DISCUSSION PAPER SERIES

IZA DP No. 661

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December 2002

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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ABSTRACT

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Efficiency wage theory predicts that the wage per unit of effort will be lower in intensively monitored sectors. This wage differential will increase in effort. Using employer-employee matched data from Ghana we provide evidence supporting this hypothesis.

JEL Classification: J41

Keywords: efficiency wages, monitoring

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* Thanks are due to Francis Teal for provision of the data. We are also grateful for comments received at the University College Dublin Applied Economics workshop. All remaining errors are our own.

1. Introduction

It has been shown theoretically that more intensive monitoring can have an ambiguous effect on wages if effort is chosen endogenously (see Walsh (1999) and Goerke (2001)). Goerke (2001) notes that the empirical literature has also been inconclusive regarding the relationship between monitoring intensity and wages. Theory does, however, predict a negative relationship between supervision intensity and the wage per unit of effort, which will be increasing in effort. In this paper we provide empirical support for this.

2. Outline of Theoretical Framework

Workers are identical, live forever, and have the following instantaneous utility function:

$$u = w - g(x) \tag{1}$$

The real wage is w and g(x) is a convex function of effort (x). In a multi-sector version of Shapiro and Stiglitz (1986), Walsh (1999) derives the wage that satisfies the no-shirking condition in sector i as:

$$w_i = g(x_i)[1 + \frac{b + r}{q_i}] + c \tag{2}$$

The Poisson arrival rate of exogenous job separations and supervisors are b and q_i respectively, the discount rate is r, and the value of unemployment is c. This comprises benefits B plus the value of job offers to the unemployed, and is constant across sectors. Equation (2) gives the relationship between x and w in the firm's profit function which is:

$$Max_{w_i, l_i} p = p_i f[x_i (w_i)^{A_i} l^{B_i}] - w_i l_i \tag{3}$$

The price level is p, f the production function, and the weights on effort and wages are (A,B). It is straightforward to show that we can choose the units of effort such that in the least effort intensive sector k we get the Solow (1979) model $A_k = B_k$. We can allow

the intensity of effort in the production function ($\frac{A_i}{B_i}$) to vary across ssectors.[1] For sectors other than sector k $A_j > B_j$. The profit maximising choice of w and n implies:

$$x_{iw_i} \frac{w_i}{x_i} = \frac{B_i}{A_i} \tag{4}$$

It can be easily shown imposing condition (4) on equation (2) that given effort intensity, a sector with more intensive monitoring will choose higher effort. The wage can be derived as:

$$w_i = \frac{c}{1 - \frac{1}{e_{g(x_i)}} \frac{A_i}{B_i}} \tag{5}$$

where $e_{g(x_i)}$ is the elasticity of the disutility of effort with respect to effort, and whether this is increasing or decreasing in effort will determine whether the impact of monitoring intensity on wages is positive or negative. Differences in effort intensity ($\frac{A_i}{B_j}$) will provide an additional ambiguity in terms of the impact of monitoring on the wage. It is clear from equation (2) that at a given effort level wages are unambiguously lower the greater the monitoring intensity and that this differential is greater for higher effort levels.

3. Empirics

The data used for our empirical analysis are drawn from the fifth wave of the *Regional Programme for Enterprise Development* (RPED) survey dataset for Ghana manufacturing firms operating in the Food, Textiles and Garments, Wood and Metals sectors collected by the Centre for Studies of African Economies (CSAE) at the

[1] Akerlof and Yellen (1986) and Ramana and Rowthorn (1991) argue that the Solow (1979) model may be too restrictive.

University of Oxford.[2] The RPED data set is essentially an employer-employee matched data in that, while each firm was interviewed for information at the firm level, additionally up to twenty of its workers, representative of ten broad occupation categories, were interviewed, providing us with a rich set of characteristics of controls for our wage equation to be estimated.[3] In terms of the current paper there are three main variables of interest. First we use information on the breakdown of employment by occupation category at the level of the firm to generate a proxy of monitoring intensity, calculated as the percentage of managers and supervisor employed, MONITORING. Most importantly, the RPED data set provides us with a direct measure of the effort exerted at the worker level. Specifically, the worker is asked whether he/she at the end of the day is (a) very tired, (b) tired, (c) not really tired, and (d) not tired at all. We use this information to construct our measures of effort, EFFORT, a simple zero-one type dummy variable taking on the value of one if answers (a) or (b) were chosen, and zero otherwise. Related to the level of effort, the worker is asked "Is it busy at work at present?". We interpret this as an indicator of shocks to the demand for worker level effort, and created a zero-one type dummy variable, BUSY, that we can use as an instrument for effort.[4] Overall non-missing observations for all variables left us with a sample of 1600 workers employed in 154 firms. Summary statistics for our most important variables are provided in Table 1.

We first estimated a wage equation for the whole sample excluding our effort variable using OLS – shown in the 1st column of Table 2. As can be seen, the monitoring intensity within the firm acts to significantly decrease a worker's wage rate. Repeating this separately for those that exert effort and those that do not in columns 3

[2] We use this wave rather than, or in addition to, earlier waves given that it is only the latter wave that provides information on the effort level of the worker.
[3] For a description of the data set see Goerg et al (2002).
[4] See, for instance, Goldsmith et al (2000) for a discussion on the likely endogeneity of effort in a wage equation. This is also clear from our theoretical model. In our wage equation the need to instrument was confirmed by a simple Hausman test.

and 4, one can see that supervision has a much larger negative impact on the wage rate for those exerting effort, than those that do not, although the latter is not significant.[5] Including our effort variable in the wage equation in column 4, but using Two Stage Least Squares to take account of the potential endogeneity of this variable using BUSY as an instrument, shows that effort acts to increase earnings as theory would suggest. In contrast, although still negative, the rate of monitoring is not a significant determinant of the wage rate. Most importantly, we investigated in the last column whether supervision affects the wage rate through effort, as would be predicted by theory, by including their interaction term.[6] The negative and significant coefficient on the interaction term shows that the rate of supervision acts to determine the pay of workers by operating through the effort variable – in other words, a higher rate of monitoring lowers the wage rate for those workers that exert effort. We thus find empirical support for our theoretical contention.

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[5] However, it must be noted that the lack of significance could be due to the much smaller sample size.
[6] The inclusion of this interaction term necessitates the use of another instruments due to its endogeneity, and the most natural candidate was the interaction of supervision with our BUSY variable.

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Table 1 – Summary Statistics

	LOG_WAGE		EFFORT		MONIT	
	Mean	*St. Dev.*	*Mean*	*St. Dev.*	*Mean*	*St. Dev.*
Total	1.22	0.86	0.74	0.44	0.17	0.12
EFFORT=1	1.18	0.85	---	---	0.17	0.11
EFFORT=0	1.31	0.87	---	---	0.16	0.12

Table 2 – The Impact of Effort and Monitoring on Earnings

	(1)	(2)	(3)	(4)	(5)
EFFORT	---	---	---	1.174*	2.000**
				(0.610)	(0 .991)
EFFORT*MONIT	---	---	---	---	-8.676*
					(5.041)
MONIT	-0.587*	-0.641*	-0.317	-0.485	5.560
	(0.330)	(0.351)	(0.369)	(0.387)	(3.615)
First Stage EFFORT:					
BUSY	---	---	---	0.123***	0.249***
				(0.037)	(0.066)
BUSY*MONIT	---	---	---	---	-0.618**
					(0.270)
First Stage EFFORT*MONIT:					
BUSY	---	---	---	---	0.060***
					(0.014)
BUSY*MONIT	---	---	---	---	-0.239***
					(0.056)
SAMPLE: EFFORT =	All	1	0	ALL	ALL
N	1600	1179	421	1600	1600
F-Test (b_i=0)	46.5***	36.4***	16.6***	556.7***	539.8***
R^2	0.57	0.59	0.66	0.22	0.21

Notes: (1) Dependent variable is the log hourly wage rate. (2) ***, **, and * are one, five, and ten per cent significance levels, respectively. (3) Firm level controls include: employment size, regional location dummies, sector dummies, incidence of state ownership, percentage of union membership, capital intensity, and percentage of foreign ownership of each firm. (4) Worker level controls include level of education, occupation dummies, tenure and its squared value, work experience at the start of the job and its squared valued, gender dummy, race dummy, marital status dummy, union membership dummy, relative of firm owner dummy, and permanent worker status. (5) In all specifications we allow for error terms to be correlated across workers within the same firm.

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