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A Test of the Fair Wage-Effort Hypothesis : An Analysis of Questionnaires[1]

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Abstract

This paper examines the empirical validity of the fair wage-effort hypothesis of George Akerlof and Janet Yellen [1990], which postulates that workers' effort depends on the relation between fair and actual wages. The data is taken from a survey within an electronics manufacturer in California, in which factory operators are asked to fill out anonymous questionnaires on their work attitudes, job satisfaction, and work environment. A discrete-choice model is developed to deal with the questionnaire data. The estimated model exhibits a significant effect of perceived fairness of pay on workers' effort, lending support for the fair wage-effort hypothesis.

I. Introduction

One major challenge facing economists is to explain why firms do not adjust wages very much in response to labor market conditions, particularly at the times of low labor demand. The downward rigidity in wages forces the firms in need of lowering labor costs to reduce labor input rather than cutting wages, causing a

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certain fraction of the labor force to be unemployed[2]. The efficiency wage model of George Akerlof and Janet Yellen [1990] is one of the latest endeavors to explain the existence of wage rigidity and unemployment. Unlike prior versions of efficiency wage models, it is capable of offering a coherent account for various empirical regularities, such as (i) wage compression within a firm among individuals with different skill levels, (ii) higher unemployment among less skilled workers, and (iii) the apparent failure of across-the-board improvement of education in reducing the aggregate unemployment rate.

The central premise of the Akerlof-Yellen model mentioned above is the fair wage-effort hypothesis, which states that each worker has a conception of a fair wage and will withdraw effort as the actual wage falls short of the fair wage. When the fair wage of a group of unskilled workers happens to depend on the actual wage of more skilled workers, one can deduce the commonly observed pattern of unemployment-skill correlation (i. e. higher unemployment for less skilled workers).

Essential as it is for the whole model, the fair wage-effort hypothesis has not undergone very much of empirical testing. Akerlof and Yellen motivate their hypothesis by experimental results from adjacent disciplines (e. g. sociology and social psychology) as well as various anecdotal evidences. A few studies, such as Levine [1993], Fehr et al. [1993], Cambell and Kamlani [1997], find some empirical relevance of the hypothesis, but all their results are obtained in experimental settings[3]. This paper is one the first econometric tests of the fair wage-effort hy-

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2. If instead wages are perfectly flexible, then they will go down to the market-clearing level and there will be no unemployment at any time.

3. Levine [1993] and Cambell and Kamlani [1997] present to corporate executives hypothetical situations which impel the firms to cut labor costs and ask them possible reasons why they would refrain from massive wage cuts. Fehr et al. [1993] analyzes an experiment of one-sided auction in which the employers offer wages and the workers, upon acceptance of the offer, determine the level of work effort.

pothesis in a non-experimental setting[4]. It utilizes a survey that contains information about both workers' perception of fairness of their pay and the effort level at work. A regression analysis based on the survey data turns out to yield a result that is consistent with the fair-wage effort hypothesis : how fair the workers consider their pay has a statistically significant effect on their effort level.

The rest of the paper is organized as follows : the next section describes the data and explains the framework of the test. Section Ⅲ presents the empirical results. Section Ⅳ summarizes the findings and concludes the paper.

Ⅱ. Data and Empirical Framework

The data set comes from an internal survey conducted (for quality-improvement purposes) in 1989 in a factory of an electronics manufacturer in California. It consists of 320 anonymous responses from factory operators in six different departments. Each questionnaire contains questions about working environment as well as workers' attitudes, among which are *1)* whether the supervisor is fair in rewarding the employees in the department and *2)* whether the respondent takes any remedial action when he or she defects a defect on the production line. The former (question *1)* in the above) concerns the perceived fairness of the amount of pay, while the latter (question *2)* in the above) concerns each worker's effort level. The answers to the both questions are given in the form of one of the five scales ranging from "almost always (more than 80% of the time)" to "almost never (less the 20% of the time)". If workers with higher opinions about the fair-

4. Notable exceptions which use real-world data to test the fair wage-effort hypothesis are Tahar [1993] and Van-Rijckeghem and Weder [2001]. The former estimates wage equations to examine the degree of interdependence among wages (an implication of the fair wage-effort hypothesis), while the latter examines the effect of wage differentials (between public and private sector) on corruption. Yet, neither of these studies uses workers' assessment of fairness of their pays, making the power of their hypothesis tests relatively limited.

ness of their pay turn out to respond more frequently to defects, then it would lend a support for the fair wage-effort hypothesis.

The regression equation used for the hypothesis test is very straightforward. Since the effort measure can take only five values, we use the following ordered probit model :

$$\Pr(y=j|x)=\Pr(\alpha_j>y^*>\alpha_{j-1})=\Phi(\alpha_j-x'\beta)-\Phi(\alpha_{j-1}-x'\beta)$$
$$j=1,\ 2,..\ ..,\ 5,\quad -\infty=\alpha_0<\alpha_1=0<\alpha_2...<\alpha_4<\alpha_5=\infty \qquad \cdots\cdots\cdots\cdots\ (1)$$
$$y^*=x'\beta+u$$

where the dependent variable y is equal to 5 if the respondent always (i.e. more than 80% of the time) stops the machine upon finding defects, losing its value as he or she stops the machine less frequently ; x is a vector of explanatory variables including each respondent's perception of fairness of the pay ; α_j is the latent threshold value ; y^* is the latent effort level of each respondent ; β is a vector of the slope coefficients ; u is an error term following the standard normal distribution N (0,1) ; and finally, Φ is the cumulative function of the standard normal distribution. The Appendix explains in detail how the regression variables (y and x) are constructed from the survey questions.

A couple of remarks on the above model are in order. First, it is possible that some workers do not stop the production line to remove defects since they are not capable of detecting product defects at all and/or they are not expected to stop the line even if product defects occur. In order to rule out such cases, the sample is restricted to those who answered that more than 40% of the time *a)* they know when the process is producing a product with defects and *b)* they are expected to stop the line when product defects occur[5]. This enables us to identify those who know-

5. As will be discussed later, the cut-off probability of 60% is not crucial to the empirical results. The regression results turn out to be very similar eve if the cut-off probability is altered to different values.

ingly let defected products pass through the production line.

Secondly, one may wonder if the respondents (especially those who usually withdraw efforts) give honest answers. There is no way to check this, yet the survey was completely anonymous and was designed so that no particular individual can be traced from the questionnaire. Furthermore, even after restricting the sample to those who are able to and responsible for removing defects, the self-reported reactions turn out to be well-spread from "almost never stop the machine ($y=1$)" to "almost always stop the machine ($y=5$)". (See Table 1 for the detailed distribution.)

Thirdly, it may seem plausible that the firm is paying a fair wage to prevent the workers from withdrawing efforts, causing the estimated coefficients to have simultaneity bias. That would be the case if the vector of explanatory variables x includes *actual wage paid*, which will be determined simultaneously with workers' effort levels. Yet, it is each worker's *subjective evaluation* (on the fairness of the pay)-not the actual wage-that is included in x. Therefore, as long as there is a sufficient degree of variation in each worker's notion of the fair wage, the worker's evaluation can be treated as exogenous, and we can correctly measure the effect of the perceived fairness on each worker's effort level.

Table 1 Operators' reaction to defects : those who are able to and expected to remove the defects

Frequency of stopping Machine	Almost never (0-19%) $y=1$	Sometimes (20-39%) $y=2$	Usually (40-59%) $y=3$	Mostly (60-79%) $y=4$	Almost always (80-100%) $y=5$	Total
# of respondents (percentage)	20 (11.6%)	18 (10.5%)	27 (15.7%)	39 (22.7%)	68 (39.5%)	172 (100%)

Notes : Sample restriction is based on the answer to the two questions, namely, *a)* whether the respondent knows when the process is producing a product with defects and *b)* he or she is expected to stop the line when a product defect occurs. Those who answered "usually" or "mostly" or "almost always" to both questions are included in the sample.

Ⅲ. Empirical Results

Let us now look at the estimation results of the ordered probit model presented above. The first column of Table 2 presents the result when we use only the intercept terms and perceived fairness of pay (denoted by FAIRWAGE) as explanatory variables. All the regression coefficients (including the one for FAIRWAGE) are statistically significant (with p-value of less than 5%) with a sign consistent with the fair wage-effort hypothesis.

The basic specification used above is arguably too simple, since workers' effort levels (measured here by how frequently they respond to defects) may well be in-

Table 2 Ordered Probit Regressions of Worker's Effort

	(1)	(2)	(3)
const	0.803	0.707	0.927
	(0.19)^{3*}	(0.32)^{2*}	(0.46)^{2*}
FAIRWAGE	0.156	0.144	0.139
	(0.06)^{2*}	(0.06)^{2*}	(0.06)^{2*}
SATISFCN		0.032	
		(0.08)	
LIKEJOB			0.045
			(0.08)
SUPERV			−0.067
			(0.08)
α_2	0.433	0.433	0.440
	(0.07)^{3*}	(0.07)^{3*}	(0.07)^{3*}
α_3	0.912	0.899	0.912
	(0.06)^{3*}	(0.06)^{3*}	(0.06)^{3*}
α_4	1.516	1.508	1.499
	(0.08)^{3*}	(0.09)^{3*}	(0.08)^{3*}
log likelihood at convergence	−257.10	−254.54	−251.36
# of obs	176	174	172
% correctly predicted	39.21	39.08	39.53

Notes : The estimation is based on the maximum likelihood method Inside the parentheses are the standard errors. Threshold parameters α_1 and α_5 are set equal to 0 and ∞, respectively. Superscripts 3*, 2*, *represent statistical significance at 1, 5, 10%, respectively.

fluenced by other factors than perceived fairness of their pay. Unfortunately, the data has very little information about workers' individual characteristics. Among a few exceptions is the degree of each worker's job satisfaction, which can be measured by the responses to the following questionnaire statements : (i) "I like the kind of work I do." and (ii) "Considering everything, I am satisfied with my job." As before, theses two statements are rated in five scales, ranging from "strongly agree (=5)" to "strongly disagree (=1)". (In the regression, the answers to questions (i) and (ii) are denoted by SATISFCN and LIKEJOB, respectively.)

Columns (2) and (3) of Table 2 present the regression results when the measures of job satisfaction (i.e. SATISFCN and LIKEJOB) are added to the basic specification. It turns out that none of the job satisfaction measures has a significant effect on the effort level. In contrast, the coefficient on FAIRWAGE (the perceived fairness of the amount of pay) remains significant.

In addition to measures of job satisfaction, another variable measuring the strictness of supervision (SUPERV) has been included in the regression. This variable is derived from a questionnaire statement "I get feedback about my poor performance". Interestingly enough, the coefficient for this variable turns out to be *negative* (although not highly significant), as can be seen in column (3) of Table 1. This means that, contrary to the so-called "shirking version" of the efficiency wage model by Shapiro and Stiglitz [1984], workers tend to expend less effort as they feel more tightly monitored.

So far we have seen the results when we use the data from the entire factory, which actually consists of six departments (based on the production process involved). As the data set enables us to identify the department each worker belongs to, we will divide the sample by department and examine whether or not the estimated coefficient on FAIRWAGE will remain significant. As we can see in Table 3, the result of the regression by department turns out to be somewhat mixed ; in

Table 3 Ordered Probit Regressions of Worker's Effort by Department

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
department	all	1	2	3	4	5	6
const	0.803	0.617	0.496	0.981	1.260	1.022	0.242
	(0.19)3*	(0.70)	(0.44)	(0.48)*	(0.40)3*	(0.45)2*	(0.55)
FAIRWAGE	0.156	0.073	0.145	0.347	0.043	0.221	0.339
	(0.06)2*	(0.21)	(0.16)	(0.19)*	(0.12)	(0.14)	(0.20)
α_2	0.433	0.406	0.423	0.652	0.559	0.367	0.205
	(0.07)3*	(0.19)*	(0.16)3*	(0.29)2*	(0.13)3*	(0.17)2*	(0.15)
α_3	0.912	0.760	1.125	1.546	0.937	0.908	0.544
	(0.06)3*	(0.19)3*	(0.14)3*	(0.18)3*	(0.12)3*	(0.15)3*	(0.20)3*
α_4	1.516	1.271	1.488	1.846	1.834	1.441	1.433
	(0.08)3*	(0.27)3*	(0.17)3*	(0.20)3*	(0.19)3*	(0.18)3*	(0.32)3*
log likelihood at convergence	−257.10	−23.15	−46.49	−23.56	−71.06	−45.06	−25.43
# of obs	176	15	30	19	49	39	19
% correctly predicted	39.21	33.33	13.33	52.63	34.69	58.97	42.11

Notes : The estimation is based on the maximum likelihood method. Inside the parentheses are the standard errors. Threshold parameters α_1 and α_5 are set equal to 0 and ∞, respectively. Superscripts 3*, 2*, *represent statistical significance at 1, 5, 10 %, respectively.

three out of the six departments (columns (4) (6) (7)), the estimated coefficients for FAIRWAGE are weakly significant with p-value of 10%-20%, while they become insignificant for other three departments. Apparently, the regression coefficient from aggregate date is not robust. Why the significance level of FAIRWAGE differs across department is a puzzle. The sample size might be too small for each department to evaluate statistical significance by the asymptotic distribution theory.

Ⅳ. Conclusion

For nearly two decades, the efficiency wage theory has been one of the most influential explanations of wage rigidity and involuntary unemployment. The Akerlof-Yellen model [1990] is one of the latest and most comprehensive versions of the efficiency wage theory, and it is built on a hypothesis (i. e. the fair wage-effort hypothesis) that workers' effort depends on the relation between actual and fair

wages. Essential as it is to the whole model, this hypothesis has not undergone much empirical testing except in experimental settings. Using questionnaire responses from factory operators, this paper conducts one of the first empirical tests of the hypothesis in a non-experimental setting.

An ordered probit model (regressing workers' effort levels on their perception of the fairness of their pay) is estimated with a result consistent with the fair wage-effort hypothesis. While the regression result has some weakness (such as the lack of robustness against sample divisions and the shortage of information about individual characteristics), it would at least be good for supplementing the favorable (experimental and anecdotal) evidences presented in previous studies.

Appendix : Construction of the Variables used in the Regressions

Dependent Variable

The ordinal variable, y, is constructed from each worker's response to the following questionnaire statement : "I stop the line when product defects occur". The original answer is given by one of the five choices, namely, "almost never (0-19%)", "sometimes (20-39%)", "usually (40-59%)", "most of the time (60-79%)", and "almost always (80-100%)". Values 1 to 5 are assigned to y, with the ascending frequency of stopping the line.

The sample is conditioned by the responses to the following two questionnaire statements : "I know when the process is producing a product with defects" and "I am expected to stop the line when product defects occur". Only those who replied "usually (40-59%)"or "most of the time (60-79%)"or "almost always (80-100%)" to both questions are included in the sample.

Independent Variables

Variable name and the corresponding questionnaire statement are as follows :

FAIRWAGE : "My supervisor is fair in the way he or she rewards employees in the department."

LIKEJOB : "I like the kind of work I do."

SATISFCN : "Considering everything, I am satisfied with my job."

SUPERV : "I get feedback about my poor performance."

The original answers are given by one of the five choices, namely, "strongly disagree", "disagree", "neutral", "agree", and "strongly agree". Values 1 to 5 are assigned accordingly.

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