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Male-Female Wage Differentials in Japan

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Abstract

This paper aims to analyze what makes male-female wage differentials in Japan largest in the developed countries. The hypothesis this paper test is that there are differences in pay between male and female who has same characteristics. Empirical result shows that there are significant differences in pay between male and female. This result implies that there are rooms for improvement for labor market quality.

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1 Introduction

The structure of wages has attracted renewed interest and there exist a lot of empirical studies examine wage structures. However, previous studies face a significant difficulty when measuring the individual's working experience, which is an important factor of wage structures. As Becker (1962) seminal work points out, workers increase their productivity while on the job, so that the variable for working experience is needed to estimate wage function. However, numbers of years after leaving school, which is often called potential working experience, is frequently used as their proxy variable due to data limitation. As Mincer and Polachek (1974) points out, it is clearly inappropriate to estimate wage function, especially for female because female has more tendency to withdrawl labour market than male, because of parenting. Proxy variable above overstates working experience for female and generates biases.

A comprehensive household survey conducted by Keio University in 2004 has an affluent information on Japanese household working history, which enables us to estimate wage function using acutual working experience. The aim of this paper is to demonstrate that using potential working experience for estimation of wage function tend to suffer from bias and leads wrong result. To illustrate that using potential experience suffers from bias and leads wrong result, this paper focuses Japanese male-female wage differentials. Although male-female wage differentials in Japan have been an important policy issue and there are a lot of empirical researches about this issue, because the gap of average pay between male and female in Japan is largest in the developped countries, all these previous researches may lead wrong result because female's working experience tends to be more overstated than male using potential experience so that male-female comparison based on this specification may easily failed.

To achieve this aim, this paper compares the estimation result of wage equation using variables stand for actual working experiences and variables potential working experience. For comparison, this paper uses an empirical approach introduced by

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Davidson and MacKinnon (1981) treating each equation as non-nested models. To estimate Wage equation, this paper uses traditional procedure introduced by Mincer (1985). To get robust result, this paper uses both parametric and semiparametric estimation techniques to remove sample selection bias introduced by Heckman (1976) and Robinson (1988) respectively.

Although there are some empirical researches[1] which have same motivation, all those researches use the data which forces to limit estimation to some age group. This paper does not face such a limitation and uses whole age group sample drawn from poplutaion in Japan. In addition to that, this paper takes account for depreciation of human capital accumulation by job change, by separating working experience of current and previous. Estimation result demonstrates that potential working experience is inapporopriate to estimate wage function. Although estimation result using actual work experience still support the existence of male-female wage discrimination, the degree of that is varies.

The remainder of this paper is as follows. Section 2 describes empirical model and Section 3 explains the data set this paper uses. Section 4 presents empirical results and conclusion.

2 Empirical Strategy

This section describes our empirical strategy briefly. In line with a traditional approach introduced by Mincer (1985), this paper assumes following standard Mincerian wage function,

$$lnW_i = x_i'\beta + u_i. \tag{1}$$

where W_i denoting wage rate, x_i denoting a vector stands for the degree of human capital accumulation, and u_i is disturbance term. x_i contains variables which stand for worker's experience and worker's education.

To correct sample selection bias, this paper estimates following model

$$y_i^* = x_i'\beta + u_i, \tag{2}$$

$$d_i^* = w_i'\alpha + \epsilon_i, \tag{3}$$

$$d_i = 1[d_i^* > 0] \text{ for } i = 1, \ldots, n \tag{4}$$

$$y_i = d_i y_i^*. \text{ not } y_i^*, \text{ but only } y_i \text{ is observable.} \tag{5}$$

First equation stands for an offered wage function, and second equation stands for a function for latent utility Third equation is a labour participation function. (1()) is the indicator function. d_i indicates whether this individual is worker or not, w_i is the vector which contains variables that influence labour participation. For identification one of the variables of w_i must not enter x_i. Although y_i^* is offered wage which is we are interested in, we cannot observe y_i directly, but can observe y_i.

[1]For example, Mincer and Polachek (1974), Kim and Polachek (1994).

To remove sample selection bias, we use semiparametric technique introduced by Robinson (1988) [2], in addition to well known parametric technique introduced by Heckman (1976).

It is well known that we cannot estimate β consistently by method introduced by Heckman (1976) when ϵ is not normally distributed. Robinson (1988) introduces the way to estimate β without assuming ϵ is normally distributed. Robinson (1988) introduces the way wage equation above changes into

$$d\{y - E(y|w'\alpha, d = 1)\} = d\{x - E(x)|w'\alpha, d = 1\}'\beta + d\{u - E(u|w'\alpha, d = 1)\}, \tag{6}$$

and estimates this by OLS, replacing $E(y|w'\alpha, d = 1), E(x|w'\alpha, d = 1)$ by using Nadaraya-Watson estimator[3]. In line with Schafgans (1998), this paper use following way to get more efficiet result. To estimate α, this paper use semiparametric technique introduced by Ichimura (1993) as follows,

$$\hat{\alpha} = \arg\min\{\sum_{i=1}^{n}(d_i - \hat{E}(d_i|w_i'\alpha))^2\},$$

[4] where $\hat{E}(d_i|w_i'\alpha)$ is Nadaraya-Watson estimator as follows,

$$E_N(d_i|w_i'a_N) \equiv \frac{K((w_j'a_N - w_i'a_N)/h)d_j}{K((w_j'a_N - w_i'a_N)/h)}.$$

This paper uses Gaussian kernel as kernel function $K()$ and bandwidth h is determined by Silverman's rule of thumb.

In line with Andrews (1994), this paper estimates β using estimated α as follows. Using OLS, We obtain $\tilde{\beta}$ and $\hat{\text{Var}}$, where

$$\tilde{\beta} = \arg\min\sum_{i=1}^{N} d_i[\{y_i - \hat{E}(d_i|w_i'\hat{\alpha}, d_i = 1)\} - (x_i - \hat{E}(d_i|w_i'\hat{\alpha}, d_i = 1)'\beta)]^2, \tag{7}$$

and

$$\begin{gathered}\hat{\text{Var}}(y_i - x_i'\beta|w_i'\alpha, d_i = 1) = \\ \hat{E}((y_i - \hat{E}(d_i|w_i'\hat{\alpha}, d_i = 1) - (x_i - \hat{E}(d_i|w_i'\hat{\alpha}, d_i = 1)'\beta))^2|w_i'\hat{\alpha}, d_i = 1).\end{gathered} \tag{8}$$

Finally, we obtain a estimator of β by OLS using $\tilde{\beta}$ and $\hat{\text{Var}}$ available above,

$$\hat{\beta} = \arg\min\sum_{i=1}^{N} d_i[\frac{y_i - \hat{E}(d_i|w_i'\hat{\alpha}, d_i = 1) - (x_i - \hat{E}(d_i|w_i'\hat{\alpha}, d_i = 1)'\beta)}{\hat{\text{Var}}(y_i - x_i'\tilde{\beta}|w_i'\hat{\alpha}, d_i = 1)^{1/2}}]^2 \tag{9}$$

3 Data

Although the estimation technique introduced above is distribution assumption free, we still need to specify x_i correctly to estimate β consistently. As Drolet (2001) pointed out, previous studies fail to specify workers' experience correctly because they

[2]See also Lee (2001), All these emprical method follows Schafgans (1998).

[3]Another semiparametric technique introduced by Newey W.K. and Walker (1990), which is replacing $E(u|\epsilon, w)$ by estimating semiparametrically, could be used.

[4]Otherwise, Semiparametric technique introduced byKlein and Spady (1993) could be used.

lack of sufficient information on the quantity of lifetime work experience. Often age or value equals age -schooling or tenure is used as a proxy for the acquisition of general human capital skills or for potential work experience. However, as Mincer and Polachek (1974) points out, these proxy variables are not desirable to analyze male-female wage differentials because female has tendency for interrupting or withdrawl labour market than male, so that actual work experience of female will be overstated than male using these proxies.

Table 1 demonstrates this point. For female, actual work experience is apporoximately 8 years shorter than potential experience, which previous researches frequently use, while there are few difference for male. For female, quarter of experience is part-time job, while almost all experience is full-time job for male.

To avoid the estimation problem generated by measurment error above, this paper utilizes the data from the 2004 wave of Keio Household Panel Survey conducted by Keio University (hereafter we abbreviate this as KHPS). KHPS asks each respondent he/she works full-time or part-time, goes school, stops work , or change the job in each age from he/she is 18.

In addition to use actual working experience instead of using potential working experience, this paper decomposes actual working experience and uses decomposed working experience, to take account for the possibility of depreciation by job change and carrer path. To take account for human capital depreciation by carrer path, this paper divides actual working experience between working experience as full time job and working experience as part time job. To take account for human capital depreciation by job change, this paper divides actual working experience between working experience on current place and working experience on previous place.

As a result, this paper uses following 4 specification of wage equation. First specification uses potential working experience as proxy variables of human capital accumulation. Column (1), (5), (9), (13) on from Table 3 to Table 6 shows the result based on this specification. We refer the explanatory variable based on this specification as X_p. This specification is frequently used in previous researches and tested against other specifiations. Second specification uses actual working experience as proxy variables of human capital accumulation. Column (2), (6), (10), (14) on from Table 3 to Table 6 shows the result based on this specification. We refer the explanatory variable based on this specification as X_a. Third specification uses both years in not employment and not in education (hereafeter we abbreviate it as NEET)and actual working experience divided between working experience for full time job and working experience for part time job as proxy variables of human capital accumulation. Column (3), (7), (11), (15) on from Table 3 to Table 6 shows the result based on this specification. We refer the explanatory variable based on this specification as X_{r1}. Fourth specification uses following 5 variables that proxies accumulation of human capital. Experience in another place as part-time job, past-experience in another place as full-time job, experience in current place as part-time job, experience in current place as full-time job, and years in NEET. Column (4), (8), (12), (16) on from Table 3 to Table 6 shows the result based on this specification. We refer the explanatory variable based on this specification as X_{r2}.

In addition to use variables above, we use schooling dummy variables (junior high school dummy, 2-year college dummy and college dummy[5]) to estimate rate of return to education and area dummies to take account for labour market separation by area.

To estimate labour participation function, this paper uses experiences, schooling variables, and area dummies above as explanatory variables. In addition to those variables we use following variables to take account for utility when individuals choose in home, # of kids whose age is under 3, # of kids whose age from 4 to 6, 3-year average income of spouse and net financial asset of household.

This paper collects sample aged 18 to 59 who are not self-employed nor managements from KHPS 2004. Descriptive statistic are summarized in Table 2.

4 Estimation Result

Table 3 and Table 4 shows the results of estimation of the labour participation function. Table 3 shows the results of probit function and table 4 shows the result of SLS estimation. Table 5 and Table 6 shows the estimation of the wage function. Table 5 shows 2nd stage of heckman estimation and table 6 shows the result of semiparametric estimation introduced by Robinson (1988).

There are no estimated coefficients that shows significant at 10% level and theoretically incorrect sign, on every distribution assumption and specifiation. However, the significance levels varies among specification. For example, income of spouse affects participation decision significantly for female, on specification using potential working experience and actual working experience (on column (1), (2), (9) and (10)), while estimation result based on specification using decomposed actual working experience (on column (3), (4), (11) and (12)) reject that significance. This demonstrates that inappropriate proxy variables leads wrong result. Test of specification will be discussed below.

The coefficients which show both theoretically correct and significant varies between male and female. Both table 4 and table 5 demonstrates the difference of determinants of labour participation between male and female. On theoretical basis, the variables which increase utility when individual stay home such as # of kids discourage indvidual to work and shows negative sign. Estimation result based on female sample is consistent with this theory, while estimation result based on male does not fit this theory. [6]

Also on both table 5 and table 6, there are no estimated coefficients that show significant and theoretically incorrect sign, on every distribution assumption and specifiation. Estimation result on both table implies return to experience varies between male and female. While male experience in another place as full-time job is reflected wage, female is not, while female experience

[5] This dummy variables based on highschool dummy.

[6] All male who has kids participate labour market, coefficients of # of kids cannot be estimated for male. On similar reason, current working experience cannot be estimated and omitted for male.

in current place as part-time job is reflected wage, male is not. Also, this result implies that return to education varies between male and female. While 2 year college (tandai) significantly affects wage for female, there are no siginificant relationship between wage and 2 year college for male.

To demonstrate that using potential working experience is inappropriate for proxy variables of human capital accumulation, this paper uses non-nested J test introduced by Davidson and MacKinnon (1981)[7]. Test result summarized on Table 7 and Table 8. Table 7 summarized for female result, Table 8 for male. There are no test statistics in significance level 5 % that supports specification using potential working experience. This demonstrates that potential working experience is inappropriate for proxy variables. Even for male, almost all work after schooling, test statistics shows that decomposed working expericence is desired for variables which proxies human capital accumulation. Almost all test statistics supports that detailed decomposed working experience is desired. (X_{r2} is most desired) This implies that return to experience varies between full time job and part time job, and between current working experience and previous working experience.

Finally, all the Chow-type test for hypothesis H_0: $\beta_m \neq \beta_f$ accepts H_0. That is, female workers will not receive same wage even though they have same characteristics and supports there are existence of male-female wage discirimation, on every distribution assumption and specification.

References

A.Delgado, Miguel and Juan Mora (1998) "Testing Non-nested Semiparametric Models: An Application to Engel Curves Specifiation", *Journal of Applied Econometrics*, Vol. 13, pp. 145–162.

Andrews, Donald WK (1994) "Asymptotics for Semiparametric Econometric Models via Stochastic Equicontinuity", *Econometrica*, Vol. 62, No. 1, pp. 43–72.

Becker, Gary S. (1962) "Investment in Human Capital", *Journal of Political Economy*, Vol. 70, pp. 9–49.

Davidson, Russell and James G MacKinnon (1981) "Several Tests for Model Specification in the Presence of Alternative Hypotheses", *Econometrica*, Vol. 49, No. 3, pp. 781–793.

Davidson, Russell and James G Mackinnon (1984) "Convenient Specification Tests for Logit and Probit Models", *Journal of Econometrics*, Vol. 25, pp. 241–262.

Drolet, Marie (2001) "The Male-Female Wage Gap", *Perspectives on Labour and Income*, Vol. 2, No. 12, pp. 29–37.

[7]Extension to binary response model is explained by Davidson and Mackinnon (1984) and Extension to partial linear semiparametric models are explained by A.Delgado and Mora (1998)

Heckman, James J. (1976) "The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables", *Annals of Economic and Social Measurement*, Vol. 5, pp. 475–492.

Ichimura, Hidehiko (1993) "Semiparametric Least Squares (SLS) and Weighted SLS Estimation of Single-index Models", *Journal of Econometrics*, Vol. 58, pp. 71–120.

Kim, Moon-Kak and Solomon W. Polachek (1994) "Panel Estimates of Male-Femae Earnings Functions", *Journal of Human Resources*, Vol. 29, No. 2, pp. 406–428.

Klein, Roger W. and Richard H. Spady (1993) "An Efficient Semiparametric Estimator for Binary Response Models", *Econometrics*, Vol. 61, No. 2, pp. 387–421.

jae Lee, Myoung (2001) *Panel Data Econometrics*: Academic Press.

Mincer, Jacob and Solomon Polachek (1974) "Family Investments in Human Capital: Earnings of Women", *Journal of Political Economy*, Vol. 82, No. 2, pp. S76–s108.

Mincer, Jacob (1985) "Inter-Country Comparisons of Labor Force Trends and of Releated Developments: An Overview", *Journal of Labor Economics*, Vol. 3, No. 1, pp. S1–S32.

Newey W.K., Powell J.L. and J.R. Walker (1990) "Semiparametric Estimation of Selection Models: Some Empirical Results", *American Economic Review*, Vol. 80, No. 2, pp. 324–328.

Robinson, P. M. (1988) "Root-N-Consistent Semiparametric Regression", *Econometrica*, Vol. 56, No. 4, pp. 931–954.

Schafgans, Marcia M. A. (1998) "Ethnic Wage Differences In Malaysia: Parametric and Semiparametric Estimation of The Chinese-Malay Wage Gap", *Journal of Applied Econometrics*, Vol. 13, pp. 481–504.

Table 1: Potential working experience & Actual working experience in years

	female		male	
Variable	Mean	Std. Dev.	Min	Max
potential experience	21.0	11.3	21.2	11.0
actual experience	12.9	8.8	20.4	10.9
experience as full time	9.0	8.2	19.6	11.1
experience as part time	3.9	5.3	0.8	2.5
previous working exp as full time	6.3	6.1	7.9	9.5
current working exp as full time	2.7	6.5	11.7	11.0
previous working exp as full time	2.7	4.2	0.7	2.1
current working exp as full time	1.2	3.0	0.1	1.0
neet	8.3	8.9	0.7	2.2

Table 2: Descriptive statistics

	Female		Male	
	Value	Std. dev	Value	Std. dev
previous working exp (as full time)	6.42	6.18	7.95	9.47
previous working experience (as part time)	2.73	4.23	0.71	2.32
NEET in years	8.43	8.96	0.72	2.44
educ:junior high	4.3%		5.7%	
educ: High school	51.1%		46.5%	
educ: 2-year college	23.6%		5.6%	
educ: college	13.9%		34.3%	
educ: graduate school	0.3%		4.7%	
educ: other	6.8%		3.1%	
# of kids 4-6	0.06	0.24	0.06	0.24
# of kids 0-3	0.14	0.40	0.15	0.42
income of spouse(10000yen)	398.03	353.82	76.08	161.84
net financial asset(10000yen)	112.67	1652.61	-135.64	2195.20
age	40.27	10.78	40.89	10.49
Observations	749		737	
	for wokers only			
wage rate	1255.01	1490.42	2052.21	1452.27
previous working exp (as full time)	6.06	5.83	7.64	9.10
previous working experience (as part time)	2.93	4.32	0.65	2.12
current working exp (as full time)	4.37	7.87	12.17	10.95
current working exp (as part time)	1.98	3.72	0.12	0.98
NEET in years	4.93	6.40	0.48	1.79
ratio of part time job	54.5%		6.4%	
educ:junior high	3.7%		5.1%	
educ: High school	50.3%		46.9%	
educ: 2-year college	21.7%		5.7%	
educ: college	15.5%		34.4%	
educ: graduate school	0.5%		4.8%	
educ: other	8.3%		3.1%	
# of kids 4-6	0.03	0.16	0.06	0.25
# of kids 0-3	0.05	0.21	0.16	0.43
income of spouse (10000yen)	327.10	343.07	76.92	161.92
net financial asset (10000yen)	119.77	1556.02	-170.98	2214.02
age	39.17	10.70	40.73	10.43
Observations	433		704	

Table 3: Parametric Estimation (Probit): 1st stage labour participation function

	female				male			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Juniorhigh	0.097	-0.547*	0.031	0.465	-0.555	-0.595*	-0.187	-0.209
	(0.277)	(0.291)	(0.326)	(0.311)	(0.358)	(0.354)	(0.452)	(0.450)
2-year college	-0.065	0.348***	0.114	-0.224	0.225	0.328	0.098	0.173
	(0.127)	(0.128)	(0.152)	(0.145)	(0.408)	(0.423)	(0.588)	(0.606)
Univ	0.157	0.684***	0.103	-0.22	0.138	0.242	-0.03	-0.109
	(0.170)	(0.173)	(0.211)	(0.198)	(0.219)	(0.224)	(0.326)	(0.328)
Income of Spouse	-8.868***	-13.810***	-5.606***	-2.795	-0.385	-2.859	-0.271	-1.664
	(1.739)	(1.696)	(2.038)	(1.898)	(5.678)	(5.677)	(7.565)	(7.896)
Net financial asset	-0.256	-0.937***	-0.801*	-0.111	-1.944***	-2.213***	-1.464	-1.369
	(0.337)	(0.351)	(0.420)	(0.385)	(0.644)	(0.657)	(0.913)	(0.937)
# of kids 6-4	-0.609***	-0.345	-0.641**	-0.798***				
	(0.231)	(0.241)	(0.263)	(0.244)				
# of kids 0-3	-1.392***	-0.993***	-1.570***	-1.812***				
	(0.170)	(0.169)	(0.196)	(0.183)				
potential exp	0.035				-0.115			
	(0.114)				(0.185)			
potential exp^2	-0.017				0.01			
	(0.012)				(0.021)			
actual exp		0.673***				0.232*		
		(0.111)				(0.140)		
actual exp^2		-0.056***				-0.017		
		(0.016)				(0.016)		
NEET in years			-1.021***	-0.794***			-3.221***	-2.989***
			(0.126)	(0.112)			(0.457)	(0.433)
NEET in years^2			0.093***	0.047**			0.693***	0.605***
			(0.021)	(0.019)			(0.120)	(0.112)
exp			0.455***				0.570***	
as full time			(0.120)				(0.210)	
exp^2			-0.054***				-0.072***	
as full time			(0.019)				(0.026)	
exp			1.206***				0.404	
as part time			(0.164)				(0.435)	
exp^2			-0.187***				-0.024	
as part time			(0.041)				(0.103)	
previous working exp				0.176				0.142
as full time job				(0.131)				(0.201)
previous working exp^2				-0.075***				-0.046*
as full time job				(0.027)				(0.028)
previous working exp				0.446***				-0.056
as full time job				(0.158)				(0.435)
previous working exp^2				-0.128***				0.024
as full time job				(0.043)				(0.111)
Constant	1.031***	-0.417**	0.704***	1.640***	2.046***	1.243***	2.280***	3.161***
	(0.249)	(0.196)	(0.236)	(0.218)	(0.411)	(0.300)	(0.466)	(0.434)
Observations	724	724	724	724	731	731	731	731

Notes:
(1) Standard erros in parenthesis.
(2) *, **, *** shows signiicance level 10%,5%,1%, respectively.

Table 4: Semiparametric Estimation (SLS): 1st stage labour participation function

	female				male			
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Juniorhigh	4.371	-2.444	3.756	17.616	-0.565	-0.362	-0.351	-0.393
	(3.299)	(2.286)	(10.11)	(8.713)	(0.069)	(0.13)	(0.431)	(0.37)
2-year college	1.934	2.446	1.315	-7.322	0.222	0.205	0.434	0.091
	(1.411)	(1.171)	(3.69)	(3.823)	(0.092)	(0.21)	(0.555)	(0.438)
Univ	2.64	1.909	-5.116	-7.857	0.143	0.302	0.374	-0.605
	(1.748)	(1.215)	(5.575)	(4.372)	(0.12)	(0.118)	(0.332)	(0.385)
Income of Spouse	-137.871	-103.296	-55.364	3.762	-0.453	-2.677	0.701	-4.183
	(38.319)	(31.853)	(54.312)	(36.822)	(2.202)	(2.975)	(7.081)	(9.792)
Net financial asset	-0.256	-0.937	-0.801	-0.256	-1.944	-2.213	-1.464	-1.369
	-	-	-	-	-	-	-	-
# of kids 6-4	-12.751	-1.626	-9.677	-21.005	-	-	-	-
	(4.27)	(1.391)	(7.401)	(7.537)	-	-	-	-
# of kids 0-3	-20.359	-5.084	-39.843	-37.28	-	-	-	-
	(5.522)	(1.84)	(14.463)	(10.844)	-	-	-	-
potential exp	0.224				0.036			
	(1.032)				(0.077)			
potential exp^2	-0.135				-0.013			
	(0.127)				(0.008)			
actual exp		2.899				0.243		
		(1.195)				(0.086)		
actual exp^2		0.087				-0.019		
		(0.173)				(0.009)		
NEET in years			-25.873	-13.715			-9.466	-8.087
			(9.519)	(4.29)			(2.559)	(3.826)
NEET in years^2			2.159	0.474			2.084	1.866
			(0.911)	(0.342)			(0.577)	(0.888)
exp			10.229				1.806	
as full time			(4.52)				(0.414)	
exp^2			-1.359				-0.232	
as full time			(0.623)				(0.055)	
exp			32.459				0.822	
as part time			(12.325)				(0.509)	
exp^2			-5.117				0.154	
as part time			(2.125)				(0.159)	
previous working exp				4.151				0.419
as full time job				(3.106)				(0.262)
previous working exp^2				-1.786				-0.133
as full time job				(0.756)				(0.063)
previous working exp				7.917				-0.429
as full time job				(3.933)				(0.329)
previous working exp^2				-2.038				0.11
as full time job				(1.035)				(0.081)
Observations	724	724	724	724	731	731	731	731

<u>Notes:</u>
(1) Standard erros in parenthesis.
(2) *, **, *** shows signiicance level 10%,5%,1%, respectively.

Table 5: Parametric Estimation (Heckman): 2nd stage wage function

	female				male			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Juniorhigh	-0.967***	-1.082***	-0.628*	-0.729**	-0.472**	-0.393**	-0.306**	-0.210*
	(0.357)	(0.328)	(0.357)	(0.362)	(0.240)	(0.164)	(0.132)	(0.124)
2-year college	0.441***	0.464***	0.311**	0.310**	0.154	0.159	0.13	0.132
	(0.147)	(0.145)	(0.137)	(0.138)	(0.168)	(0.122)	(0.101)	(0.095)
Univ	0.446**	0.411**	0.328*	0.255	0.381***	0.386***	0.368***	0.334***
	(0.185)	(0.192)	(0.173)	(0.172)	(0.102)	(0.073)	(0.062)	(0.059)
potential exp	-0.024				0.274***			
	(0.109)				(0.089)			
potential exp^2	0.002				-0.018*			
	(0.013)				(0.010)			
actual exp		-0.288**				0.301***		
		(0.133)				(0.062)		
actual exp^2		0.049***				-0.020***		
		(0.017)				(0.007)		
NEET in years			-0.253	-0.134			-0.663***	-0.521**
			(0.156)	(0.153)			(0.256)	(0.266)
NEET in years^2			0.013	-0.003			0.174***	0.133**
			(0.033)	(0.033)			(0.065)	(0.063)
exp			0.09				0.269***	
as full time			(0.109)				(0.051)	
exp^2			0.006				-0.017***	
as full time			(0.016)				(0.006)	
exp			-0.325**				-0.11	
as part time			(0.165)				(0.115)	
exp^2			0.061				0.023	
as part time			(0.038)				(0.029)	
current working exp				0.353***				0.217***
as full time job				(0.116)				(0.042)
current working exp^2				-0.034*				-0.006
as full time job				(0.020)				(0.006)
previous working exp				-0.084				0.123***
as full time job				(0.143)				(0.046)
previous working exp^2				0.025				-0.016**
as full time job				(0.033)				(0.007)
current working exp				-0.820***				-0.301
as part time job				(0.230)				(0.282)
current working exp^2				0.254***				0.125
as part time job				(0.078)				(0.089)
previous working exp				-0.057				0.021
as part time job				(0.166)				(0.121)
previous working exp^2				0.026				-0.016
as part time job				(0.046)				(0.032)
mills ratio	-0.188	-0.485**	0.082	0.084	1.198	0.86	0.662**	0.619*
	(0.257)	(0.242)	(0.258)	(0.243)	(0.854)	(0.525)	(0.287)	(0.350)
Constant	6.718***	7.099***	6.760***	6.739***	6.483***	6.447***	6.655***	6.808***
	(0.244)	(0.341)	(0.240)	(0.205)	(0.198)	(0.158)	(0.110)	(0.091)
Observations	433	433	433	433	704	704	704	704

Notes:
(1) Standard erros in parenthesis.
(2) *, **, *** shows signiicance level 10%,5%,1%, respectively.
(3) Test statistics of $H_0 : \beta_{male} = \beta_{female}$ is calculated as
$(\beta_m - \beta_f)' * (Var_m + Var_f)^{-1} * (\beta_m - \beta_f)$.
34.19*** ((1) vs (5)), 54.04*** ((2) vs (6)), 27.89*** ((3) vs (7)) and 30.35*** ((4) vs (8))

Table 6: Semiparametric Estimation (Robinson): 2ndt stage wage function

	female				male			
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Juniorhigh	-1.048***	-1.050***	-0.632*	-0.676*	-0.445***	-0.428***	-0.236**	-0.240*
	(0.348)	(0.263)	(0.356)	(0.371)	(0.150)	(0.129)	(0.116)	(0.130)
2-year college	0.302**	0.439***	0.271**	0.259*	0.078	0.155	0.123	0.113
	(0.138)	(0.129)	(0.130)	(0.146)	(0.095)	(0.095)	(0.101)	(0.088)
Univ	0.308*	0.490***	0.259	0.232	0.347***	0.371***	0.392***	0.334***
	(0.173)	(0.176)	(0.166)	(0.173)	(0.058)	(0.059)	(0.065)	(0.085)
potential exp	-0.009				0.294***			
	(0.106)				(0.047)			
potential exp^2	-0.0004				-0.021***			
	(0.012)				(0.006)			
actual exp		-0.274**				0.303***		
		(0.123)				(0.050)		
actual exp^2		0.043**				-0.020***		
		(0.017)				(0.005)		
NEET in years			-0.181	-0.084			-0.883	-1.075
			(0.224)	(0.184)			(1.012)	(0.869)
NEET in years^2			-0.006	-0.001			0.226	0.294
			(0.039)	(0.036)			(0.226)	(0.204)
exp			0.014				0.330*	
as full time			(0.117)				(0.197)	
exp^2			0.016				-0.024	
as full time			(0.017)				(0.025)	
exp			-0.226				-0.183	
as part time			(0.247)				(0.130)	
exp^2			0.031				0.061*	
as part time			(0.048)				(0.036)	
current working exp				0.315***				0.206***
as full time job				(0.108)				(0.040)
current working exp^2				-0.029				-0.005
as full time job				(0.019)				(0.006)
previous working exp				-0.082				0.154**
as full time job				(0.138)				(0.063)
previous working exp^2				0.024				-0.024
as full time job				(0.033)				(0.016)
current working exp				-0.910***				-0.566*
as part time job				(0.229)				(0.310)
current working exp^2				0.252***				0.191**
as part time job				(0.077)				(0.093)
previous working exp				-0.118				0.035
as part time job				(0.168)				(0.126)
previous working exp^2				0.04				-0.019
as part time job				(0.048)				(0.035)
Observations	433	433	433	433	704	704	704	704

Notes:
(1) Standard erros in parenthesis.
(2) *, **, *** shows signiicance level 10%,5%,1%, respectively.
(3) Test statistics of $H_0 : \beta_{male} = \beta_{female}$ is calculated as
$(\beta_m - \beta_f)' * (Var_m + Var_f)^{-1} * (\beta_m - \beta_f)$.
34.19*** ((9) vs (13)), 54.04*** ((10) vs (14)), 27.89*** ((11) vs (15)) and 30.35*** ((12) vs (16))

Table 7: J test for female

Tested hypothesis			
Probit	W_a	W_{r1}	W_{r2}
W_p	9.14***	19.88***	17.46***
	15.57***	0.83	-0.95
	W_{r1}	W_{r2}	
W_a	15.00***	18.37***	
	0.01	4.41***	
	W_{r2}		
W_{r1}	1.54		
	11.16***		
Heckman	X_a	X_{r1}	X_{r2}
X_p	4.29***	7.73***	9.46***
	2.40**	-0.16	-0.16
	X_{r1}	X_{r2}	
X_a	6.36***	8.32***	
	-0.78	-0.3	
	X_{r2}		
X_{r2}	5.13***		
	-1.56		
Robinson	X_a	X_{r1}	X_{r2}
X_p	2.42**	5.75***	8.00***
	0.6	-0.17	-0.0002
	X_{r1}	X_{r2}	
X_a	4.62***	6.87***	
	0.003	0.01	
	X_{r2}		
X_{r2}	4.02***		
	-1.07		

Notes:
The first element of each entry is the value of t statistic of α in the equation of
$y_i - \hat{f} = \alpha(\hat{g} - \hat{f}) + \hat{F}b + \epsilon$,
where $\hat{f}$ is predicted value of specification based on tested hypothesis (left column), $\hat{g}$ is predicted value of specification based on each column. The second element of α in the equation of
$y_i - \hat{g} = \alpha(\hat{f} - \hat{G}) + \hat{G}b + \epsilon$.

Table 8: J test for male

f Probit	W_a	W_{r1}	W_{r2}
W_p	5.39***	14.60***	12.95***
	1.35	0.79	-0.39

	W_{r1}	W_{r2}
W_a	14.38***	13.31***
	0.55	1.27

	W_{r2}
W_{r1}	4.51***
	3.66***

Heckman	X_a	X_{r1}	X_{r2}
X_p	1.07	3.77***	9.97***
	1.82	2.90***	3.71***

	X_{r1}	X_{r2}
X_a	3.39***	9.90***
	1.53	2.29**

	X_{r2}
X_{r2}	9.19***
	2.20**

Robinson	X_a	X_{r1}	X_{r2}
X_p	0.28	3.27***	8.65***
	0.98	1.29	2.44***

	X_{r1}	X_{r2}
X_a	3.72***	8.62***
	0.04	0.007

	X_{r2}
X_{r2}	7.80***
	1.21

Notes:
The first element of each entry is the value of t statistic of α in the equation of
$y_i - \hat{f} = \alpha(\hat{g} - \hat{f}) + \hat{F}b + \epsilon$,
where $\hat{f}$ is predicted value of specification based on tested hypothesis (left column), $\hat{g}$ is predicted value of specification based on each column. The second element of α in the equation of
$y_i - \hat{g} = \alpha(\hat{f} - \hat{G}) + \hat{G}b + \epsilon$.