E C O N O M I C S B U L L E T I N

The role of computer use and English proficiency in gender wage inequality: Taiwanese evidence

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Abstract

This paper uses the Blinder-Oaxaca decomposition and accounts for potential identification bias in order to shed light on the role of computer use as well as English ability on the gender wage differential in Taiwan. The results show that both computer use and English proficiency benefit female wage earners and contribute to an equalization of the gender wage gap.

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1. Introduction

One advantage of using computers at work is that it helps in improving productivity regardless of physical strength. Since males are physically stronger than females on average, do females use computers more frequently at work than males according to the principle of comparative advantage? On the other hand, boys are good at math and girls are good at language (Brown and Corcoran, 1997), do females benefit more from English proficiency than males? What are the consequences for gender wage differentials?

Computer science is largely based on math, while the adoption of computer technology is not necessarily related to math but more related to language skills as most of the websites are in English. Gupta (2006) analyzes data from the Danish National Competency Account (NKR) 2004 and finds that men have better competencies in English than women, whereas there is no significant difference in computer ability. While both men and women benefit from computer competencies, only women at lower level jobs are rewarded for their English skills. Dolton et al. (2007) find based on UK data that the impact of using computers on wages differs by gender: men have higher earnings no matter what task they are employed to do, whereas females' earnings depend on the specific task for which they use computers at work. Banerjee et al. (2007) explore the inter-gender wage gap for both computer user and non-user are high in the United States by employing a number of multiplicative dummy variables in OLS estimation. However, this research does not inform us how the extended computer use affects the overall gender wage gap.

For a non-English speaking country, like Taiwan, we could expect computer use as well as English ability can have a strong effect on the gender wage gap. Evidence on this is scarce, however, Liu et al. (2004) explore the 1999 Taiwan Social Change Survey and show that 3.8 per cent of men use of more of computer at work and earn 17 % higher wages than females after controlling for computer use. The current study uses a more detailed data set to focus on gender differences caused by differences in returns to computer use and to English language skill on wages, respectively.

2. The Data

The Research, Development and Evaluation Commission of Taiwan has conducted the Digital Dividing Survey since 2004 to inform the public debate and policy making, but wage information was not included before 2006. A random 0.1% sample of households were interviewed by telephone. The data include individual socio-demographic information such as birth year, education, occupation, employment statutes, working hours and monthly earnings[1]. The data set also provides information about the English language skills of the computer users. After excluding respondents with missing values on key variables, 10,416 individuals aged 21 to 65 remain in the sample for our analysis. Thereof, 7,626 are employed.

3. Descriptive Statistics

Table 1 presents descriptive statistics by gender and computer use. The second column shows that male workers are slightly less educated than women. Female workers' schooling years have exceeded those of males since 1994, and schooling has been thought of as an equalizer of wage inequality in Taiwan (Hsu et al., 2006). Men earn more than females and computer users earn more than non-users. The gender earnings ratio does not change much when computer users are compared to all workers.

The two first columns of Table 2 show the percentage of workers in each category and the proportion of females. The percentages of workers using computers at work in each demographic group are given in column 3 and 4. Females use computers at work more than men.

4. Empirical Model

Following Krueger (1993) I estimate for all workers the following wage equation:

$$\ln W_i = \alpha + \beta X_i + \theta CU_i + \delta \lambda_i + \varepsilon_i \quad \textbf{(1)}$$

where X_i is a vector of individual's characteristics. $CU_{ic} = 1$ is a dummy for workers who use computer at work, λ_i is the inverse Mills' ratio from the probit prediction model of labor participation[2]. In order to decompose the gender differential, we use of Fields and Wolff (1995) steps to construct the model for gender difference in using computer:

$$\ln W_{gi} = \alpha_g + \beta_g X_{gi} + \theta_{gc} CU_{ic} + \varepsilon_{gi}\text{,} \quad i = 1,....,M \quad \varepsilon_{gi} \sim (0, \sigma^2) \quad \textbf{(2)}$$

where suffix g equal to "m" are male workers and g equal to "f" are female workers[3].

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1 We create an hourly wage rate by dividing monthly earning by monthly working hours, i.e. wage rate = monthly earning/ (weekly working hours*4.28)

2 The independent variables in the probit model include gender, age, schooling, number of students in the family, other household members' income and a dummy variable for a foreign spouse.

3 The Heckman model had been test for control for selectively problem of labor participation. However, λ are insignificant in both male and female samples.

Then the predicted wage equation of a representative worker i using computer c is:

$$\ln \hat{W}_{gc} = \hat{\alpha}_g + \hat{\beta}_g \overline{X}_{gc} + \hat{\theta}_{gc} \quad \textbf{(3)}$$

The decomposition model of gender gap for computer use is :

$$\ln \hat{W}_{mc} - \ln \hat{W}_{fc} = (\hat{\alpha}_m - \hat{\alpha}_f) + (\hat{\theta}_{mc} - \hat{\theta}_{fc}) + \overline{X}_{mc}(\hat{\beta}_m - \hat{\beta}_f) + \hat{\beta}_m(\overline{X}_{mc} - \overline{X}_{fc}) \quad \textbf{(4)}$$

The gender gap between computer users and non-users is:

$$\hat{g}_c = (\hat{\alpha}_m - \hat{\alpha}_f) + (\hat{\theta}_{mc} - \hat{\theta}_{fc}) \quad \textbf{(5)}$$

The first item on the RHS is the difference in intercept terms which represent the initial gender gap. The second item is the gender gap in computer use. Horrace and Oaxaca (2001) argue that if both dummy variables and intercepts are included among the explanatory variables, this will give rise to an identification problem. They propose an alternative specification which adds the $(\hat{\beta}_m - \hat{\beta}_f)$ term to neutralize the variation for intercept for measurement. Thus, we have:

$$\hat{\phi}_c = (\hat{\alpha}_m - \hat{\alpha}_f) + (\hat{\theta}_{mc} - \hat{\theta}_{fc}) + \overline{X}_{mc}(\hat{\beta}_m - \hat{\beta}_f) \quad \textbf{(6)}$$

Both $\hat{g}_c$ and $\hat{\phi}_c$ will be reported to evaluate the gender wage difference in computer use.

5. Empirical Results

From the first column in Table 3, we can see that workers using computers at work earn on average 13% higher wage than others. This result is 2 percentage points higher than in Liu et al. (2004) when we do not account for English skills and experience of using computers. The second and third columns give results for males and females separately. Returns to computer use for females are 16 per cent which is higher than males' returns of 12 per cent.   This result is opposite to what has been found for the UK by Dolton et al. (2007) and Dolton and Makepeace (2004).   Furthermore, for computer users who have advanced English proficiency, women's wages are also 5 per cent higher than men's; for employees with basic English skills, women's premia is 7 per cent and significant, whereas for men no premia can be found.

The last column contains the decomposition.   As for the human capital variables, women have advantages in education, using computers, using experience and fair English abilities, whereas men only have an obvious advantage in work experience and a small fraction from possession of advanced English skills.

The first row in Table 4 summarizes the decomposition in Table 3.   The second row reports the same regression without controlling for computer use.   The "attributable difference" consists of two differences: the endowment differential (E) which represents difference of human capital and workplace characteristics between men and women, and the other is "returns"(C) which is the regression coefficients differential.   Both endowments and returns are to advantage of females.   The endowment difference between genders is very small, however.   But males have a huge advantage in the unexplained differential, i.e., the intercept term.   After accounting for computer usage variables, the intercept is reduced by 10.4% and the attributable difference is increased by 2.8 percentage points.   The overall endowment difference remains unchanged.   Thus, although women have advantages regarding both computer use and English language skills, their wages are still lower than men's due to some unobservable capabilities.

Table 5 gives the analysis of gender wage differentials between the computer users and non-users. $(\hat{\alpha}_m - \hat{\alpha}_f)$ is the difference of shift coefficient and $(\hat{\beta}_c^m - \hat{\beta}_c^f)$ is the gap in computer use, both are calculated from Table 3.   The difference in the shift coefficient is 24.1 % and to the advantage of male workers.   The computer use differential is advantageous for females, but is only 4.8%.   The sum of the first two items ($\hat{g}_c$) is 19.3% and which is an advantage to males.   Finally, $\hat{\phi}_c$, which accounts for the potential identification problem via $\bar{x}_c^f(\theta^m - \theta^f)$, is 10.8%.   Thus, the results document that gender differentials remain although increasing use of computer technology has contributed to an equalization of gender wage inequality in Taiwan.

6. Conclusion

Does adoption of computers in Taiwanese workplaces increase wages more for females than for males? This paper decomposes gender wage inequality into different sources and focuses on the role of computer use in the Taiwanese labor market characterized by computer industry clusters and a labor force that is quite skilled in computer use. The results show that women indeed have an advantage in using computers as well as in English language skills. Both skills tend to equalize the gender inequality in wages, but not entirely remove it.

References

Banerjee, S., R. Parai, and A.K. Parai (2007) "Computer use and wage differentials: US and foreign born male and female workers" *Applied Economics Letters* **14:6**, 409 – 413.

Brown, C., and M. Corcoran (1997) "Sex based differences in school content and the male/female wage gap" *Journal of Labor Economics* **15** (3, part 1), 431-465.

Dolton, P., and G. Makepeace (2004) "Computer use and earnings in Britain" *Economic Journal* **114**, 117-129.

Dolton, P., G. Makepeace, and H. Robinson (2007) "Use IT or lose IT? The impact of computer on earnings" IZA Discussion paper No. 2588.

Fields, J., and E. N. Wolff (1995) "Inter-industry wage differentials and gender wage gap" *Industrial and Labor Relations Review* **49**, 105-120.

Gupta, N. D. (2006) "Are women falling behind in the new economy? Gender gaps in new skills and competencies" Under submitting.

Horrace, W., and R. Oaxaca (2001) "Inter-industry wage differentials and the gender wage gap: an identification problem" *Industrial and Labor Relations Review* **54**, 611-618.

Krueger, A. (1993) How computers change the wage structure: evidence from microdata, 1984-1989" *Quarterly Journal of Economics* **108**, 33-60.

Liu, J.-T., M.-W. Tsou, and J. K. Hammitt (2004) "Computer use and wage: evidence from Taiwan" *Economics Letters* **82**, 43-51.

Hsu, M., B.-L. Chen, and J.D. Fang (2006) "The effects of industrial structure and sex discrimination on changes in female and male wage differential in Taiwan 1978-2003" *Academia Economic Papers* **34:4**, 505-539.

Table 1. Descriptive Statistics for Labor Participator

Variables	All		Gender			Computer user		
	Mean	Std. Dev.	Male	Female	F-M(F/M)	Male	Female	F-M(F/M)
Schooling	13.20	3.00	13.16	13.26	0.10	14.56	14.38	-0.18
Age	39.90	9.68	40.59	39.02	-1.57	38.98	37.32	-1.66
Earning(NT$/month	45,301	27,114	50,366	38,826	(0.77)	56,019	42,611	(0.76)
Wage(NT$/h)	245.51	189.67	265.59	219.83	(0.83)	295.68	239.44	(0.81)
Working hours	46.79	13.71	48.38	44.75	(0.93)	47.64	43.69	(0.92)
Observations	7626		4,279	3,347		2,634	2,369	

Source. Author's calculations of 2006 Taiwan Digital Dividing Survey.

Table 2. Percentage of using computer at work and female ratio

	%	% of female	Using computer at work	
			All worker	% of female
All	100%	43.89%	65.57%	70.78%
Gender				
Male	56.11%	-	61.56%	-
Female	43.89%	-	70.78%	-
Employment Status				
Private	60.56%	34.51%	64.72%	33.13%
Government	22.00%	44.10%	90.52%	45.49%
Self-employed	17.44%	46.51%	37.22%	50.65%
Urbanization				
Rural	11.67%	34.51%	66.29%	38.14%
Township	12.16%	44.10%	58.14%	45.08%
City	76.17%	46.51%	66.69%	49.07%
Observations	7626*		5003**	

* and ** represent total number of labor participators and workers who using computer at work, respectively.

Table 3. Regression results and coefficent decomposition of gender difference

y=ln(wage)	All Coeff.	All t-ratio		male Coeff.	male t-ratio		female Coeff.	female t-ratio		Decomposition†(%) Attrib	Endow	Coeff
Gender	0.04	0.93		-	-		-	-		-	-	-
Schooling	0.04	6.81	***	0.05	13.54	***	0.06	12.02	***	-6	-0.6	-5.4
Experience	0.04	20.84	***	0.04	17.01	***	0.03	12.04	***	12.7	-1.3	14
Square of Experience/100	-0.05	-12.46	***	-0.06	-10.73	***	-0.04	-7.16	***	-7.2	-0.2	-7
English skills(Ref. Without)												
Advanced	0.16	6.12	***	0.14	4.35	***	0.19	4.67	***	0.1	0.3	-0.2
Basic	0.04	2.95	***	0.02	0.88		0.07	3.38	***	-1.3	0	-1.4
Employ Status (Ref. Private)												
Government	0.18	10.90	***	0.18	7.85	***	0.16	7.03	***	0.4	0	0.4
Self-employed	0.04	2.29	**	0.05	1.92	*	0.03	0.95		0.6	0.3	0.2
Rural(Ref. City)												
Rural	0.02	0.97		0.03	1.4	***	0.00	-0.09		0.5	0.1	0.3
Township	-0.01	-0.64		0.02	0.83		-0.05	-1.99	**	0.8	0	0.8
Computer use	0.13	8.33	***	0.12	5.5	***	0.16	6.55	***	-4.4	-1.1	-3.4
Experienced User	0.04	3.00	***	0.02	1.1		0.08	3.46	***	-4.1	-0.1	-4
Constant	4.05	27.08	***	3.83	63.75	***	3.59	51.08		-	-	-
Lamada	-0.47	-3.20	***	-	-		-	-		-	-	-
Wald chi2/Adj-R square	3950.83			0.3506			0.3786			-	-	-
No. of Obs/Subtotal of Decomp	10416			4279			3347			-5.1	-0.1	-5

All regressions include dummy variables for eleven occupations. ***,**,and * represent statistical significant 1%,5% and 10%, respectively. † positive number indicates advantage to male

Table 4. Change in gender wage gap before and after control for computer use and English

	Amount attributable Endowments (E)	Coefficients(C)	(E)+(C)	Shift coefficient
Decompsition in table 3 (1)	-0.1	-5	-5.1	24.1
Before account for (2)*	-0.1	-7.8	-7.9	26.9
Change (1)-(2)	0	2.8	2.8	-2.8
%	0.00%	35.90%	35.44%	-10.41%

*: Regression (2) without control for computer use, using experence and English skills.

Table 5. The computer using wage differentaials by gender

	$\hat{\alpha}_m - \hat{\alpha}_f$	$\hat{\beta}_c^m - \hat{\beta}_c^f$	$\hat{g}_c$		$\bar{x}_c^f(\theta^m - \theta^f)$	$\hat{\phi}_c$	
Parameters	0.241	-0.048	0.193	***	-0.085	0.108	***
t-value			20.119			3.40	

*** represent statistical significant levels at 1%.