands	Workplace is located in the East Midlands; 0 otherwise	0.075
West Midlands	Workplace is located in the West Midlands; 0 otherwise	0.098
East of England	Workplace is located in the East of England; 0 otherwise	0.089
London	Workplace is located in London; 0 otherwise	0.131
South East	Workplace is located in the South East; 0 otherwise	0.137
South West	Workplace is located in the South West; 0 otherwise	0.076
Scotland	Workplace is located in Scotland; 0 otherwise	0.097
Wales (omitted)	Workplace is located in Wales; 0 otherwise	0.051
Manufacturing	Manufacturing industry; 0 otherwise	0.135
Electricity, water and gas	Electricity, water and gas industry; 0 otherwise	0.020
Construction	Construction industry; 0 otherwise	0.049
Wholesale and retail trade	Wholesale and retail trade; 0 otherwise	0.140
Hotel and restaurant industry	Hotel and restaurant industry; 0 otherwise	0.048
Transport and communication	Transport and communication industry; 0 otherwise	0.063
Financial services	Financial services industry; 0 otherwise	0.057
Other business services	Other business services; 0 otherwise	0.122
Public administration	Public administration; 0 otherwise	0.060
Education	Education; 0 otherwise	0.091
Health	Health; 0 otherwise	0.154
Other community services (omitted)	Other community services; 0 otherwise	0.062
Manager or senior official	Proportion of workforce in manager or senior official occupations.	0.108
Professional	Proportion of workforce in professional occupations.	0.110
Associate professional and technical	Proportion of workforce in associate professional and technical occupations.	0.113
Administrative and secretarial	Proportion of workforce in administrative and secretarial occupations.	0.157
Skilled trades	Proportion of workforce in skilled trades occupations.	0.070
Personal services	Proportion of workforce in personal service occupations.	0.082
Sales and customer services	Proportion of workforce in sales and customer services occupations.	0.137
Process, plant and machine	Proportion of workforce in process, plant and machine operatives occupations.	0.087

operatives		
Elementary (omitted)	Proportion of workforce in elementary occupations .	0.127
Temporary	Proportion of workforce on temporary or fixed period contract.	0.062
Full-time	Proportion of workforce working full-time.	0.725
Trade union member	Proportion of workforce who are trade union members.	0.275
Female	Proportion of workforce who are female.	0.510
Disabled	Proportion of workforce who are work-limited disabled.	0.012
Aged less than 21	Proportion of workforce who are aged between 16-21.	0.090
Aged over 50	Proportion of workforce who are aged over 50.	0.211
Non-white	Proportion of workforce who are from a non-white ethnic group.	0.080
Workplace Characteristics	Dummy variable equals 1 if	
Payment by results	Any employee at the establishment receives payment by results; 0 otherwise	0.316
Merit pay	Any employees at the establishment receives merit pay; 0 otherwise	0.245
Appraisal	Manager reports that there is a formal appraisal system at the workplace; 0 otherwise	0.862
Teamwork 100%	100% of the largest occupational group work in teams; 0 otherwise	0.390
Teamwork 80-100%	80-100% of the largest occupational group work in teams; 0 otherwise	0.223
Teamwork 0-80% (omitted)	0-80% of the largest occupational group work in teams; 0 otherwise	0.387
Train 100%	100% of the largest occupational group have been given training; 0 otherwise	0.302
Train 80-100%	80-100% of the largest occupational group have been given training; 0 otherwise	0.135
Train 60-80%	60-80% of the largest occupational group have been given training; 0 otherwise	0.105
Train 0-60% (omitted)	0-60% of the largest occupational group have been given training; 0 otherwise	0.458
Overtime 100%	100% of the largest occupational group regularly work overtime; 0 otherwise	0.081
Overtime 80-100%	80-100% of the largest occupational group regularly work overtime; 0 otherwise	0.080
Overtime 0-80% (omitted)	0-80% of the largest occupational group regularly work overtime; 0 otherwise	0.839
Physical health problem	Manager reports any work-related physical health problem among workforce; 0 otherwise	0.384
Single establishment	Dummy variable equals 1 if workplace is a single independent establishment not belonging to another body; 0 otherwise	0.227
Log workplace size	Log of the total number of employees in workplace.	4.457
Index of organization change	Number of changes to the workplace introduced by management over the last 2 years.	3.705
Established	Number of years for which the organization has been established	43.032
Redund	Percentage of employees (in employment last year) that have been made redundant.	1.553
Control Index	Average of manager ranked response to perceptions to which employees have variety, discretion, control and input into their job design.	
Workplace Measures		
$\overline{JA}_j$	Average JA across all employees in the employee sample at workplace *j*.	-0.193
$\overline{JA}_j$ Quartile 1 (omitted)	Dummy variable equals 1 if workplace in lowest quartile with respect to $\overline{JA}_j$; 0 otherwise.	0.250
$\overline{JA}_j$ Quartile 2	Dummy variable equals 1 if workplace in second quartile with respect to $\overline{JA}_j$; 0 otherwise.	0.250
$\overline{JA}_j$ Quartile 3	Dummy variable equals 1 if workplace in third quartile with respect to $\overline{JA}_j$; 0 otherwise.	0.250
$\overline{JA}_j$ Quartile 4	Dummy variable equals 1 if workplace in highest quartile with respect to $\overline{JA}_j$; 0 otherwise.	0.251
Predicted $\overline{JA}_j$	Average predicted JA across all employees in the employee sample at workplace *j*.	-0.203
Financial Performance		
Log (sales)	Logarithm of the value of sales per full-time equivalent (workplace level)	4.154
Log (value-added)	Logarithm of value-added per full-time equivalent (workplace level)	9.538

Notes to table: Data are unweighted. Average over all workplaces in sample where the information is available.

WERS Panel 1998-2004

Dependent variables		Average
Closed	Dummy variable equals 1 if workplace surveyed in 1998 has closed by 2004; 0 otherwise	0.125
Employment change	Log employment growth rate per annum between 1998 and 2004.	-0.007
Relative Financial Performance	Manager ranked response relating to workplace financial performance relative to industry average.	2.257
Absolute Financial Performance	Manager ranked response relating to workplace financial performance.	2.468

Notes to table: Data are unweighted. Average over all workplaces in sample.