The Employer Size-Wage Differentials in Taiwan

Yih-chyi Chuang
Pi-fum Hsu

ABSTRACT. This paper examines the factors affecting wage differentials for firms of different sizes, using Taiwan's Manpower Utilization Survey data of 1996. The main findings of the paper are as follows: (a) People with years of education, working experience, degrees in Science, Engineering, and Medicine, as well as females and married people tend to have a greater preference for working in big firms. Workers in public utility companies and manufacturing industries also prefer to work in big firms. While professionals, technicians, and service and sales workers prefer to work in large firms, business executives and managers have a preference for small firms. (b) Small-scale (less than 100 workers) firms tend to have a negative selection, while large-scale (more than 500 workers) firms tend to have a positive selection. That is, under self-selection, more able workers choose to work at large firms and less able workers at small firms.

I. Introduction

Numerous studies have shown a significant positive relationship between wage and firm size; see, e.g., Lester (1967), Mellow (1983), Oi (1983a, b), Garen (1985), Brown and Medoff (1989), Evans and Leighton (1989), Schmidt and Zimmermann (1991), and Bayard and Troske (1999), among others.[1] Theoretically, there are many reasons that large firms pay higher wages than small ones. First, large firms employ workers of higher quality, and thus they pay higher wages. For example, large firms are more capital-intensive, requiring more able and skilled labor provided that physical and human capital are complementary to each other (Griliches, 1969; and Hamermesh, 1980). Schmit and Zimmermann (1991) and Tan and Batra (1997) find that large firms are able and willing to undertake R&D activities and hence they require workers of higher quality to carry out such activities. Furthermore, the efficiency wage theory asserts that wages are positively correlated to productivity, and under asymmetric information, higher wages provide an incentive for working hard (Shapiro and Stiglitz, 1984), lower the cost of monitoring (Weiss and Landau, 1984; Garen, 1985), and decrease the rate of turnover and the associated costs of recruiting and training (Salop, 1979).

The second reason for higher wages is that according to the theory of compensation wage differential, wage and job conditions are a tie-in sale in the labor market. Large firms tend to be more rigid in organizational structure and rely on rules to discipline their workers (Duncan and Stafford, 1980; Mellow, 1982), or they will impose greater pressure on workers and thus suppress workers' creativity (Lester, 1967). As a result, large firms have to pay higher wages to compensate for adverse working conditions.

The third reason follows Weiss (1966), Mellow (1982), Dunn (1986), and Shi (2002), who claim large firms may exercise monopoly power in the product market. Thus, they are more willing to share their monopolistic profits with their employees by paying them higher wages. In order to avoid unionization and maintain a harmonious relationship with their workers, it may also be true that large firms tend to pay higher wages (Foulkes, 1980; Freeman and Medoff, 1984).

Most empirical studies consider only wage differentials among firms of different sizes and fail to take into account the possible selection process

Final version accepted on November 11, 2002

Yih-chyi Chuang
Department of Economics
National Chengchi University
Taipei
Taiwan, R.O.C.
E-mail: ycchuang@nccu.edu.tw

Pi-fum Hsu
Department of Finance
I-Shou University
Kaohsiung
Taiwan, R.O.C.

Small Business Economics **23**: 285–297, 2004.

between heterogeneous labor and firms. However, in the recent literature many empirical works have adopted the selectivity-corrected approach to estimate the employer size-wage effect; see, e.g., Idson and Feaster (1990), Main and Reilly (1993), Oosterbeek and Van Praag (1995), and Albaek (1998), among others.[2] In the real world, the labor market acts as a matching process in which an individual worker searches for a suitable job while a firm selects an appropriate worker for a position.

Workers and firms do bear observable and unobservable attributes. Hence, they actually sort among these observable and unobservable attributes in the labor market. Using data from the National Longitudinal Survey of Young Men and the Current Population Survey, Evans and Leighton (1989) find evidence of sorting on observed and unobserved ability characteristics across firm sizes. Under this circumstance, a model that fails to consider the selection process will encounter selectivity bias in its estimation of size-wage differentials.

This paper adopts a two-stage estimation method to examine the factors affecting wage differentials with firms of different sizes using Taiwan's Manpower Utilization Survey data of 1996. First, an ordered probit model is used to estimate the worker-employer selection. Second, the wage equations of different firm sizes are estimated by incorporating the possible selection bias obtained in the first stage. The aim of this paper is not to examine and test all competing hypothesis, but instead our investigation of Taiwan's labor market will shed light on our understanding of why large employers pay higher wages than small employers.

Estimation results show significant selectivity effects increase with firm size. The selectivity acts to reduce the wage gap between small and large firms. Using the wage decomposition method, we find that main size-wage differentials are generated by higher rewards paid by large firms to workers and job attributes. Among the differences in the value of the attributes, most come from education and the average annual profit per worker. The results are consistent with a model of job screening.

The paper is organized as follows. Section II provides the empirical two-stage model of size-wage differentials. Section III describes the data. Section IV presents the estimation results. Section V further decomposes the size-wage differentials to identify the main sources of the differences. Concluding remarks are included in Section VI.

II. The empirical model

As workers are sorted into different firms, the wages we observe in the labor market are a truncated non-random distribution. In this case, a direct OLS estimation of size-wage differentials will be biased. To cope with this problem, we use Heckman's (1979) two-stage method. First, as the selection variable (firm size) is well ordered, an ordered probit model is thus adopted to estimate the worker-employer selection process. Assuming n workers and m types of firms, the selection function of the optimal firm size for each individual worker is expressed as

$$S_i = \beta' H_i + u_i \quad i = 1, 2, 3, \dots, n, \tag{1}$$

where S_i is the ith worker's optimal preference on firm size, H represents factors affecting the selection of the firm size, such as worker and employer attributes, and $u_i \sim N(0, 1)$ is an error term.

In this paper, personal attributes include education, tenure, other work experience, gender, marital status, and fields of academic study. In addition, the area of residence and industry dummies are used to capture the variations in geographic and regional economic development and industry-specific characteristics. Due to data limitation, detailed information about an worker's employer is not available. As the work condition is part of a worker's job selection, as in Brown and Medoff (1989) and Morissette (1993), the occupational dummy is used to capture work pressure and satisfaction.

Term S_i is in fact a latent and unobservable variable. In reality, the observed selected firm size is used and represented by a dummy variable Z_{ij}, where $Z_{ij} = 1$ when the ith worker chooses a jth type of firm; otherwise $Z_{ij} = 0$.

Let the wage equation for each employer size be

$$W_{ij} = \alpha_j + \gamma'_{ij} X_{ij} + v_{ij}$$
$$i = 1, 2, 3, \dots, n, \quad j = 1, 2, 3, \dots, m, \tag{2}$$

where i and j are indices for the ith individual and jth firm size, respectively, W_{ij} is the wage rate, X represents all observable factors that affect wage, and v represents all unobservable variables. Observable factors include individual attributes such as gender, tenure and its square term, other work experience and its square term, education, marital status, and occupation, as well as exogenous variables such as the geographical location to represent variations in regional development, and the average profits of the firm to capture the idea of q profit-sharing assertion. Since the wages we observe under self-selection would be a truncated normal distribution, the estimation of α_j and γ_{ij} in (2) by OLS will be biased and inconsistent.

Let ψ_{ij} be the covariance matrix of error terms between the selection equation and wage equation, and let λ_{ij} be the expected value of the correction term (or inverse Mills ratio). Equation (2) can then be rewritten as:

$$W_{ij} = \alpha_j + \gamma_{ij}' X_{ij} + \psi_{ij}\lambda + e_{ij}. \quad (3)$$

In the second stage, substituting the sample selection corrected terms λ into (3) and then using the OLS estimation method will solve the problem of sample selection bias, in this case $E(e_{ij}|X_{ij}, Z_{ij} = 1) = 0$. In addition, as the cross-section data are likely to be subject to the problem of heteroscedasticity, we apply White's (1980) correction method when such problems occur.

III. The data

The data employed in this study came from the Manpower Utilization Survey of 1996 conducted by the Directorate-General of Budget, Accounting and Statistics, Executive Yuan, Taiwan, Republic of China. This study includes only full-time workers who do not work in the government or agricultural sector. A total of 19,351 samples are available and they were further classified by firm size according to the number of employees in the major working site. Samples are divided into the following seven size categories: up to 10 workers, 10–29 workers, 30–49 workers, 50–99 workers, 100–199 workers, 200–499 workers, and 500 or more workers.[3] Appendix A contains the definitions and brief description of all the variables used in the analysis.

Workers' attributes include years of education, tenure, other work experience, sex, marital status, and academic study. Industrial and geographical dummies are used to capture the industry-specific effect as well as political and geographical developmental effects. Occupational dummies represent the differences in job conditions and working environment (see, e.g., Brown and Medoff, 1989; Morissette, 1993).

Table I reports the mean values for the relevant variables broken down by employer size. It is clear that significant employer-size patterns are found with increasing levels of wages, education, tenure, and average annual profits per worker. Employers working in a large (more than 500 workers) firm, in general, receive a wage premium of 22.4% more than one working in a small (up to 10 workers) firm. Large firms in general hire more educated workers and experience a lower turnover rate of employees as employees' average years of schooling and tenure increase with firm size. As for the capital employee ratio and profit per employee, large firms are more capital intensive and also more profitable than small firms. However, other work experience shows a decreasing tend with firm size, implying that young workers tends to select and work in large firms.

IV. Estimation results

Table II shows the estimation results of the ordered probit model for employer-size selection. In general, workers with higher education levels, more work experience, and training in Science, Engineering, and Medicine, as well as workers who are female and married tend to choose large firms. Garen (1985) points out that because of the complexity in production technology and complementarity between physical and human capital, large firms tend to take educational attainment as an indicator of the workers' potential productivity. Oi (1983a, b) claims that marginal monitoring cost increases with firm size and characteristics that need not much monitering can be reflected in education, therefore large firms hire a marginal worker with more education to impose less monitoring cost. Large firms also provide and require stable working conditions, which also match the inherent need of female or married workers. These

TABLE I
Summary of basic statistics

		Firm size							
		< 10 people	10–29 people	30–49 people	50–99 people	100–199 people	200–499 people	≥ 500 people	Total
Observations (people)		8710 [45.0%]	4536 [23.4%]	1706 [8.8%]	1303 [6.7%]	1259 [6.5%]	767 [4.0%]	1070 [5.5%]	19351 [100%]
Monthly wage ($NT)	Mean	30441	31083	32343	33521	33412	34243	37268	31689
	(S.D.)	(22194)	(27047)	(29074)	(23323)	(22000)	(31993)	(36290)	(25538)
Education (years)	Mean	9.89	10.7	11.12	11.53	11.78	11.83	12.18	10.62
	(S.D.)	(3.19)	(3.28)	(3.50)	(3.30)	(3.52)	(3.51)	(3.31)	(3.38)
Tenure (years)	Mean	5.60	4.89	4.86	5.56	5.85	6.64	7.78	5.54
	(S.D.)	(6.27)	(5.46)	(5.13)	(5.80)	(6.17)	(6.47)	(7.27)	(6.06)
Other work experience (years)	Mean	12.37	11.44	11.75	11.20	10.45	9.93	8.50	11.58
	(S.D.)	(11.09)	(10.59)	(11.44)	(10.77)	(10.42)	(9.91)	(9.19)	(10.84)
Average net fixed assets per employee ($NT million)		1688	1228	1683	1459	2323	2309	3531	2032
Average annual profit per employee ($NT million)		191	164	156	154	249	226	346	212

Notes: Figures in the square bracket are relative share and those in the parentheses are standard deviation.
Data of the average net fixed assets per employee and average annual profit per employee are from the Report on 1996 Industrial and Commercial Census for Taiwan-Fukien Area, the Directorate-General of Budget, Accounting and Statistics, Executive Yuan, Republic of China.

results are consistent with the findings of Idson and Feaster (1990) for the U.S., Main and Reilly (1993) for Britain, and Oosterbreek and van Praag (1995) for the Netherlands. Furthermore, academic training in Science, Engineering, and Medicine are more specialized and hence people with such training are better suited to work in more capital-intensive, coordination-oriented, and large-scale firms.

Industries that provide the chance of being employed in large firms are in the following order: electricity, gas, and water, manufacturing, transportation and warehousing, finance and insurance, and mining industries. While professionals and technicians and sales and service workers prefer to work in large firms, executives and managers tend to choose small firms.[4] Because of historical and political developments in Taiwan, the island's West and North are more developed than the East and the South. Naturally, workers living in those better-developed areas, especially the two major cities of Taipei and Kaohsiung, tend to work in large firms.

Table III displays the traditional log wage regressions with firm-size dummies, and separate regressions by firm-size groups that are corrected for selectivity bias through the inclusion of the correction terms are obtained from the first-stage ordered probit model of firm-size selection. The results of column 1 show that even after controlling for the workers' attributes, and occupational and geographical dummies, the firm-size variables remain positive and significant.[5] As mentioned before, this traditional estimation neglects the sorting process between workers and employers. Furthermore, it assumes that various employer-size groups value workers' attributes indifferently.

Results from columns 2–5 suggest the need for the correction of selectivity bias when examining the size-wage differentials. The importance of taking selection bias into account can be shown from the statistical significance of the selection term (λ). These significant selection effects indicate that the existence of unobservable variables is common to both the selection and wage determination process, which, if not explicitly treated as endogenous, would bias the estimation of employer-size effects on wages (Idson and

TABLE II
Determinants of an individual's attachment to different firm sizes: ordered probit model

Variables	Coefficient	χ-sq statistics
Constant	1.752***	(534.808)
Personal characteristics		
EDUC	–0.063***	(204.238)
OEXP	–0.005***	(23.933)
SEX	0.047***	(5.880)
MARI	–0.087***	(19.636)
Industry		
MIN	–0.519***	(8.211)
MFG	–1.208***	(1817.942)
UTI	–1.280***	(27.887)
CON	–0.017	(0.245)
TRA	–0.717***	(250.092)
FIN	–0.617***	(308.785)
SER	–0.405***	(158.469)
Occupation		
PRO	–0.484***	(240.639)
EXE	0.262***	(40.228)
AST	–0.509***	(311.970)
SAL	–0.240***	(57.828)
WOR	–0.111***	(8.242)
Academic study		
LAW	0.024	(0.036)
BUS	0.010	(0.119)
SCI	–0.322***	(9.437)
ENG	–0.100***	(14.336)
AGR	–0.036	(0.341)
MED	–0.374***	(34.941)
EDT	0.078	(0.324)
OTH	0.030	(0.271)
Area of residence		
NOR	–0.441***	(59.211)
MID	–0.204***	(12.147)
SOU	–0.199***	(11.539)
TPI	–0.531***	(81.947)
KOH	–0.512***	(65.973)
$\alpha 2$	0.729	
$\alpha 3$	1.054	
$\alpha 4$	1.350	
$\alpha 5$	1.723	
$\alpha 6$	2.053	
Pearson χ Sq	107917	
N	19351	

Notes:
Positive coefficients imply greater probability of working at small firms.
*** Indicates significant at the 1% level.
Reference groups are: Commerce for industry, Production laborer for occupation, Humanities for academic study; and East region for area of residence.

Feaster, 1990). The calculation of the sign of selection bias (the product of the estimated coefficient and the mean value of the selection term for each different firm size) shows a negative selection for a firm size below 100 workers and a positive selection for a firm size above 500 workers. Large firms provide a better work environment, a comprehensive promotion system, and better fringe benefits, and as a result, more educated or more able workers choose to work at larger firms.

Small firms by contrast provides a clumsy work environment, insecure employment, narrow promotion channel, and poor fringe benefits, and thus less educated, less stable, and less able workers will work in small firms.[6] Therefore, the observed negative selection terms for small firms and positive selection terms for larger firms are quite intuitive. That is, without correcting for the selection bias, the OLS will underestimate wages paid by firms of sizes below 100 workers and will overestimate wages paid by firms of sizes above 500 workers. Therefore, these results imply that the actual size-wage differentials are lower than what we observed directly in the labor market, i.e. the observed pattern of sorting acts to increase the wage differential between small and large firms from what it would be with a random sorting.[7]

Education does have a positive and significant effect which increases with firm size.[8] The return on education for firms of more than 500 workers is about 2.7 times that in small firms with less than 100 workers. This result supports the argument that large firms require workers of high quality and often regard education as an indicator of potential productivity. Hence, they tend to reward education with higher wages.

Both variables of tenure and other work experience have positive and significant coefficients, but their square terms have negative and significant coefficients, implying a diminishing return on both tenure and other work experience. However, the effect of tenure is greater than that of other work experience across all firm sizes. This means that firm-specific human capital is more important than general human capital. It is also noteworthy that the return on tenure is higher than that on education for firms with less than 30 workers, while the return on education is higher than that of tenure for firms with more than 30 workers.

TABLE III
Wage regression by firm size

	Full sample	< 10 people	10–29 people	30–49 people	50–99 people	100–199 people	200–499 people	≥ 500 people
Constant	3.749**	4.235**	4.081**	3.929**	3.729**	3.443**	2.953**	2.339**
	(64.540)	(31.562)	(32.543)	(30.208)	(34.871)	(18.557)	(7.296)	(8.265)
EDUC	0.029**	0.027**	0.033**	0.038**	0.043**	0.055**	0.049**	0.077**
	(16.940)	(8.835)	(8.925)	(10.034)	(9.717)	(11.005)	(6.610)	(14.078)
OEXP	0.014**	0.016**	0.014**	0.009**	0.017**	0.009**	0.010**	0.011**
	(13.262)	(9.188)	(6.072)	(4.141)	(6.376)	(3.124)	(2.691)	(3.720)
OEXPSQ	–0.0003**	–0.000395**	–0.0003**	–0.0002**	–0.0003**	–0.00003	–0.00004	–0.00004
	(–14.129)	(–10.510)	(–6.956)	(–4.227)	(–5.206)	(–0.480)	(–0.510)	(–0.659)
TENU	0.035**	0.036**	0.034**	0.032**	0.034**	0.034**	0.025**	0.032**
	(22.504)	(14.414)	(9.879)	(8.099)	(8.487)	(8.992)	(4.030)	(7.314)
TENUSQ	–0.001**	–0.001**	–0.001**	–0.0004**	–0.001**	–0.001**	–0.0002	–0.0004**
	(–11.268)	(–8.445)	(–5.135)	(–2.649)	(–3.893)	(–4.165)	(–0.936)	(–2.818)
SEX	0.382**	0.416**	0.345**	0.273**	0.313**	0.290**	0.355**	0.243**
	(48.681)	(28.166)	(20.744)	(16.692)	(17.699)	(14.852)	(12.889)	(11.856)
MARI	0.102**	0.131**	0.122**	0.086**	0.082**	0.055**	0.075**	0.097**
	(10.484)	(7.722)	(6.110)	(4.127)	(3.511)	(2.230)	(2.163)	(3.771)
PROF	0.066**	0.016	0.020	0.045**	0.045**	0.076**	0.092**	0.142**
	(6.756)	(0.698)	(0.960)	(2.166)	(3.263)	(3.516)	(2.368)	(4.494)
PRO	0.170**	0.293**	0.123**	0.139**	0.247**	0.150**	0.168**	0.267**
	(12.541)	(10.539)	(4.402)	(4.921)	(8.278)	(4.405)	(3.759)	(7.702)
EXE	0.294**	0.202**	0.195**	0.503**	0.686**	0.493**	0.576**	0.526**
	(16.703)	(7.166)	(5.569)	(11.688)	(15.028)	(7.804)	(5.915)	(6.963)
AST	0.072**	0.097**	0.080**	0.115**	0.176**	0.112**	0.197**	0.124**
	(5.684)	(3.527)	(3.158)	(4.516)	(6.611)	(3.687)	(4.739)	(3.755)
SAL	0.043**	–0.022	0.055**	0.153**	0.178**	0.124**	0.266**	0.182**
	(3.372)	(–1.051)	(2.050)	(5.585)	(5.757)	(3.785)	(5.307)	(3.932)
WOR	–0.042**	–0.052**	–0.089**	–0.074*	–0.015	–0.130*	–0.190**	0.044
	(–2.777)	(–2.222)	(–2.782)	(–1.827)	(–0.326)	(–1.896)	(–1.940)	(0.746)
NOR	0.019	0.123**	0.039	0.041	0.025	0.048	0.448	0.218**
	(0.845)	(3.899)	(0.720)	(0.590)	(0.348)	(0.349)	(1.330)	(2.722)
MID	0.016	0.096**	0.045	–0.011	–0.027	0.025	0.371	0.108
	(0.711)	(3.010)	(0.814)	(–0.159)	(–0.375)	(0.181)	(1.095)	(1.306)
SOU	–0.057**	–0.001	–0.053	–0.026	–0.029	–0.013	0.397	0.147*
	(–2.512)	(–0.018)	(–0.960)	(–0.371)	(–0.391)	(–0.098)	(1.174)	(1.811)
TPI	0.115**	0.185**	0.144**	0.131*	0.106	0.130	0.567*	0.325**
	(5.054)	(5.529)	(2.608)	(1.900)	(1.441)	(0.960)	(1.682)	(4.100)
KOH	0.010	0.087**	0.060	0.056	0.002	0.001	0.390	0.293**
	(0.407)	(2.304)	(1.024)	(0.772)	(0.025)	(0.009)	(1.148)	(3.495)
FS2	0.019**							
	(2.056)							
FS3	0.068**							
	(5.134)							
FS4	0.053**							
	(3.526)							

TABLE III *(Continued)*

	Full sample	< 10 people	10–29 people	30–49 people	50–99 people	100–199 people	200–499 people	≥ 500 people
FS5	0.015 (0.956)							
FS6	0.003 (0.149)							
FS7	0.021 (1.211)							
λ		0.164** (10.504)	0.077** (4.585)	0.048** (2.610)	0.037* (1.652)	0.013 (0.466)	0.003 (0.079)	0.419** (5.210)
N	19351	8710	4536	1706	1303	1259	767	1070
Adj. *R*-sq	0.2929	0.2561	0.253	0.499	0.576	0.565	0.539	0.567

Notes: Figures in the parentheses are *t* values.
** and * indicate statistically significant at 5% and 10% levels, respectively.
A white-corrected standard deviation is applied for the full sample and samples with a firm size of 10 people and below, 10–29 people, and 500 people and above.

These results support the notion that large firms often use education as a screening device for labor quality and are willing to pay higher wages for better education, while small firms are relatively more labor-intensive and thus firm-specific experience is relatively more important.

As consistent with most studies, male or married workers in general earn higher wages than female or single workers. Higher wages are paid to occupations in the following order: professionals and technicians, executives and managers, assistant managers, and sales workers. The geographical effect is rather insignificant, except for small firms employing less than 10 workers and those located in the North, in Central Taiwan, and in Taipei and Koahsiung, and for large firms with workers above 500 and located in the North, the South, Taipei, and Kaohsiung, that actually pay higher wages. Finally, the annual profit per worker has a positive and significant effect and also increases with firm size. This is consistent with the findings of Weiss (1966) and Mellow (1982), whereby large firms are more willing to share their monopolistic profits with their workers.

As people may perceive firm size differently, we further reorganize our measure of firm size into the following three different groups for sensitivity analysis: (1) up to 100 workers (defined as “small”) and 100+ (defined as “large”); (2) up to 500 workers (defined as “small”) and 500+ (defined as “large”); and (3) up to 100 workers (defined as “small”), 100–499 (defined as “medium”), and 500+ (defined as “large”). The results show that all the explanatory variables remain significant with the same sign.[9] Moreover, a significant negative selection for small firms and a positive selection for large firms are also reconfirmed. Thus, the estimation results reported above are robust.

V. Decomposition of wage differentials

To understand better various sources of size-wage differentials, we use Cotton (1988) and Neumark’s (1988) weighted wage decomposition[10] method to further decompose the wage differentials. From the wage equation defined in equation (3), the wage differentials can be decomposed and expressed as

$$\overline{W}_j - \overline{W}_1 = (\alpha_j - \alpha_1) + \gamma^{*\prime}(\overline{X}_j - \overline{X}_1) + \overline{X}_j'(\gamma_j - \gamma^*) + \overline{X}_1(\gamma^* - \gamma_1) + (\varphi_j \overline{\lambda}_j - \varphi_1 \overline{\lambda}_1) \quad j = 2, \ldots, 7 \qquad (3)$$

where, $\overline{w}$, $\overline{x}$, and $\overline{\lambda}$ are the average values of each size-group’s wages, the factors affecting wages, and the selection bias term, respectively. Term γ^* is the weighted averages of the jth firm size and the smallest firm size for which the relative employment share is the weight. The last four terms on the right-hand side of equation (3) correspond to (a) productivity advantage (or endowment effect) of the *j*th firm size; (b) *j*th firm-size advantage or the amount by which the *j*th firm-size's employees are overcompensated (return of endowment in *j*th firm size); (c) small firm size's disadvantage; and (d) selection bias, respectively.

Table IV shows the calculation of wage decomposition by incorporating the estimation results obtained in Table III. We find that for a firm size of 50 people the return on endowment increases with firm sizes. Moreover, most of the wage differentials come from differences in the return to endowment, rather than the endowment, per se. These results are consistent with the findings that employers in large firms pay the best wages given the same distribution of endowment, see, e.g., Idson and Feaster (1990) and Oosterbeek and Van Praag (1995). Table IV further identifies that most of the differences in the return to endowment come from education and average annual profit per worker. For example, for the largest firm size, its advantages are from education (42%) and profit sharing (54%); for the smallest firm size, its disadvantages come from education (71%) and profit sharing (74%).

Table V summarizes the wage decomposition by firm size. It should be noted that the differences in the return of endowment and selection bias increase with firm size. The positive sign of selection bias reveals that selection on unobservable characteristics tends to increase all wage gaps which is consistent with the findings of underlying selection process of wage regression. For firms with workers below 50, most of the differences are from differences in the selection bias term. Workers with a higher education, more skills, and preference for a stable working environment tend to choose large firms which value these attributes highly. These results are consistent with the findings of Evans and Leighton (1989), Troske (1994), Oosterbeek and Van Praag (1995), and Winter (2001). The differences in the selection bias terms are also more important than that of the endowment for the main source of the wage gap. Thus, these results go strongly against using the traditional wage equation with firm-size dummies to interpret the size-wage differentials. As a result, after correcting for these selection biases, the size-wage differentials should be less than what we normally observed.

Calculating the conditional wage gap on the firm size into which the worker has been sorted can also confirm the above results. For example, the computed wage gap for an individual worker who has been sorted into the largest firm or the smallest firm is given by

$$\begin{aligned} &E(W_L|Z_{ij} = L) - E(W_s|Z_{ij} = L) \\ &\quad = \gamma_L' \bar{X}_L + \varphi_L \bar{\lambda}_L - [\gamma_S' \bar{X}_L + \varphi_S \bar{\lambda}_L] \\ &\quad = 2.5931 + 0.2283 - [1.2424 + 0.0896] \\ &\quad = 1.4894 \end{aligned}$$ [11]

and

$$\begin{aligned} &E(W_L|Z_{ij} = S) - E(W_s|Z_{ij} = S) \\ &\quad = \gamma_L' \bar{X}_S + \varphi_L \bar{\lambda}_S - [\gamma_S' \bar{X}_S + \varphi_S \bar{\lambda}_S] \\ &\quad = 2.2668 - 0.8460 - [1.0734 + 0.3321] \\ &\quad = 0.6795, \end{aligned}$$ [12]

where L represents the largest firm and S represents the smallest firm.

The unconditional wage gap is 1.5197 (2.5931 – 1.0734). Without controlling for the selection bias, an average worker in a firm with 500 or more employees would gain a (log) wage increase of 1.3507 (2.5931 – 1.2424, i.e., $\gamma_L' \bar{X}_L - \gamma_S' \bar{X}_L$) over what he would expect to earn if he chooses to work in a firm with up to 10 workers. After correcting for the selectivity, it increases to 1.4894. Thus, selectivity factors increase the expected gain for a large-firm worker by 13.9%.

Without controlling for the selection bias, an average worker in a firm with less than 10 workers would experience by contrast a (log) wage increase of only 1.1934 (2.2668 – 1.0734, i.e., $\gamma_L' \bar{X}_S - \gamma_S' \bar{X}_S$) over what he would expect to earn if he chooses to work in a firm with 500 or more workers. If selectivity is considered, then it drops to 0.6795. Likewise, selectivity factors reduce the expected gain for a small-firm worker by 51.4%. From these calculations, it is clear that with selectivity taken into consideration, the actual wage gap is smaller than what we expected or observed.[13]

VI. Concluding remarks

As the labor market functions to match heterogeneous workers and firms, the observed size-wage differentials are the result of pre-sorting in the

TABLE IV
Wage decomposition by firm sizes

	10–29 persons		30–49 persons		50–99 persons		100–199 persons		200–499 persons		≥ 500 persons		
	$\beta^*(x_j - x_1)$	$x_j(\beta_j - \beta^*)$	$\beta^*(x_j - x_1)$	$x_j(\beta_j - \beta^*)$	$\beta^*(x_j - x_1)$	$x_j(\beta_j - \beta^*)$	$\beta^*(x_j - x_1)$	$x_j(\beta_j - \beta^*)$	$\beta^*(x_j - x_1)$	$x_j(\beta_j - \beta^*)$	$\beta^*(x_j - x_1)$	$x_j(\beta_j - \beta^*)$	$x_1(\beta^* - \beta_1)$
EDUC	0.0294	–0.0293	0.0446	0.0242	0.0594	0.0809	0.0685	0.2199	0.0707	0.1528	0.0824	0.4939	0.0938
OEXP	–0.0131	–0.0011	–0.0091	–0.0525	–0.0164	0.0291	–0.0274	–0.0507	–0.0346	–0.0367	–0.0543	–0.0294	–0.0232
OEXPSQ	0.0114	0.0105	0.0028	0.0383	0.0118	0.0104	0.0202	0.0094	0.0277	–0.0111	0.0410	–0.0089	0.0126
TENU	–0.0241	0.0002	–0.0250	–0.0131	–0.0013	–0.0009	0.0091	–0.0049	0.0361	–0.0647	0.0749	–0.0154	–0.0090
TENUSQ	0.0108	–0.0037	0.0132	0.0120	0.0039	0.0014	–0.0013	0.0070	–0.0099	0.0379	–0.0273	0.0272	0.0053
SEX	–0.0162	–0.0086	–0.0436	–0.0456	–0.0321	–0.0257	–0.0443	–0.0362	–0.0390	–0.0024	–0.0171	–0.0696	–0.0341
MARI	–0.0043	0.0052	–0.0023	–0.0146	0.0023	–0.0186	0.0011	–0.0340	0.0037	–0.0231	0.0078	–0.0103	–0.0101
PROF	–0.0053	–0.0784	–0.0072	0.0479	–0.0077	0.0477	0.0095	0.2226	0.0060	0.3087	0.0211	0.6241	0.0976
PRO	0.0101	–0.0116	0.0147	–0.0113	0.0220	0.0047	0.0295	–0.0146	0.0351	–0.0123	0.0389	0.0115	–0.0086
EXE	0.0001	–0.0067	–0.0048	0.0081	–0.0036	0.0173	–0.0095	0.0049	–0.0126	0.0045	–0.0112	0.0046	0.0063
AST	0.0094	–0.0043	0.0145	0.0017	0.0163	0.0159	0.0131	0.0011	0.0124	0.0174	0.0113	0.0032	0.0015
SAL	–0.0003	–0.0002	0.0012	0.0143	0.0006	0.0168	0.0006	0.0092	–0.0021	0.0191	–0.0042	0.0068	0.0097
WOR	0.0016	–0.0015	0.0031	–0.0004	0.0033	0.0019	0.0041	–0.0017	0.0039	–0.0036	0.0039	0.0032	–0.0009
NOR	0.0014	–0.0201	–0.0003	–0.0186	0.0099	–0.0309	0.0043	–0.0190	0.0141	0.1518	0.0165	0.0531	–0.0064
MID	–0.0005	–0.0059	0.0006	–0.0186	–0.0033	–0.0169	–0.0035	–0.0080	–0.0054	0.0415	–0.0090	0.0031	–0.0047
SOU	–0.0003	–0.0101	–0.0002	–0.0058	–0.0003	–0.0057	0.0000	–0.0041	–0.0004	0.0581	–0.0006	0.0174	0.0012
TPI	0.0091	–0.0084	0.0096	–0.0115	0.0056	–0.0150	0.0090	–0.0113	0.0058	0.0733	0.0086	0.0289	–0.0001
KOH	0.0010	–0.0023	0.0006	–0.0025	–0.0001	–0.0057	–0.0004	–0.0054	0.0011	0.0234	0.0031	0.0205	0.0003
TOTAL	0.0203	–0.1763	0.0124	–0.0476	0.0701	0.1067	0.0825	0.2841	0.1126	0.7347	0.1858	1.1640	0.1314

TABLE V
Decomposition of wage differentials by firm size

	10–29 people	30–49 people	50–99 people	100–199 people	200–499 people	≥ 500 people
Intercept[a]	–0.153	–0.306	–0.505	–0.792	–1.282	–1.896
Endowments[b]	0.020	0.012	0.070	0.083	0.113	0.186
Jth firm–size advantage[c]	–0.176	–0.048	0.107	0.284	0.735	1.164
Smallest firm–size disadvantage[d]	0.131	0.131	0.131	0.131	0.131	0.131
Selectivity[e]	0.215	0.271	0.289	0.318	0.327	0.554
Total[f]	0.037	0.061	0.092	0.024	0.023	0.140

[a] Difference in intercept: $\alpha_j - \alpha_1$.
[b] Differences in endowments: $\gamma^{*\prime}(\overline{X}_j - \overline{X}_1)$.
[c] jth firm size advantage: $\overline{X}_j'(\gamma_j - \gamma^*)$.
[d] Smallest firm size disadvantage: $\overline{X}_1(\gamma^* - \gamma_1)$.
[e] Selection bias: $(\varphi_j \overline{\lambda}_j - \varphi_1 \overline{\lambda}_1)$.
[f] Total wage differentials = (a) + (b) + (c) + (d) + (e).

observable and unobservable attributes of workers and firms. In this respect, the traditional wage regression with firm-size dummies is not only biased due to the selectivity effect having not been taken into consideration, but also disguises the various evaluations of workers' attributes across firm size. This study uses Taiwan's Manpower Utilization Survey data of 1996. We first adopt an ordered probit model for job selection among different firm sizes. We then run a wage regression by including selectivity terms obtained in the ordered probit model.

Significant selectivity effects from this study are found to increase with firm size. For example, the expected wage of a worker employed in a firm with up to 100 employees is biased downward, while that of a worker employed in a firm with 500 or more employees is biased upward. That is, workers who are more skilled and have more of a desire for job stability are attracted into large firms, while workers who are less skilled and more independent prefer small firms. Further calculations show that selectivity factors increase the expected wage gain for a large-firm (500 or more employees) worker by approximately 13.9% and reduce the expected wage increase for a small-firm (up to 10 employees) worker by approximately 51.4%. These results suggest that with selectivity taken into consideration, the actual wage gap is smaller than what we expected or observed.

Using the wage decomposition method, we find that differences in the value of workers' endowment rather than differences in workers' endowment contribute to the size-wage differentials. Among the differences in the value of the attributes, most come from education and average annual profit per worker. The results are consistent with a model of job screening. As claimed by Garen (1985), a higher return of education by large firms may imply the uncertainty of true productivity of an individual, whereby firms choose a less precise screening device by rewarding schooling more. Oosterbeek and Van Praag (1995) find that larger firms pay higher returns on schooling in the Netherlands, but Main and Reilly (1993) see no significantly different returns to education among different firm sizes for Britain.

The main size-wage differentials in Taiwan are generated by higher rewards paid by large firms to workers and job attributes. This may suggest that information problems and/or organizational structure cause large firms to pay higher prices in return for a high-quality performance from workers or for better decision-making, which generate higher benefits under the hierarchical structure (Rosen, 1982). Viewing the rapid increase in the supply of college graduates in Taiwan in the 1990s, education may not be as effective as it was in being a type of screening device. Furthermore, if more educated, more experienced, and more skilled workers tend to work in large firms and larger firms pay higher returns on schooling, then from the perspective of human capital accumulation the functioning of Taiwan's labor market should focus on policies that foster and encourage the establishment of listed companies and make labor market information as transparent as possible.

Due to the limited data on job attributes, we finally can only use occupational or industrial dummies as proxies, which certainly do not fully reflect job attributes, such as work pressure, organizational rigidity, or environmental stability. Data limitation on the availability of an individual's ability may cause the return on schooling to be upward biased. The relatively low *R* square of the wage equation for the smallest firm-size group may also suggest the exclusion of other relevant variables. All these factors deserve future investigation to increase the understanding of firm-size wage differentials in Taiwan.

Appendix A. The definition of variables

Variable	Description
Wage	Logarithmic form of hourly wage
Workers' characteristics	
EDUC	Years of education: primary school = 6 years; junior high = 9; senior high = 12; college & university = 16
TENU	Years of employment with current employer
OEXP	Years of other work experience (defined as age-EDUC-TENU-6)
SEX	Male = 1; female = 0
MARI	Marital status: married = 1; single = 0
Specialty dummy	Academic Study dummies = 1 if Law (LAW), Business (BUS), Science (SCI), Engineering (ENG), Agriculture (AGR), Medicine (MED), Education (EDT), and others (OTH), respectively (Humanities is the reference group)
Working conditions	
Industry dummy	Industry dummies = 1, if Mining (MIN), Manufacturing (MFG), Electricity, Gas, and Water (UTI), Construction (CON), Transportation, Storage, and Communication (TRA), Finance, Insurance, and Real Estate (FIN), and Social and Business Services (SER), respectively (Commerce is the reference group)
Occupation dummy	Occupation dummies = 1; Professionals (PRO), Executives and Managers (EXE), Assistants (AST), Service workers and Market sales workers (SAL), and Machine operators (WOR), respectively (Production laborer is the reference group)
Region dummy	Area of residence dummies = 1, if in the North (NOR), Central Taiwan (MID), South (SOU), Taipei city (TPI), and Koahsiung city (KOH) (the East is the reference group)
PROF	Average annual profit of the firm (defined as the average annual profit per worker)

Notes

1 See also Oi and Idson (1999) for a recent survey of the literature.

2 See Rosen (1986) for a detailed description of these sorting properties of the labor market.

3 As the individual's idea of firm size (small, medium, and large) may vary, in the subsection of the robustness test, we further divide the size categories into: up to 100 workers (small), 100+ (large); less than 500 workers (small), 500+ (large); and less than 100 (small), 100–499 workers (medium), 500+ (large). This is for sensitivity analysis.

4 The traditional belief of "better to be the head of a donkey than the tail of a horse" may be one of the reasons why executives and managers tend to choose small instead of large firms.

5 The joint test of the zero effect for all firm-size dummies cannot be rejected. Moreover, as the effect of average annual profits per worker (PROF) varies significantly across firm sizes (see columns 2–5), all firm-size variables become significant after dropping the variable PROF.

6 Most of small- and medium-size enterprises in Taiwan are family-run enterprises which used to hire relatives or person who has some connections with the family. As a result, people with certain family connection use to get promotion easier than those who are not.

[7] In contrast, Idson and Feaster's (1990) study of the U.S. find positive selection in small firms and negative selection in large firms, which in turn reduce the wage difference from what it would be with a random sorting. Main and Reily (1993) and Oosterbeek and Van Praag (1995) find no evidence of non-random sorting of workers across different firm sizes in Britain and the Netherlands, respectively.

[8] Oosterbeek and Van Praag (1995) also find that the return on education is higher for large firms than for small firms in the Netherlands. However, on the contrary, Main and Reilly (1993) find that the estimated returns are highest in small plants with the effect in large plants reported as insignificant.

[9] The results are not shown here, but are available upon request.

[10] The traditional unweighted decomposition analysis of Oaxaca (1973) and Blinder (1993) dose not guarantee that using a given firm-size's wage structure as the reference wage group will give the same results as when we assume any other firm-size's wage structure as the reference wage group. As a result, the traditional unweighted decomposition leads to different and various estimates of the wage gap, which render inconsistent estimates. I thank one of the referees for pointing this out for me.

[11] The figure implies that if a worker who works in the largest firm size chooses to work in the smallest firm size instead, then the wage gap from the return of endowment will be 4.43.

[12] The figure implies that if a worker who works in the smallest firm size chooses to work in the largest firm size instead, then the wage gap from the return of endowment will be 1.97.

[13] Here, $(1.4894 + 0.6795)/2 < (1.3507 + 1.1934)/2 < 1.5197$.

References

Albaek, K., M. Arai, R. Asplund, E. Barth and E. Madsen, 1998, 'Measuring Wage Effects of Plant Size', *Labour Economics* **5**(4), 425–448.

Brian, G., M. Main and B. Reilly, 1993, 'The Employer Size-Wage Gap: Evidence for Britain', *Economica* (1993), 60, 125-42

Bayard, K. and K. R. Troske, 1999, 'Examining the Employer-Size Wage Premium in the Manufacturing, Retail Trade, and Service Industries Using Employer-Employee Matched Data', *American Economic Review* **89**(2), 99–103.

Blinder, A., 1973, 'Wage Discrimination-Reduced Form and Structural Estimates', *Journal of Human Resources* **8**, 436–455.

Brown, C. and J. Medoff, 1989, 'The Employer Size-Wage Effect', *Journal of Political Economy* **97**, 1027–1059.

Cotton, J., 1988, 'On the Decomposition of Wage Differentials', *Review of Economics and Statistics* **70**, 236–243.

Dunca, G. J. and F. P. Stafford, 1980, 'Do Union Members Receive Compensating Wage Differentials?', *American Economic Review* **70**, 355–371.

Dunn, L. F., 1986, 'Work Disutility and Compensating Differentials: Estimation of Factors in the Link between Wages and Firm Size', *Review of Economics and Statistics* **68**, 67–73.

Evans, D. S. and L. S. Leighton, 1989, 'Why Do Smaller Firms Pay Less?', *Journal of Human Resources* **24**, 299–318.

Foulkes, F. K., 1980, *Personnel Policies in Large Nonunion Companies*, Englewood Cliffs, N.J.: Prentice-Hall.

Freeman, R. B. and J. L. Medoff, 1984, *What Do Unions Do?* New York: Basic Books.

Garen, J., 1985, 'Worker Hetergeneity, Job Screening, and Firm Size', *Journal of Political Economy* **93**, 715–739.

Greene, W. H., 1993, *Econometric Analysis*, New York: Macmillan.

Griliches, Z., 1969, 'Capital-skill Complementarity', *Review of Economics and Statistics* **51**(4), 465–468.

Idson, T. L. and D. J. Feaster, 1990, 'A Selectivity Model of Employer-Size Wage Differentials', *Journal of Labor Economics* **8**, 99–122.

Lester, R., 1967, 'Pay Differentials by Establishment Size', *Industrial Relations* **7**, 57–67.

Main, B. G. M. and B. Reilly, 1993, 'The Employer Size-Wage Gap: Evidence for Britain', *Economica* **60**, 125–142.

Mellow, W., 1982, 'Employer Size and Wages', *Review of Economics and Statistics* **64**, 495–501.

Mellow, W., 1983, 'Employer Size, Unionism, and Wages', in R. G. Ehrenberg (ed.), *Research in Labor Economics*, Greenwich, Conn.: JAI, pp. 253–382.

Morissette, R., 1993, 'Canadian Jobs and Firm Size: Do Smaller Firms Pay Less?', *Canadian Journal of Economics* **26**(1), 159–174,

Neumark, D., 1988, 'Employers' Discriminatory Behavior and the Estimation of Wage Discrimination', *Journal of Human Resources* **23**, 279–295.

Oaxaca, R., 1973, 'Male-Female Wage Differentials in Urban Labor Markets', *International Economic Review* **14**, 693–709.

Oi, W., 1983a, 'The Fixed Employment Costs of Specialized Labor', in J. Triplett (ed.), *The Measurement of Labor Cost*, Chicago: University of Chicago Press, pp. 63–116.

Oi, W., 1983b, 'Heterogeneous Firms and the Organization of Production', *Economic Inquiry* **21**, 147–171.

Oi, W. and T. Idson, 1999, 'Firm Size and Wages', in O. Ashenfelter and D. Card (eds.), *Handbook of Labor Economics*, Volume 3B, New York and Oxford: Elsevier Science, North-Holland, pp. 2165–2214.

Oosterbeek, H. and M. Van-Praag, 1995, 'Firm-Size Wage Differentials in the Netherlands', *Small Business Economics* **7**, 173–182.

Rosen, S., 1982, 'Authority, Concentration and the Distribution of Earnings', *Bell Journal of Economics* **13**, 311–323.

Rosen, S., 1986, 'The Theory of Equalizing Differences', in O. Ashenfelter and R. Layard (eds.), *Handbook of Labor Economics*, Amsterdam: North-Holland, pp. 641–692.

Salop, S. C., 1979, 'A Model of Natural Rate of Unemployment', *American Economic Review* **69**(1), 117–125.

Schmidt, G. M. and K. F. Zimmermann, 1991, 'Work Characteristics, Firm Size and Wages', *Review of Economics and Statistics*, 705–710.

Shapiro, C. and J. E. Stiglitz, 1984, 'Equilibrium Unemployment as a Worker Discipline Device', *American Economic Review* **74**(3), 433–444.

Shi, S., 2002, 'Product Market and the Size-Wage Differential', *International Economic Review* **43**(1), 21–54.

Tan, H. and G. Batra, 1997, 'Technology and Firm Size-Wage Differentials in Colombia, Mexico, and Taiwan (China)', *World Bank Economic Review* **11**(1), 59–83.

Weiss, A. and H. J. Landau, 1984, 'Wages, Hiring Standards, and Firm Size', *Journal of Labor Economics* **2**, 477–499.

Weiss, L. W., 1966, 'Concentration and Labor Earnings', *American Economic Review* **56**, 96–117.

White, H., 1980, 'A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity', *Econometrica* **48**, 817–838.

Wise, D. A., 1975) 'Academic Achievement Job Performance', *American Economic Review* **65**, 350–366.