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EFFECT OF IT JOB TRAINING ON EMPLOYMENT AND WAGE PREMIUM: EVIDENCE FROM KOREA PANEL DATA

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In this paper, we examine whether IT job training raises the probability of getting employed and enables the trainee to obtain a high wage. In this paper, it is reported that, in the Republic of Korea, IT job training as a whole affects not only employment but also wage premium, even though the effect on wage premium is somewhat less conspicuous. In particular, the intensity of IT job training is more instrumental in the opportunity of getting employed than simply whether receiving IT job training or not. This effect is intensified in the low-education group. In this group, the probability for the persons who undergo IT job training for more than six months of getting employed is higher than that for a person without any job training. Additionally, provision of IT job training by a private institute and cost sharing with the government enhances the opportunity of employment.

I. INTRODUCTION

THE economy of the Republic of Korea was seriously affected by the financial crisis of November 1997. In the wake of the crisis, turmoil in the financial market increased and the real economy shrank precipitously. As a result, the Korean economy experienced the most severe recession in 1998, with a contraction of a historical high of 5.8 per cent. Although the Korean economy has made a remarkable recovery from the crisis since then, one of the major problems which the Korean society has faced since the crisis is the unemployment problem, especially unemployment of the youth. The real GDP grew by 10.7 per cent in 1999, but the unemployment rate was 8.6 per cent in February 1999, especially the unemployment rate among the people of 20–24 years old was 17.3 per cent.

While the overall economy experienced drawbacks during this period, the information technology (IT) sector recorded a remarkable growth. Due to the favorable demand conditions for IT products overseas and the depreciation of the exchange

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rate followed by the financial crisis, the export of IT products increased, resulting in a $12.2 billion trade surplus in the IT sector in 1998. Some domestic factors such as the Y2K problem and the so-called "dot-com" boom also raised the domestic IT investment, facilitating the growth of the IT sector. Consequently, the IT industry grew by 16.7 per cent in 1998, although the overall growth rate of industrial production recorded negative values. However, the slow pace of reallocation of the labor force as well as the rapid growth of the IT industry was associated with a skill shortage problem. Thus those concerned with the IT industry asked the government to take action to address such problems.

Being confronted with the unemployment problem following the economic recession and the skill shortage problem, the Korean government gave priority to IT job training[1] for alleviating these shortcomings. As a result of this policy, the number of trainees who participated in the IT job training program dramatically increased from 48,000 in 1999 to 80,000 in 2000, which was the largest among all the categories of job training.[2]

The question that naturally follows this kind of government policy is whether the policy was effective in solving the unemployment problem as intended. Thus, we address two main issues in this study. First, does receiving IT job training raise the probability of getting a job? Second, does it reward the trainee with high wages? In addition, we also determine who benefits most from IT job training, in addition to evaluating the effectiveness of who provides and how to provide IT job training.

Besides the policy evaluation, this paper has academically meaningful implications. To be more specific, from the academic angle, there are some reports on how IT, especially computer use, affects the labor market–related variables. In these studies, the effect of computer use on wages is mainly analyzed. According to these studies, the impact of computer use on wages is controversial. While Krueger (1993) demonstrated that workers using computers were better paid than non-users, DiNardo and Pischke (1997) and Entorf and Kramarz (1997) showed that higher returns for the computer users were in all likelihood explained by individual heterogeneity.[3] While the impact of computer use on wage is vague, the impact of computer use on employment is relatively clear. Doms, Dunne, and Troske (1997) and Machin (1996) showed that the introduction of computers into a plant was associated with an increase in the share of managers and technicians as well as a decrease in that of unskilled manual workers. Furthermore, Entorf, Gollac, and Kramarz (1999) demonstrated that computer users were relatively more protected from unemployment compared to non-users. However, these studies have a drawback in that

1 In this study, job training refers to the training provided at the time of unemployment. Thus on-the-job training is excluded in the analysis.

2 The proportion of IT job training to the whole job training was 34.4 per cent in 2000, which was the highest among all the categories of job training.

3 For more details, see Entorf, Gollac, and Kramarz (1999).

the direct effect of computer use on employment was not analyzed. As mentioned above, in these studies, the effect of computer use on employment was indirectly analyzed through the percentage change in occupational mix in plants in relation to technology or the protection effect of computer use in terms of employment.

From the labor economics angle, one strong point of our work is that the relationship between IT and employment is analyzed directly by using more specific and measurable "IT job training" criteria than the ambiguous "computer use." By restricting our attention to IT job training for the unemployed persons in a year and their probability of getting a job in the subsequent year, we could focus on the direct relationship between IT and employment.

In this paper, we analyze the effect of IT job training on employment and wage premium[4] through the Korean case. We select Korea for the following two reasons. First, as mentioned above, IT job training has been the core policy of Korea to solve the unemployment problem. Second, the relative growth rate of the IT industry in Korea has been among the highest in the global economy. In the literature, in many cases, it appears that both advanced and developing countries have recently considered that IT job training can reduce the unemployment rate following a rapid expansion of the IT industry. Thus even though this study focuses only on the Korean case, it has more implications due to the distinctive features related to the IT industry in Korea. To the extent that this study confirms the effect of IT job training on employment and wage premium, we can determine whether not only the core labor policy of the Korean government (i.e., IT job training) was effective in reducing unemployment rate but also whether this policy can be applied to other countries. It is the other strong point of this paper from the angle of development process.

In this study, we utilize data from the Korea Labor and Income Panel Study (hereafter referred to as KLIPS) collected at the Korea Labor Institute. The Probit model is used to determine whether IT job training is effective in solving unemployment problems and Heckman's two-stage estimator is used to examine whether it guarantees high-wage jobs for the IT job-trained workers.

The main findings are as follows. First, while IT job training is effective in raising the probability of employment, it does not generate wage premium significantly. Second, the intensity of IT job training is by far more instrumental in the opportunity of getting employed than whether receiving IT job training or not. While the mere undergoing of IT job training reduces the probability of getting a job by 15 per cent, the persons with IT job training for more than six months have a higher opportunity of getting employed than the persons who did not undergo any job training, by 24 per cent. Third, the effect is stronger in the low-education group.[5] In this group, the probability for a person who received IT job training for more than six

[4] In this study, wage premium refers to employment with a high salary.

[5] The low-education group is composed of persons with a high school educational level or below high school.

months of getting employed is higher than that for a person without any job training, by 38 per cent. Thus, this result indicates that IT job training shows an important distribution effect by helping the minority (low-education group) to compensate for their weakness. Fourth, who provides IT job training and who covers the training cost are also important factors in determining the probability of getting employed. According to the results obtained, provision of IT job training by a private institute and cost sharing with the government enhances the opportunity of employment.

This study is composed of five sections. In Section II the data set to be used in this study is briefly described. In Sections III and IV, the effect of IT job training on employment and wages, respectively, is analyzed. In Section V, this effect is analyzed based on the education level. Section VI provides a conclusion.

II. DATA

The main purpose of this paper is to determine whether IT job training is an effective means of solving the unemployment problem and whether it secures a wage premium. We examine these effects by estimating equations for employment and wage, taking account of the fact that the focused group consists of the unemployed and the focused explanatory variable is the IT job training variable. It is well known that family or individual characteristics such as sex, education, or family income are important factors in estimating these equations. Since in this paper the effect of IT job training is examined, data on IT job training are essential for the empirical study, in addition to these variables. For our study, we obtain all the related data from KLIPS. KLIPS is a panel data set which has been published annually since 1998, and includes 5,000 families and 13,000 individuals.

There are three reasons for using the KLIPS data set. First, as we recognize that IT job training often requires more than six months,[6] we need a data set for at least two years to estimate the effect of IT job training on employment or wage premium accurately.[7] As described above, the KLIPS data set meets this condition. Second, as the main purpose of this paper is to examine the impact of IT job training, data on IT job training are essential. KLIPS is only a domestic data set containing information about IT job training.[8] In addition to the variables related to IT job training, the KLIPS data set also covers data on other types of job training. Thus we can test the relative effectiveness of IT and non-IT job training on employment and wage pre-

6 Other types of job training also frequently require more than six months.

7 Since there is no job training program that requires more than twelve months (one year), using data between two years is appropriate for examining the IT job training's effect on employment and wage premium.

8 In Korea, there are several labor-related panel data other than KLIPS, for example, "Daewoo Panel Study," "Additional Examination on Economic Activity," and "Annual Reports on Urban Households." However, none have relevant information on job training.

mium. Third, to examine the effect of job training on employment and wage premium, data related to family or individual characteristics are also required. KLIPS has a large amount of data about these aspects. In this study, KLIPS data of 1998 and 1999 are used. The sample is composed of the persons who were unemployed in 1998 and the total number of observations is 1,877.

TABLE I

VARIABLE DEFINITION AND SUMMARY STATISTICS

(1,000 won)

Variables	Variable Definition	Mean	Standard Deviation
Y	*Y*=1 if employed in 1999 *Y*=0, otherwise	0.3287	0.4689
W	Monthly income of 1999	225.5	390.2
FNLINC	Family nonlabor income	3,746.7	51,626.0
AGE	Age	37.2	14.70
SEX	*SEX*=1 if male *SEX*=0 if female	0.40	0.4902
EDU	Education level	11.05	3.7053
MARRY01	*MARRY01*=1 if married *MARRY01*=0 if not married	0.60	0.4894
DINC	Desired income (monthly)	999.3	524.2
PDINC	Predicted desired income (monthly)	900.9	260.4
PJINC	Income of previous job (monthly)	621.5	791.1
ITTIME	Number of hours for receiving IT job training	19.13	188.5
NITTIME	Number of hours for receiving non-IT job training	50.30	275.6
IT01	*IT01*=1 if undergo IT job training *IT01*=0, otherwise	—	—
NIT01	*NIT01*=1 if undergo non-IT job training *NIT01*=0, otherwise	—	—
ITS1	*ITS1*=1 if the number of hours for receiving IT job training is less than 171.43 hours *ITS1*=0, otherwise	—	—
ITS2	*ITS2*=1 if the number of hours for receiving IT job training ranges between 171.43 hours and 1,028.57 hours *ITS2*=0, otherwise	—	—
ITS3	*ITS3*=1 if the number of hours for receiving IT job training is more than 1,028.57 hours *ITS3*=0, otherwise	—	—
NITS1	*NITS1*=1 if the number of hours for receiving non-IT job training is less than 171.43 hours *NITS1*=0, otherwise	—	—

TABLE I (Continued)

Variables	Variable Definition	Mean	Standard Deviation
NITS2	*NITS2*=1 if the number of hours for receiving non-IT job training ranges between 171.43 hours and 1,028.57 hours *NITS2*=0, otherwise	—	—
NITS3	*NITS3*=1 if the number of hours for receiving non-IT job training is more than 1,028.57 hours *NITS3*=0, otherwise	—	—
TRNSITE	*TRNSITE*=1 if job training is received in the public sector *TRNSITE*=0, otherwise	—	—
TRNFEE	*TRNFEE*=1 if the cost is shared by the government *TRNFEE*=0, otherwise	—	—
λ	Inverse Mills ratio	—	—

Variable definition to be used in this study is listed in Table I. Education level (*EDU*), age (*AGE*), sex (*SEX*), marital status (*MARRY01*), desired income (*DINC*),[9] and family nonlabor income (*FNLINC*) are used as variables to reflect individual or family characteristics. For IT job training variables, we use these items for determining whether IT job training (or non-IT job training) is received or not, and the duration of the period of IT job training (or non-IT job training). To be specific, variables for job training are used by three ways. First, the number of total hours of IT and non-IT job training are used as continuous variables, and *ITTIME* and *NITTIME* in Table I fall into this category. Second, whether IT and non-IT job training is received is used as dummy variables, and *IT01* and *NIT01* are variables to capture this information. Third, we construct dummy variables, *ITS1*, *2*, *3* and *NITS1*, *2*, *3*, by converting the number of total job training hours into months.[10] *ITS1* (or *NITS1*) is 1 if the number of total hours for receiving job training corresponds to less than one month, and otherwise 0. *ITS2* (or *NITS2*) is 1 if the number of total hours for receiving job training ranges between one month and six months, otherwise 0. *ITS3* (or *NITS3*) is 1 if the number of total hours for receiving job training corresponds to more than six months, otherwise 0.

The reason for using the duration of the period of job training is that the quality of job training is also expected to play a decisive role in raising the probability of getting a job, which might provide a deeper implication than the variable of whether

9 Desired (monthly) income is directly derived from the raw data of the respondents in the KLIPS survey.

10 The duration of the period of job training is expressed in terms of hours per week in KLIPS. It is converted into months under the assumption that one receives eight-hour education per day for five days per week. Thus if someone received 171.43 hours (8 hours/day × 5 days/week × [30/7] weeks) of job training, the duration of the job training period converted into months would be one month.

simply receiving job training or not. However, KLIPS data do not contain the information related to the quality of job training. Thus we use the duration of the period of job training as a proxy variable for the quality of job training, which implies that we assume that the longer the duration of the period of job training, the higher the intensity of job training.

III. IT JOB TRAINING AND EMPLOYMENT

A. *Effect of IT Job Training on Employment*

In this section, the effect of IT job training on employment is analyzed by using the Probit model. Denoting Y_i as the binomial dummy variable to represent whether an individual *i* is employed or not in 1999, the estimation equation used to examine the effect of IT job training on employment can be expressed as follows:

$$P(Y_i = 1) = \beta_0 + X_i\beta_1 + Z_i\beta_2 + \varepsilon_i. \quad (1)$$

Here, $P(Y_i = 1)$ represents the probability for Y_i of being 1, in which Y_i is equal to 1 if the individual *i* is employed in 1999 and 0 if otherwise. X is a variable vector representing family or individual characteristics expected to affect the probability, Z is a variable vector for job training, and ε denotes an error term.

The empirical analysis is carried out through the estimation of equation (1). Before estimating equation (1), however, we should estimate the desired income (*PDINC*) included in X of equation (1) first, because it is not exogenously determined, but is determined by some variables such as sex, education, and other variables representing family or individual characteristics, that is, there is an endogenity problem. To solve this problem, equation (1) is estimated at two stages. At the first stage, the predicted desired income is obtained by estimating equation (2) through the OLS.

$$DINC_i = \alpha_0 + \alpha_1 SEX_i + \alpha_2 EDU_i + \alpha_3 MARRY01_i + \alpha_4 PJINC_i + \zeta_i, \quad (2)$$

ζ = error term.

At the second stage, by using the estimated desired income, equation (1) is estimated by the Probit model. The result of the first stage estimation is summarized in Table II. Independent variables used are *SEX*, *EDU*, *MARRY01*, and *PJINC*. These variables are all significant at the 1 per cent level. Furthermore, signs of estimate are the same as expected.[11]

Table III gives the results of the second stage of estimation of equation (1). The

[11] One might consider that since the adjusted R^2 is low, proper instrumental variables are not chosen. Note that it is a well-known fact that if F-statistic shows a value higher than 10, we do not need to be concerned about the weak correlation between the instruments and dependent variables. For more details, see Staiger and Stock (1997). Here, F-value is 28.82.

TABLE II

ESTIMATION RESULTS OF DESIRED INCOME

Constant	*SEX*	*EDU*	*MARRY01*	*PJINC*	Adj. R^2	F-value
17.95* (10.86)	32.82*** (5.61)	3.54*** (0.80)	17.17*** (5.63)	0.17*** (0.05)	0.2760	28.82

Note: Standard errors are indicated in parentheses.
* Significant at the 10 per cent level.
** Significant at the 5 per cent level.
*** Significant at the 1 per cent level.

estimation is performed by three ways according to job training variables. Reg-1 is the estimation result when the job training variable is used as continuous variable (i.e., *ITTIME* and *NITTIME*) and Reg-2 is the estimation result when the variable is used as *IT01* and *NIT01*. Finally, Reg-3 is the result when *ITS1* (or *NITS1*) – *ITS3* (*NITS3*) are used as job training variables. The estimated coefficients of the variables related to individual or family characteristics are similar, irrespective of the type of job training variable used. *EDU*, *AGE*, *SEX*, and *MARRY01* are all significant and positive. That is, the higher the education level and age, the higher the probability of getting a job. Furthermore, the male and married people have a higher probability of getting a job relative to female and non-married person, respectively.

The estimated results of job training by and large are found to be significant and to exert a beneficial effect on employment, even though there are differences depending on the use. Before proceeding to further discussion, we need to pay attention to one fact. That is, the coefficients of variables do not represent the probability of getting a job. In the Probit model, if the model is given by equation (1), the effect of Q on the probability for Y_i to be 1 is obtained through equation (3):

$$Y_i = \beta_1 + \beta_2 Q_i + \varepsilon_i, \tag{3}$$

$$\frac{dP}{dQ} = \frac{d\Phi(Z)}{dZ}\frac{dZ}{dQ} = \phi(Q)\beta_2, \tag{4}$$

where
Φ = cumulative distribution function of standard normal distribution,
ϕ = probability density function of standard normal distribution.

By using equations (3) and (4), we can convert the coefficient value into a probability value. First, by applying this formula to *ITTIME* and *NITTIME*, the probability of getting a job by an additional hour of IT job training is found to be higher than that of non-IT job training by five times. However, this result significantly changes when the dummy variable reflecting only whether job training is received or not is

TABLE Ⅲ

PROBIT ESTIMATION OF THE EFFECT OF IT JOB TRAINING ON EMPLOYMENT

Variables	Reg-1	Reg-2	Reg-3
Constant	0.12440** (0.00486)	0.13723*** (0.00486)	0.12279*** (0.00488)
EDU	0.09738*** (0.00043)	0.098543*** (0.00043)	0.09879*** (0.00043)
AGE	0.01872** (0.000081)	0.01854*** (0.000082)	0.01873*** (0.000082)
SEX	0.40525*** (0.00258)	0.41532*** (0.00360)	0.40065*** (0.00361)
MARRY01	0.36712*** (0.005286)	0.36434*** (0.00260)	0.35842*** (0.00260)
PDINC	–0.01981*** (0.00008)	–0.02002*** (0.00008)	–0.01988*** (0.00008)
FNLINC	5.6424E–6*** (1.64779)	5.65498E–6*** (1.64608E–7)	5.66697E–6*** (1.64513E–7)
ITTIME	0.00014*** (4.07504E–6)		
NITTIME	0.000028*** (2.8249E–6)		
IT01		–0.17482*** (0.00422)	
NIT01		0.13051*** (0.00301)	
ITS1			–0.41841*** (0.00664)
ITS2			–0.025137*** (0.00618)
ITS3			0.67498*** (0.01145)
NITS1			0.034857*** (0.00707)
NITS2			–0.03184*** (0.00488)
NITS3			0.06872*** (0.0053)
Number of observations	1,877	1,877	1,877

Note: Standard errors are indicated in parentheses.
* Significant at the 10 per cent level.
** Significant at the 5 per cent level.
*** Significant at the 1 per cent level.

used as a job training variable. In this case, while undergoing non-IT job training raises the probability of getting a job, receiving IT job training rather reduces the probability. This result seems to be totally different from and contradictory to that of Reg-1.

However, if the quality of job training is more important than simply whether job training is received in determining employment in the case of IT job training, this inverse result could occur. To be more specific, the total number of job trainees could be classified by the quality of job training they received, e.g., high- and low-quality groups, and the coefficient of *IT01* reflects the combined effect of these groups. Let us assume that low-quality IT job training lowers the opportunity of employment, and high-quality IT job training exerts a beneficial effect on employment. If the magnitude of the former effect is much larger than that of the latter, then the combined effects could become negative. Thus, the remarkable differences in the effect depending on the job training quality can explain this result. Below we will examine whether this is actually the case.

Reg-3 reports the results when the job training variable is used as a dummy variable to reflect the quality of job training. It is interesting to note that lower-quality IT job training significantly reduces rather than increases the probability of employment. We interpret this result as follows: we recognize that the main curriculum of lower-quality IT job training is the introductory use of computers, such as Windows, internet browser, and basic word processor use. Thus the fact that an unemployed person receives this kind of IT job training means that his basic IT skills are by far lacking relative to an average person, which reduces the probability of employment. On the other hand, another interesting aspect from Reg-3 is that the coefficient of *ITS3* is not only significant but also the highest among the variables considered. By converting the coefficient into probability, the estimated value is 0.24. This indicates that in the case of the person who received IT job training for more than six months, the probability of getting employed is higher by 24 per cent than that for a person without any job training. Thus it is concluded from this result that especially in the case of IT job training, the quality of job training is more important than whether one receives job training or not, in raising the probability of getting employed.

With this empirical analysis, we could roughly determine whether the Korean government unemployment policy focusing on IT job training actually contributes to the solution of the unemployment problem. For this analysis, we need the supply-side statistics from the above-mentioned policy. We borrow this statistics from Kwon and Ko (2001). They found that among all the government-sponsored IT job training programs, the proportion of people who received IT job training for more than six months was about 35–36 per cent in 1999. With the estimated result, we assume that roughly 65 per cent of the people who received IT job training did not benefit from this policy in getting a job. Based on the Reg-3 results and the fact just mentioned, we could calculate the changes in the probability of getting employed due to the government unemployment policy focusing on IT job training. According to this calculation, the policy actually reduces rather than increases the probability of getting a job by 1.9 per cent, mainly because the major part of the government-sponsored IT job training program was too much concentrated on short-period, low-quality training.

These results provide a very important policy implication. That is, labor policy should be focused on quality-based IT job training, rather than on the simple number of people who receive the job training, to address the unemployment problem effectively.

B. *Difference in the Effect of IT Job Training Related to the Provision and Financing Methods*

In this section, we examine whether the probability of getting a job depends on who provides job training and how the training cost is covered. This analysis has an important significance, because it is one of the popular topics among the studies related to job training.[12]

For this analysis, we classify the institutions that provide job training into the public sector and the private sector, and the way to finance the training cost into self-financing and government financing.[13] Here, the sample is composed of the people who received job training while being unemployed in 1998 and the estimator used is the Probit model. *TRNSITE* and *TRNFEE* in Table I are variables representing the institutions that provide training and the way to finance the cost, respectively.[14]

Estimation is performed for two groups as follows: one for the people who received any kind of job training and the other for the people who received only IT job training. Estimation results are summarized in Table IV. First, in the case of the variables standing for individual or family characteristics, the results are similar to those in Table III in the former group, but are quite different from Table III in the latter group. When the estimation is performed for only the people who received IT job training, the coefficients of *EDU, SEX,* and *MARRY01* are all significantly negative. These findings are somewhat surprising, since, for example in the case of *SEX,* it appears that the probability of getting a job for a female who received IT job training

12 For more details, see Shackleton (1995).

13 Government financing does not imply that the total training cost is entirely funded by the government. It indicates that the government provides funds for some of the training cost. The Korean government has subsidized institutes for providing IT job training since the IMF crisis, including the private institutes.

14 Note that the sample size of Table III is 1,877, which is composed of the persons who were unemployed in 1998 among 13,000 KLIPS panels. Since we want to capture the employment effects of IT and non-IT job training, we need to include the persons who did not receive job training at all. On the other hand, we need to focus on the actual job-trainees shown in Table IV, since we want to compare the provision and financing effects among IT and non-IT job trainees shown in Table IV. The sample size of 345 and 140 in Table IV indicates that 345 people among those unemployed in 1998 actually received any kind of job training, and 140 people received IT job training.

TABLE IV

EFFECT OF IT JOB TRAINING ON EMPLOYMENT
(Difference in the Effect Depending on the Provision and Financing Methods)

Variables	All Job Training			IT Job Training		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.112*** (0.0158)	1.119*** (0.0158)	1.091*** (0.0159)	0.7409*** (0.033)	0.6079*** (0.033)	0.4831*** (0.033)
EDU	–0.0394*** (0.0012)	–0.041*** (0.0011)	–0.038*** (0.0012)	–0.1852*** (0.0029)	–0.2084*** (0.0028)	–0.1796*** (0.0029)
AGE	0.0209*** (0.0003)	0.0220*** (0.0003)	0.0211*** (0.0003)	0.0369*** (0.0009)	0.0472*** (0.0009)	0.0545*** (0.0010)
SEX	0.2030*** (0.0085)	0.2232*** (0.0081)	0.2067*** (0.0086)	–0.3222*** (0.018)	–0.4669*** (0.0181)	–0.3522*** (0.0181)
MARRY01	0.5192*** (0.0069)	0.5107*** (0.0067)	0.5256*** (0.0069)	–0.2474*** (0.0156)	–0.2549*** (0.0159)	–0.1758*** (0.016)
PDINC	–0.0134*** (0.00017)	–0.0128*** (0.0002)	–0.0134*** (0.0002)	0.0096*** (0.00048)	0.0146*** (0.0005)	0.0075*** (0.0005)
TRNTIME	0.00008*** (3.09E–6)	0.00007*** (3.12E–6)	0.00009*** (3.16E–6)	0.0003*** (5.61E–6)	0.0004*** (6.33E–6)	0.00047*** (6.18E–6)
TRNFEE	0.1466*** (0.0052)		0.1671*** (0.0055)	0.2189*** (0.0094)		0.5233*** (0.011)
TRNSITE		–0.0219*** (0.0054)	–0.073*** (0.0057)		–0.5368*** (0.010)	–0.7743*** (0.0118)
Number of observations	345	345	345	140	140	140

Note: Standard errors are indicated in parentheses.
* Significant at the 10 per cent level.
** Significant at the 5 per cent level.
*** Significant at the 1 per cent level.

is higher than the probability for a male who received the same IT job training.

Two interpretations could be provided for this result. The first interpretation is as follows. If it is true that, for some reasons, even a female with a high qualification generally has a disadvantage in getting a job compared to a male, she will take IT job training to overcome the disadvantage and this might increase the probability of getting a job. In other words, one reason for these unexpected results seems to arise from the fact that a person with a good qualification who has nevertheless some characteristics[15] known to generally exert an adverse effect on employment may undergo IT job training as a means of compensating for these characteristics. Thus to the extent that this interpretation is correct, we can infer from this result that IT job

[15] For example, married, female, or low-education level correspond to these characteristics.

training can be considered to be a better compensating means compared to other types of job training for these people.

The second interpretation is that this may be due to the incongruity between the jobs the trainees are seeking and the jobs the employers are providing. That is, female trainees who undergo IT job training tend to get jobs more easily than males because some employers prefer to employ females for a single task job such as IT operators.

Similar explanations could be applied to the case of *MARRY01*. In addition, the negative sign of *EDU* may be due to the fact that the reservation wage of a person with a higher education level is higher than that of a person with a lower education level. That is, since the highly educated persons have a high reservation wage, they might have a low probability of getting a job.[16]

The effects of who provided and how to provide training for employment are roughly equal in the two groups. That is, Table IV shows that when job training is provided by the private sector and the cost is shared by the government, the probability of getting a job is higher. However, the magnitude is different in these two groups. First in the case of cost financing, when the cost is partially borne by the government, while the probability increased by 0.0029 per cent in the group with any types of job training, the probability increases by 0.0212 per cent in the group with only IT job training. Second, when the public sector provided job training, the probability of getting a job decreases by 0.8 per cent in the group with any types of job training, while the probability decreases by 20.8 per cent in the group with only IT job training. These findings may account for the fact that since an individual private institution's performance on employment plays an important role in determining the size of the government subsidy, the private sector places emphasis on providing various education programs required by the trainees for securing employment.

In summary, we can draw the following conclusions from these findings: (1) Who provides and how to provide job training play an important role in the probability of getting a job. (2) To raise the probability of success in getting a job, it is desirable for the private sector to provide job training services and for the training cost to be partially borne by the government, whoever provides the service.

IV. IT JOB TRAINING AND WAGE PREMIUM

It might be expected that receiving job training guarantees a high wage. In this section, equations will be used to determine the effect on the income. The income equation used in this study is basically Mincer's income equation. To be specific, the in-

[16] An anonymous referee generously indicated this point and the second interpretation described above.

come equation used to examine the effect of IT job training on wage premium is as follows:

$$\ln W_i = \alpha_0 + X_i\alpha_1 + Z_i\alpha_2 + \varepsilon_i, \qquad \varepsilon \sim N(0, \sigma_\varepsilon^2), \tag{5}$$

where

$\ln W$ = monthly income expressed by natural log,

X = variable vector related to individual or family characteristics,

Z = variable vector related to job training, and

ε = error term.

In estimating equation (5), it should be noted that the data for wage are only observed for a working person. Thus if equation (5) is estimated by OLS, the estimate is biased because of sample selection bias. To avoid this sample selection bias, equation (5) can be estimated through Heckman's two-stage estimator. In order to estimate equation (5) by using Heckman's two-stage estimator, an equation to determine labor market participation is additionally needed. The labor market participation equation to be used[17] is as follows:[18]

$$h_i = \beta_0 + \beta_1 \ln W_i + \beta_2 \ln FNLINC_i + X_{2i}\gamma + u_i, \qquad u \sim N(0, \sigma_u^2), \tag{6}$$

where

h = number of working hours,

$\ln W$ = wage expressed by natural log,

$\ln FNLINC$ = family nonlabor income expressed by natural log,

X_2 = variable vector related to individual or family characteristics, and

u = error term.

By using equations (5) and (6), we can derive the following estimation equation for the empirical study.

$$\ln W_i = \alpha_0 + X_i\alpha_1 + Z_i\alpha_2 + \frac{\sigma_{\varepsilon u}}{\sigma_u}\lambda(-K^*) + \xi, \qquad \xi \sim N(0, \sigma_\xi^2), \tag{7}$$

where

$$\lambda(-K^*) = \text{inverse Mills ratio} = E\left(\frac{u}{\sigma_u}\,\middle|\,\frac{u}{\sigma_u} > -\frac{K}{\sigma_u}\right),$$

$$K^* = \frac{K}{\sigma_u} = \frac{\beta_0}{\sigma_u} + \frac{\beta_1}{\sigma_u}\ln W_i + \frac{\beta_2}{\sigma_u}\ln FNLINC_i + X_{2i}\frac{\gamma}{\sigma_u}. \tag{8}$$

17 In fact, the equation corresponds to the labor supply.

18 The use of Heckman's two-stage estimator applies to wage and nonlabor income without the use of log in the labor supply equation. However, since wage with log is used for the estimation of the wage equation in our study, wage with log is also used in the labor supply equation. For more details, see Heckman, Killingsworth, and MaCurdy (1981).

The income equation can also be estimated by three ways according to the job training variables used. The results are given in Table V. The main finding is that all the variables related to job training, except for *ITS1* and *NITS1* are not significant, contrary to general expectation. In particular, while *ITS3*, which exerted a significant effect on employment, does not exert strong effects on wage premium, *ITS1* (or *NITS1*) generates wage premium significantly.

It should be noted that the persons with lower-quality IT job training (*ITS1*) have a "lower" probability of getting employed compared to non-trainees, as shown in Table III. As indicated before, we can consider that these persons are by far lacking IT skills relative to an average person, since the curriculum of lower-quality IT job training involves the introductory use of computers, such as Windows, internet browser, and basic word processor use. Under these conditions, what is the reason for the significantly high wage premium given to this people? How can we provide a logical explanation for the consistency of the lower employment opportunity and the higher wage premium?

One reason might be that some of the short-term trainees are likely to get higher wages because they can upgrade their skills by themselves after they received fundamental training.[19] In this way, the lower employment opportunity and the higher wage premium for the persons with lower-quality training are compatible.

Another explanation which might be less elaborate is to rely on other factors than IT job training. That is, the reason why the people with IT job training for less than one month are able to get a high-wage job is not because of IT job training but because of some other factors like experience or career, which are not specified in the model.

In any case, however, there is no direct effect of IT job training on the wage premium in the case of *ITS1*. According to the first explanation, the wage premium depends on the subsequent effort made by the *ITS1* trainee and not on the training itself. The second explanation also rules out the direct effect from training. Taking into account the above explanation and the nonsignificant coefficients of *ITS2* and *ITS3*, it can be concluded that, while IT job training is instrumental in getting a job, as shown in Table III, it does not imply that the job will be associated with a high salary.

One more finding obtained from this study is that the coefficients of the variables related to non-IT job training generally are higher than those of the variables related to IT job training. This finding implies that non-IT job training is relatively more effective than IT job training in wage premium. Additionally, Table V shows that *EDU, AGE,* and *SEX* are all significant and exert a beneficial effect on wage premium, as expected.

[19] An anonymous referee generously indicated this point.

TABLE V

EFFECT OF IT JOB TRAINING ON WAGE PREMIUM: HECKMAN TWO-STAGE ESTIMATOR

Variables	(1)	(2)	(3)
Constant	2.591*** (0.237)	2.577*** (0.237)	2.541*** (0.236)
EDU	0.036*** (0.008)	0.0338** (0.0078)	0.0328*** (0.0078)
AGE	0.040*** (0.0107)	0.0414*** (0.0107)	0.0440*** (0.0107)
AGE_2	–0.0005*** (0.00014)	–0.0005 (0.0001)	–0.0006*** (0.0001)
SEX	0.488*** (0.049)	0.491*** (0.0485)	0.495*** (0.0485)
ITTIME	–0.00002 (0.00013)		
NITTIME	0.00005 (0.000008)		
IT01		0.1276 (0.108)	
NIT01		0.1919 (0.0847)	
ITS1			0.4196*** (0.1581)
ITS2			–0.1211 (0.1514)
ITS3			0.1295 (0.3937)
NITS1			0.4456*** (0.1510)
NITS2			0.0715 (0.1265)
NITS3			0.1183 (0.1527)
λ	0.155*** (0.0632)	0.1559*** (0.0630)	0.1660 (0.0627)
Adjusted R^2	0.2255	0.2323	0.2409
Number of observations	1,877	1,877	1,877

Note: Standard errors are indicated in parentheses.
* Significant at the 10 per cent level.
** Significant at the 5 per cent level.
*** Significant at the 1 per cent level.

V. EFFECT OF IT JOB TRAINING DEPENDING ON THE EDUCATION LEVEL

One of the purposes to undergo job training, including IT job training, is to overcome a disadvantage. It is a well-known fact that high school graduates (or below high school) usually experience a disadvantage in both employment and wage premium compared to college graduates. Thus it can be expected that the purpose and the level of job training may vary depending on the school level attained. For example, high school graduates have a tendency to receive job training to compensate for the lack of college degree, while the college graduates have a tendency to undergo job training to compensate for a low-ranking school degree or less popular major.[20] In this section, in order to examine this differential effect of job training on employment depending on the education level, we classified the sample into a low-education group and a high-education group.[21]

A. *Effect of IT Job Training on Employment Based on the Education Level*

The estimation is performed by using the Probit model and based on three ways of specifying the job training variables used above. Table VI shows the estimated results.

We can see that in the low-education group, the signs of the coefficients of the variables representing individual or family variables except for job training are the same as Table III, while the coefficients of job training variables are somewhat different from those shown in Table III. In the low-education group, two features related to job training variables can be derived from Table VI. One is that the coefficients of the variables related to non-IT job training are not only significant and positive but also higher than those of in Table III for all the regressions. The other is that the effect of the duration of the training period on the probability of getting a job is more conspicuous for IT job training than for non-IT job training. In

20 Under the Korean conditions, we have some indirect evidence for this tendency. According to the results of the survey conducted in 1998 by the Korea Research Institute for Vocational Education and Training (Kim et al. 1998), while the proportion of the persons who graduated from high school or below high school was found to account for 68 per cent among the persons who received job training, the ratio of college graduates (including two-year college graduates) was 32 per cent. Furthermore, according to this survey, almost 60 per cent among college graduates who received job training were persons with the two-year college degree. Job training pattern based on the education level is known to vary with the countries. For example, Britain has a similar pattern to that of Korea. That is, the proportion of the job trainees who graduate from high school or below high school is higher than that of college graduates. However, in the case of the United States, the proportion of the college graduates is higher than that of the persons who graduate from high school or below high school. For more details, see Blanchflower and Lynch (1992).

21 High-education group includes the persons who graduated from some college (two-year college) or higher institution than some college.

TABLE VI

PROBIT ESTIMATION OF THE EFFECT OF IT JOB TRAINING ON EMPLOYMENT
(Difference in the Effect Depending on the Education Level)

Variables	Low-Education Level			High-Education Level		
	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.727*** (0.005)	0.754*** (0.005)	0.761*** (0.0051)	4.991*** (0.037)	4.974*** (0.037)	4.959*** (0.038)
AGE	0.012*** (0.00007)	0.012*** (0.00008)	0.012*** (0.000008)	0.011*** (0.0002)	0.012*** (0.0002)	0.012*** (0.0002)
SEX	0.0008 (0.0037)	0.027*** (0.0037)	0.022*** (0.0037)	0.814*** (0.009)	0.803*** (0.0094)	0.796*** (0.0095)
MARRY01	–0.020*** (0.0024)	–0.019*** (0.0024)	–0.023*** (0.0024)	3.957*** (0.030)	3.935*** (0.030)	3.928*** (0.03)
PDINC	–0.008*** (0.00006)	–0.0085*** (0.00007)	–0.0086*** (0.00006)	–0.061*** (0.0005)	–0.061*** (0.0005)	–0.061*** (0.0005)
FNLINC	4.65E–6*** (1.63E–7)	4.75E–6*** (1.63E–7)	4.75E–6*** (1.63E–7)	0.00025*** (3.665E–6)	0.0003*** (3.67E–6)	0.00025*** (3.68E–6)
ITTIME	0.00048*** (7.70E–6)			–0.00038*** (9.489E–6)		
NITTIME	0.000036*** (3.19E–6)			–0.00004*** (6.07E–6)		
IT01		–0.015*** (0.0063)			–0.3063*** (0.0059)	
NIT01		0.249*** (0.0036)			–0.3043*** (0.0059)	
ITS1			–0.538*** (0.010)			–0.373*** (0.0093)
ITS2			–0.157*** (0.010)			–0.288*** (0.0078)
ITS3			1.102*** (0.016)			–0.070*** (0.021)
NITS1			0.527*** (0.0062)			–0.288 (0.0095)
NITS2			0.110*** (0.0060)			–0.408*** (0.0087)
NITS3			0.1174*** (0.0058)			–0.102*** (0.013)
Number of observations	1,358	1,358	1,358	519	519	519

Note: Standard errors are indicated in parentheses.
* Significant at the 10 per cent level.
** Significant at the 5 per cent level.
*** Significant at the 1 per cent level.

particular, in the case of *ITS3,* the probability value is 38 per cent. This value is not only the highest among the variables considered but also much higher than that of the total sample (i.e., Table III).[22] Compared to *NITS3*, the magnitude of probability for *ITS3* is larger by five times. Taking into account the fact that the duration of the training period is a proxy variable for the quality of job training received, this finding implies that a longer period of IT job training fulfills its expected function of compensating for formal schooling. That is, this result shows that IT job training exerts an important distribution effect by helping the minority (low-education group) to compensate for their weakness.

Table VI also shows that in the high-education group, the sign of the coefficients of the variables related to individual or family characteristics is the same as that in Table III, while the signs of the coefficients of job training variables are quite different not only from those of Table III but also from those of the low-education group. That is, the coefficients of all the variables related to job training show a negative value. Especially the coefficient for *ITS3* also has a negative sign. These results imply that receiving job training reduces the opportunity of getting employed. We may conclude from these results that job training, especially IT job training does not play a significant role in compensating for the disadvantage[23] in the high-education group, in contrast to the low-education group.

However, we should note that in the high-education group, the persons with low qualifications tend to receive job training to overcome their disadvantage.[24] Obviously, the probability for these persons of getting a job would be much lower due to the intrinsic low qualifications than if they had not received job training. This implies that the coefficient of the job training variable is negative, since the adverse effect of the intrinsic low qualification on the probability of getting a job is more pronounced than the beneficial effect of job training on the probability of getting a job.

In addition, Table VI shows that even though the coefficients of IT job training variables are negative, the degree decreases as the duration of the training period increases in the high-education group. Thus, we can assume that as the duration of the training period increases, the beneficial effect of job training on the probability of getting a job increases. Furthermore, this finding implies that IT job training also fulfills its function of compensating for a disadvantage in the high-education group. In conclusion, in the case of the high-education group, to the extent that it is true that persons with low qualifications receive IT job training, IT job training also fulfills its function of compensating for their disadvantage.

22 The value was 24 per cent.

23 The minority in the high-education group refers to a low-ranking school degree or less popular major. In general, these people have low qualifications.

24 For more details, see footnote 20 in this paper.

B. *Effect of Job Training on Wage Premium Based on the Education Level*

The effect of job training on the wage premium based on the education level is also estimated through Heckman's two-stage estimator because of the sample selection bias. The estimation results are summarized in Table VII. This table shows that while the coefficients of the variables associated with individual or family characteristic are all significant and positive in the low-education group, only *SEX* is significant and positive in the high-education group. This finding is similar to that shown in Table V.

In relation to the job training variables, three important facts can be derived from Table VII. The first is that while IT job training (especially *ITS1*) is relatively effective in the low-education group, non-IT job training (especially *NITS1*) is relatively effective in the high-education group. The second is that in the case of *ITS3*, the coefficient is not significant, but it is the largest among all the variables considered in the low-education group in contrast to the total sample (i.e., Table V). Finally, the third is that the coefficients of the IT job training variables are larger than those of the non-IT job training variables. It is thus concluded from these results that IT job training somewhat affects the wage premium in the low-education group, even though the effect is less conspicuous than that on employment.

VI. SUMMARY AND CONCLUSION

In this paper, we attempted to determine whether IT job training raised the probability of getting a job and of securing high wages. It was found that IT job training as a whole affected not only employment but also the wage premium, even though the effect on the wage premium was somewhat less conspicuous. In particular, the intensity of IT job training was more instrumental in the opportunity of getting employed than whether receiving IT job training or not. This effect became more pronounced in the low-education group, where for the persons who received IT job training for more than six months, the probability of getting a job was higher by 38 per cent than that for the persons without any other job training. Thus, it appears that IT job training exerts an important distribution effect by helping the minority (low-education group) to compensate for their weakness.

Another interesting finding is that irrespective of IT job training or non-IT job training, job training was effective when the service was provided by the private sector even though the training cost was shared by the government. The effect was much more pronounced in IT job training.

These findings suggest some important policy implications. First, the finding that the effect of longer and more quality-intensive IT job training on employment is the most significant factor, implies that in order to reduce the unemployment rate through IT job training, emphasis should be placed on specialized education, even

TABLE VII

EFFECT OF IT JOB TRAINING ON WAGE PREMIUM: HECKMAN TWO-STAGE ESTIMATOR
(Difference in the Effect Depending on the Education Level)

Variables	Low-Education Level			High-Education Level		
	(1)	(2)	(3)	(1)	(2)	(3)
Constant	2.834*** (0.270)	2.737*** (0.2741)	2.711*** (0.275)	3.248*** (0.414)	2.783*** (0.414)	2.944*** (0.417)
AGE	0.051*** (0.0127)	0.055*** (0.013)	0.056*** (0.0129)	0.0260 (0.0231)	0.024 (0.022)	0.045* (0.023)
AGE_2	–0.0007*** (0.0002)	–0.0008*** (0.0002)	–0.0008*** (0.0002)	–0.0003 (0.0003)	–0.0003 (0.0003)	–0.0006* (0.0003)
SEX	0.558*** (0.3189)	0.562*** (0.1830)	0.5691*** (0.056)	0.419*** (0.095)	0.427*** (0.089)	0.4035*** (0.093)
ITTIME	–0.0004 (0.2195)			–0.000005 (0.00016)		0.3964*** (0.0004)
NITTIME	0.00002 (0.0002)			0.0002 (0.00019)		
IT01		0.445** (0.1725)			–0.0156 (0.142)	
NIT01		0.1177 (0.1025)			0.390** (0.152)	
ITS1			0.6296*** (0.240)			0.4148* (0.221)
ITS2			0.2382 (0.259)			–0.2421 (0.197)
ITS3			0.7692 (0.633)			0.0394 (0.527)
NITS1			0.2532 (0.192)			0.8667*** (0.271)
NITS2			0.0417 (0.161)			0.2400 (0.2147)
NITS3			0.1029 (0.170)			0.2547 (0.3603)
λ	0.130* (0.068)	0.127* (0.067)	0.136** (0.068)	0.290*** (0.129)	0.161*** (0.042)	0.289 (0.360)
Adjusted R^2	0.2309	0.2403	0.2376	0.1146	0.1785	0.1583
Number of observations	1,358	1,358	1,358	519	519	519

Note: Standard errors are indicated in parentheses.
* Significant at the 10 per cent level.
** Significant at the 5 per cent level.
*** Significant at the 1 per cent level.

though it is costly and requires a longer training period. Second, the finding that the minority (low-education group) benefits most from IT job training implies that IT job training should be taken into account more seriously if the government is interested in distribution aspects in the digital economy era. Third, the finding that the probability of getting employed was higher in the trainee group that received job training at the private sector level than at the public sector level indicates that the private sector should be encouraged to take the initiative in providing IT job training.

Finally let us point out the limitation of this paper. We acknowledge that the employment dynamics is time consuming to a large extent, especially during a period of economic turbulence and low demand conditions in the labor market such as during the 1998–99 period in Korea. However, at the time we are writing this paper, the available data covers only the 1998–99 period. In the future, it will be possible to extend this issue using a longer data set and a more sophisticated method.

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