Labour Economics 1 (1994) 383–390. North-Holland

Replication Study

Stochastic reservation and offer wages*

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Received September 1991; final version received August 1993

Abstract

Relative employee and employer ignorance on the labor market is estimated by a two-tiered earnings frontier approach. The results show that some employees are less informed than others, but employers' information does not markedly differ between individual characteristics of employees.

Key words: Wages; Two-tiered frontier model

JEL classification: J3

1. Introduction

Empirical results indicate that workers who possess equivalent bundles of observable characteristics may earn quite different wage levels. One line of research to explain such unexplained differences applies self-selection models. These models attempt to take account of the influence of unobservables. Another approach has been proposed by Polachek and Yoon (1987) who develop a two-tiered frontier model in which earnings differentials are attributed to information deficiencies from either the worker or the firm. Both approaches share that they try to retrieve information from the residual of the earnings equation.

Whereas the self-selection approach has been applied repeatedly, Polachek and Yoon's approach is relatively unexplored. A reason for this might be that their model doesn't fit too well with the modern theoretical literature on asymmetric information in the labor market. This ignores however, that

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*We thank two anonymous referees for helpful comments on an earlier draft.

SSDI 0927-5371(93)E0014-J

Polachek and Yoon report empirical findings that are quite supportive for their approach. We think it worthwhile to investigate whether these results stand up in a replication analysis. In this note we first replicate the two-tiered earnings frontier estimation technique for measuring employer and employee information in the labor market as developed by Polachek and Yoon (henceforth P&Y). In their paper P&Y give separate estimates of employee and employer information for different sub-groups. This approach, however, ignores the possibility of correlation between different sub-groups. Therefore, in this note we extend the original P&Y paper by letting the parameters, which reflect the relative employer and employee labor market information, depend on individual characteristics.

2. The two-tiered earnings frontier model

In this section we first outline the two-tiered earnings frontier model and discuss some limitations of the model. Second, we extend the model to allow for stochastic bounds on the employer's information concerning the reservation wage of the employee and on the employee's information of wage offers. For reasons of space we limit our presentation of the model as much as possible.[1]

The starting point of the model is the assumption that both employers and employees possess less than perfect information about reservation wages and offer wages respectively. The reason for this lack of perfect information is that search involves cost. A necessary condition for a firm to work efficiently is to minimize cost. According to P&Y, each employer will therefore try to hire those employees of a given quality with the lowest reservation wage, and to pay only just that reservation wage. However, in the absence of full information on reservation wages the employer may pay a higher wage than that. The difference between the reservation wage and the actual wage measures employer ignorance. Similarly, employee ignorance is defined as the difference between the wage offer a worker of a given quality can get from the highest wage firm and the wage the employee actually receives.

In the methodology developed by Polachek and Yoon the (unobservable) reservation and offer wages are incorporated into a two-tiered earnings frontier equation:

$$y_i = \beta' x_i + u_i + v_i + w_i , \tag{1}$$

where y is the log of the wage level and x is a vector of wage determinants with coefficients β; u is the usual random term; v and w are one-sided error terms with expectations $E(v) = -\mu_v < 0$ and $E(w) = \mu_w > 0$. The term μ_v can be interpreted as employee ignorance, as it measures the average difference between the

[1] An exposition of the model in the context of search in the labour market can be found in Polachek and Siebert (1993, pp. 238–242).

highest available wage offer and actual wages. Likewise μ_w is a measure for employer ignorance, since it equals the average difference between the lowest reservation wage and actual wages.

It should be noted that in this approach the labor market is modelled quite analogously to a competitive product market with imperfect information. Several features that make the labor market rather special are ignored. We mention two such features. First, employers may not be searching for cheap workers, but rather set the wage level for the vacancy they have before it is actually filled, and then try to hire the best worker from the pool of applicant that has been created [cf. Van Ours and Ridder (1992)]. This seems a common procedure in the labor market and nothing in this procedure guarantees that even with perfect information, the worker earns just his reservation wage. Second, another reason for employers to pay wages above reservation wages may be to prevent a worker from shirking, or to minimize the probability that a worker quits and thereby destroys specific human capital.

Although the model does no justice to these modern insights it should be emphasized that the model is compatible with a game-theoretic approach to the worker-firm relation. This interpretation of the one-sided error terms v and w runs as follows. The sum of v and w measures the difference between the worker's marginal product (the highest available offer) and the worker's outside opportunity (the lowest reservation wage) at any level of employment. Assume that the firm has private information about the marginal product and the worker possesses private information about his reservation wage. The observed wage rate might then be the Bayesian Nash equilibrium of a double auction [see Hall and Lazear (1984) and Gibbons (1992, pp. 158–163)]. In that case the ratio $\mu_v/(\mu_v + \mu_w)$ represents the average relative payoff of the employers and $\mu_w/(\mu_v + \mu_w)$ that of the employees.

The two preceding paragraphs suggest that results of the P&Y-model can be interpreted in more than one way. As the main purpose of this note is to replicate (and extend) the P&Y-model we will stick in the remainder of this paper to an interpretation in terms of offer wages, reservation wages, information and ignorance.

In order to derive the likelihood function, the following assumptions regarding the error components are made: u has a normal distribution with zero mean and variance σ_u^2; $-v$ follows an exponential distribution with mean μ_v; w has an exponential distribution with mean μ_w; and u, v and w are independent. The loglikelihood function is then:

$$\log L = n \log(\theta_u \theta_v \theta_w/(\theta_v + \theta_w)) + [\theta_u \theta_v \textstyle\sum_i e_i + (n/2)\,\theta_v^2]$$

$$+ \textstyle\sum_i \log\{1 - \Phi(\theta_u e_i + \theta_v) + [1 - \Phi(-\theta_u e_i + \theta_w]$$

$$\exp[-0.5(2\theta_u e_i + \theta_v - \theta_w)(\theta_v + \theta_w)]\}, \qquad (2)$$

where:

$$\theta_u = 1/\sigma_u ,$$

$$\theta_v = \sigma_u/\mu_v ,$$

$$\theta_w = \sigma_u/\mu_w ,$$

$$e_i = u_i + v_i + w_i = y_i - \beta' x_i ,$$

$\Phi(.)$ = distribution function of the standard normal ,

n = number of observations .

As noted by P&Y, the parameters θ_v and θ_w measure relative employee and employer labor market information, while μ_v and μ_w are the employee and employer labor market ignorance.

One disadvantage of the above specification is that it constrains the differences between reservation and actual wages, and between offer and actual wages to be the same for each individual: given the actual wage, the reservation wage and the offer wage are the same for each observation. Ideally these differences should vary for each observation. This, however is impossible to estimate, at least with cross-sectional data. Therefore, P&Y perform separate estimates for different sub-groups. In stead of this interstrata analysis, we parameterize μ_v and μ_w by allowing these parameters to vary with individual characteristics. This has the advantage over separate estimations in providing not only information on average interstrata differences, but also on marginal intrastrata differences. We specify:

$$\theta_v = \beta_v' x_i \quad \text{and} \quad \theta_w = \beta_w' x_i . \tag{3}$$

Another advantage of this approach over that of P&Y is that it allows estimation on smaller data sets.

The data for the analysis are taken from the OSA-labor market survey 1985, a national random sample of 4020 individuals held in the Netherlands[2]. From this sample we have taken a sub-sample of employees. This yields 2400 usable observations. The dependent variable in the analysis is the natural logarithm of the net hourly wage rate. In the appendix of the paper we provide a description of the variables.

[2]For a detailed description of this data set, see Vissers and Groot (1988).

Table 1

Employer and employee ignorance for various groups.

Group	Employee ignorance μ_v	Employer ignorance μ_w	random error σ_u	#
Total sample	0.190	0.243	0.067	2400
Males	0.157	0.238	0.085	1560
Females	0.235	0.246	0.052	840
Public sector	0.169	0.209	0.081	889
Private sector	0.195	0.262	0.058	1511
Union members	0.201	0.247	0.064	1761
Non-union members	0.143	0.231	0.078	639
Urban area	0.200	0.231	0.057	1313
Non-urban area	0.182	0.263	0.052	1087
Dutch nationality	0.189	0.244	0.071	2290
Non-Dutch	0.169	0.226	0.000	110

Parameterization of μ_v and μ_w:

	β	$\theta_v(=\sigma_u/\mu_v)$	$\theta_w(=\sigma_u/\mu_w)$
Constant	1.713 (60.5)	0.511 (4.38)	0.288 (4.43)
Schooling	0.036 (21.3)		
Experience	0.032 (16.3)		
Expr sq/1000	0.494 (10.9)		
Female		− 0.128 (3.88)	0.015 (0.92)
Public		0.120 (3.51)	0.008 (0.53)
Union		− 0.084 (2.35)	− 0.005 (0.33)
Urban		− 0.009 (0.49)	0.005 (0.34)
Dutch		− 0.063 (1.12)	− 0.015 (0.43)
$\theta_u(=1/\sigma_u)$	14.725 (5.8)		
Log-likelihood	− 438.012		
cases	2400		

3. Estimation results

In the upper half of table 1 the estimates of labor market ignorance for separate sub-groups are given. In general there are more interstrata differences in employee ignorance than in employer ignorance. A second point worth noting is that, similar to P&Y, we find that employee ignorance is always less than employer ignorance. This is a plausible finding since information on reservation wages is probably more private than information on offer wages. For the sample as a whole the results indicate that employees earn 16% less than the maximum offer wage, and employers pay 32% more than the reservation wage of the employees.[3] It can further be noted that the relative payoffs of both parties are

[3] $E(e^v) = 1/(1 + \mu_v) = 0.840$ and $E(e^w) = 1/(1 - \mu_w) = 1.321$.

rather balanced: for the total sample the average relative payoff of the employer (employee) is 0.44 (0.56).

On average, males have more labor market information than females. This is probably caused by the greater labor market attachment of males, which makes the opportunity costs of ignorance greater for males than for females. This result too, is in accordance with the results reported by P&Y. Employees in the public sector possess more market information than workers in the private sector. This is probably due to the fact that wage policies in the private sector are in general less public knowledge and more individually based. Non-union members have more information than union members. This might be a self-selection mechanism: employees with less information on the labor market let their interests be represented by the union. Employees living in an urban area have less information than workers in non-urban areas. The information density in non-urban areas is probably less than in urban areas, which may lead to a more favorable ratio between the costs and benefits of information acquisition for non-urban employees. Finally non-Dutch employees have more information than employees with the Dutch nationality. Non-Dutch workers are not evenly distributed over all industries and job levels, but are mainly confined to low paid industrial jobs. This may explain their relative informational advantage.

One finding worth noting with respect to the employer ignorance is that public sector employers are more informed than private sector employers. By its size the public sector often exercises some sort of monopsony power on the labor market, leading to information advantages over employers in the private sector. When we view the public sector as one large employer, one may expect public employer ignorance to be lower than private employer ignorance, as a large employer probably has more information about the reservation wages of employees than a small-scale employer does.

The lower half of table 1 contains the results of our extension of the original P&Y-model. In that part the estimates of the parameterized specification of θ_r and θ_w are given. The sign of the informational effects is for all characteristics in accordance with those of the separate sub-groups. Except for the intercept, all parameters in the employer information equation are insignificant, implying that employer information is constant and does not vary with the characteristics discerned. In the employee information equation the coefficients for gender, public sector, and union membership are significant. From the coefficients we can conclude that females are the least and public sector workers the most informed group on the labor market.

In principle the estimation results of the parameterized specification can be such that for a particular bundle of worker characteristics the lowest reservation wage exceeds the highest offer wage. In that case a problem arises since economic theory predicts that such individuals are (voluntary) unemployed whereas our sample consists entirely of employed persons. It is therefore

reassuring that even for workers with the least attractive bundle of characteristics from this point of view, the reservation wage is well below the offer wage[4].

4. Conclusion

The contribution of this note is twofold. First we apply the two-tiered earnings frontier model recently developed by P&Y. Similar to the findings of P&Y, all results make intuitive appeal thereby confirming the plausibility of the approach. Our second contribution is the extension of the P&Y-model by parameterizing the reservation and offer wages. This approach takes account of possible correlation between the average outcomes for overlapping strata. The results of the parameterized specification indicate that in the data set we used there are no such distorting correlations. Furthermore we find that even for workers with the 'worst' bundle of characteristics, the lowest reservation wage is well below the highest offer wage.

Appendix

Table A.1

Description of the variables

Variable	Description	Mean value	Standard deviation
Wage rate	Net hourly wage rate: Net earnings per month divided by actual working hours per month	13.25	7.32
Male	Dummy with value 1 if respondent is a male; 0 otherwise	0.65	
Public	Dummy with value 1 if the respondent is a public servant; 0 otherwise	0.37	
Union	Dummy with value 1 if the respondent is a union member; 0 otherwise	0.73	
Urban	Dummy with value 1 if the respondent lives in a city with 50.000 inhabitants or more; 0 otherwise	0.55	
Dutch	Dummy with value 1 if the respondent has the Dutch nationality; 0 otherwise	0.95	
Schooling	Number of years required to obtain the highest certificate that the respondent possesses	10.88	3.39
Experience	Actual work experience	16.62	10.33

[4]The smallest gap between $E(e^w) - E(e^r)$ occurs for the bundle 'male, public sector, non-union, urban, non-dutch', and is equal to 0.39. The largest difference results for the orthogonal bundle 'female, private sector, union, non-urban, Dutch', and is equal to 0.54. The mean gap is equal to 0.47 (standard error 0.0007).

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