Abstract

This paper examines the wage premium to computer use in Sweden in the early 1990's. I use simple regression model and interaction terms in my paper to examine the effect of computer use at work. Although the data is only one-year cross-section data, my results clearly show a wage premium to computer use in Sweden. There are also interesting findings in my paper by using Swedish data. From the results, I find wage premium to be related to intensity of computer use at work.

List of Contents

Key words: wage premium, computer use, upskilling, deskilling.

1-Introduction

Researchers started investigating the impact of technology on wage differentials in the 1970's. Blackburn, Bloom, and Freeman [1991] got their conclusion that U.S. productivity showed only a sluggish growth since 1980's and the wage structure during this period showed no dramatic changes. However, Alan B. Krueger [1993] argued that technology change may change the distribution of earnings without a dramatic effect on aggregate wage growth. In his paper, he studied the U.S. wage premium to computer use in 1984 and 1989. His results suggested that employees who directly use a computer at work earn a 10 to 15 percent wage premium. This paper triggered the debate of 'upskilling' and 'deskilling' with computer use.[1] Braverman[1974] considered that computerization can be 'deskilling' and lead to lower wages while proponents of 'upskilling' counter that computerization can lead to higher productivity and higher wage. Zoghi and Sabrina Wulff [2004] considered that both impacts could be possible. She stated in her paper: 'In fact, the introduction of new technology may be upskilling for some workers (i.e. because it complements them in production) and deskilling for other workers (i.e. because it substitutes for them in production), even within a single firm.' Levy and Murnane [2002] found in a case study that within the same bank, receptions processors spent more time on problem solving while the staff of deposit processors spent more time on repetitive tasks and hence it reduces their skill requirements. In this perspective, those who spend most of their time working in front of computers may perform routine tasks and their wages are supposed to be low due to the cutting down of skill requirements. In contrast, those who work with computer only a small part of their working time may spend more time on problem solving and computer use allows them to perform a variety of tasks. In this case, computers complement problem solving and lead to a wage premium.

1. Upskilling is the increasing of workers' skills over the production process, normally through training while 'deskilling' is a negative impact of technology upon which a process or machine can perform a task better than the human hand.

Although there are many studies about wage premium to computer use during the last 15 years, the results are different. Results from some countries exhibit large wage premiums to computer use, usually 10 to 15 percent (see Krueger [1993] for a study on United States data and Sabrina Wulff [2004] for Canadian results. Also see Entorf and Kramarz [1997] for French results). However, reports from other countries suggest small or insignificant returns to computer use (see Gollac, and Kramarz [1999] for French results and Haisken-Denew and Schmidt [1999] from German results)

In Sweden, surveys about computer use both at work and at home started in the 1980's. Henrik Romanov [1997] found that computer use both at work and at home increases by more than 5 percent between year 1984 and year 1989. Computer access at work increases by nearly 10 percent during that period. With such a significant change in working environment, it is possible for skilled and unskilled workers to change their situation.

The main purpose of this paper is to present several models and measure wage premium to computer use in Sweden. At the same time, I will design variables to examine the upskilling effect and the deskilling effect of computer use. I will also design models for testing the relation between computer use and the returns to year of schooling as well as the returns to working experience.

The outline of this paper is as follows: In section 2, I will motivate theoretically how computer use can affect wage distribution. In section 3, I will present several models to examine wage premium to computer us. In section 4, I am going to describe the data. In section 5, I will report my regression results. The following section will focus on the comments on regression results and present analyses about whether the results I get are reasonable or not. In section 7, I will make some further analysis on the Swedish data. The final section will present some concluding remarks about what I have done and propose areas for future research on wage premium to computer use.

2-Theoretical motivation

In this section, I am going to motivate an econometric model that will be used to study the wage premium to computer use.

Traditional economists assume that the wage is related to the marginal productivity. Firms' employment decision maximizes profits. Employers decide how many workers and what kind of workers they employed during production. Since workers are highly heterogeneous with respect to skills and experience, wages will also differ among workers. In this sense, I will theoretically motivate relationship between computer skills and wage level.
So firstly, I start with the production function

$$Q = A\ f(K,L) \tag{2.01}$$

Where Q is output, A is total factor productivity, K measures capital and L is labour used in production.
The cost function is:

$$C = g\ (K, L) = wL+rK \tag{2.02}$$

Where C is cost of production, L is labour used in production, w is the wage level in labour market, K is capital input and r is capital cost.

So, the profit function for producers is:

$$\prod = PQ - (wL+rK) \tag{2.03}$$

Where, ∏ is profit, P is price of products and (w, r, K and L) are the same as mentioned above. According to the basic assumption, producers maximize their profits. So, the first order condition with respect to L is:

$$\text{F.O.C.} \quad \frac{\partial \pi}{\partial L} = P * \frac{\partial Q}{\partial L} - w = 0 \tag{2.04}$$

For simplicity, we assume P = 1. Then:

$$\frac{\partial Q}{\partial L} = w = \text{MPL (here L is effective labour)} \tag{2.05}$$

If the production function is Cobb-Dougalas function which is:

$$F(K,L) = AK^{1-\alpha} L^{\alpha} \qquad (2.06)$$

Where A is total factor productivity.

Then equation (2.05) becomes:

$$w = MPL = \frac{\partial F}{\partial L} = \alpha\, A \left(\frac{K}{L}\right)^{1-\alpha} \qquad (2.07)$$

Take natural logarithm on both sides of equation (2.07), and get

$$\ln w = \ln\alpha + \ln A + (1-\alpha)(\ln K - \ln L) \qquad (2.08)$$

Suppose lnA varies between workers who use a computer and those who do not use a computer. Let $\ln w^{c}$ denote the wage of computers users and $\ln w^{nc}$ denote the wage of those who do not use a computer. Then, difference in log wages is given by:

$$\ln w^{c} - \ln w^{nc} = \ln A^{c} - \ln A^{nc} \qquad (2.09)$$

$$\Delta \ln w = \Delta \ln A \qquad (2.10)$$

So skilled workers and unskilled workers may vary in wages. Suppose, in the paper, labour skills are computer skills. The skill difference is represented by a computer dummy D. Therefore:

$$\Delta \ln A = \beta_1 D \qquad (2.11)$$

So the natural logarithm of the wage is:

$$\ln w = \beta_0 + \beta_1 D \qquad (2.12)$$

3-Methodological motivation

In this section, I am going to present an empirical model for estimating the wage differentials between computer use and non-computer use at work. Due to the theoretical motivation in the previous section, I set the benchmark model as:

$$lnw_i=\beta_0+\beta_1 D_i+e_i \qquad (3.01)$$

Where, lnw_i is individual i's gross wage in its logarithm form. Di represents computer dummy variable equalling one if an individual use a computer at work. β_0 and β_1 are parameters to be estimated. This model allows me to examine computer effects on wage differentials as well as to compare with results from previous studies.

The estimation of equation (3.01) can provide information about computer effects on wage differentials. However, the Swedish data allows me to examine computer effects with intensity. Equation (3.02) below will explore if the computer wage differential varies with the degree of computer use at work.

$$lnw_i=\beta_1 +\beta_2 Da_i+\beta_3 Db_i+\beta_4 Dc_i+e_i \qquad (3.02)$$

Where Da_i is a dummy variable equalling one if individual i works with a computer most of the time, Db_i is a dummy variable equalling one if individual i works with a computer approximately half of the time, Dc_i is a dummy variable equalling one if individual i works with a computer only a small part of the time and Da_i, Db_i, Dc_i all equal zero when the individual does not work with computer at all. β_1, β_2, β_3 and β_4 are parameters to be estimated.

There may be other factors that could affect the wage differential. Indeed, such factors are concealed in the error term and make model (3.02) biased if those factors are correlated with computer use. Here, I assume that such factors are: years of schooling, working experience, sectors, and gender. For instance, reports from studies exhibit a positive relationship between wage differentials and years of schooling. Possibly individuals with the same degree of computer use may have wage differentials due to different level of education. So the model is improved if we control for these variables in the regression model. Working experience relates to on-the-job training and is often considered an important factor to differentiate wages. Gender and sector are also factors that result in wage differentials. Controlling for such factors in the regression model will reduce the omitted variables bias of model (3.02).

$$\ln w_i = \beta_1+\beta_2 X_i+\beta_3 Da_i+\beta_4 Db_i+\beta_5 Dc_i+e_i \qquad (3.03)$$

Equation (3.03) includes a vector of control variables X_i in the regression model. These variables are years of schooling, working experience, working experience square, gender and sectors. Da_i, Db_i and Dc_i are dummies for different degree of computer use at work. β_1, β_2, β_3, β_4 and β_5 are parameters to be estimated. From the results in studies, I expect coefficients β_3, β_4 and β_5 to be smaller than the corresponding coefficients in equation (3.02).

Equation (3.03) is not quite enough to estimate wage differentials to computer use since wages and computer use may vary between different industries. To improve estimation model (3.03), it is necessary to control for industry dummy variables in the equation. My data allows me to control for 34 industry dummies in the regression model. The disadvantage of including these industry dummies is that, it may increase the possibility of imprecision. Since the more variable included in the model, the less observations assigned to each variables, smaller t-values are assumed to appear with the inclusion of these industry dummies.

An additional issue concerns heterogeneity in the returns to computer use. Models (3.01)-(3.03) assume that the returns are homogeneous between different types of workers. To investigate whether the returns to computer use vary because of observable characteristics, interaction terms between computer use and such characteristics may be used. If the parameter estimates of these interaction terms are zero in a statistical sense, they indicate that the returns to computer use are the same across different types of workers.

Given this consideration, I will check the homogeneity of the returns to computer use by using interaction terms. In my paper, I will check the relation between computer effects and years of schooling as well as computer effects and working experience.

The model designed to examine correlation between computer effects and years of schooling is:

$$\ln w_i=\beta_1+\beta_2 X_i+\beta_3 Da_i+\beta_4 Db_i+\beta_5 Dc_i+\beta_6 S_i Da_i+\beta_7 S_i Db_i+\beta_8 S_i Dc_i+e_i \qquad (3.04)$$

Where, S_iDa_i is the product of schooling and dummy Da, S_iDb_i is the product of schooling and dummy Db and S_iDc_i is the product of schooling and dummy Dc. Other variables are the same as equation (3.01).

And, the model designed to examine correlation between computer effects and working experience is:

$$\ln w_i=\beta_1+\beta_2X_i+\beta_3Da_i+\beta_4Db_i+\beta_5Dc_i+\beta_6E_iDa_i+\beta_7E_iDb_i+\beta_8E_iDc_i+e_i \qquad (3.05)$$

Where, E_iDa_i is the product of working experience and dummy Da, E_iDb_i is the product of working experience and dummy Db and E_iDc_i is the product working experience and dummy Dc. All the other variables are the same as equation (3.01).

The main goal of employing these two models is to find whether computer use at work can enhance or attenuate returns to years of schooling and working experience. Say, in equation (3.04), I will check relationship between β_2 and $\beta_2+\beta_6$, $\beta_2+\beta_7$, $\beta_2+\beta_8$, that is whether the return to years of schooling is higher for those who do not use computer than those who use a computer most of the time, those who use a computer half of the time and those who use a computer only a small part of the time. The principle is the same for equation (3.05) as equation (3.04).[2]

From equation (4) we know:

$$\ln w_i=\beta_1+\beta_2S_i+\beta_3Da_i+\beta_4Db_i+\beta_5Dc_i+\beta_6S_iDa_i+\beta_7S_iDb_i+\beta_8S_iDc_i+e_i \qquad (6)$$

For those who do not use computer at all, $Da_i=Db_i=Dc_i=0$. The marginal return to years of schooling is β_2. For those who work with a computer most of time, $Da_i=1$ and $Db_i=Dc_i=0$. The marginal return to years of schooling is $\beta_2+\beta_6$. For those who work with a computer half of the time, $Db_i=1$ and $Da_i=Dc_i=0$. The marginal return to years of schooling is $\beta_2+\beta_7$. For those who work with a computer only a small part of the time, $Dc_i=1$ and $Da_i=Db_i=0$. The marginal return to years of schooling is $\beta_2+\beta_8$. It is the same for equation (5)

4-Data Description

The data comes from the Swedish level of living survey conducted in 1991. 2683 observations have full information about computer use at work. Questions concerning working status were asked during the interview. I selected 11 variables into my regression model that are relevant to my study. Four of the dummy variables are related to computer use at work. The question for these dummies is: 'how long do you work at a computer screen?' The answer contains four alternatives: 1. Most of the time. 2. Approximately half of the working time. 3. Only a small part of the time. 4. Do not work at a computer screen. I set computer dummy for those who do not work at a computer screen as the omitted category. Other variables in the regression are: gender, schooling, working experience, sector, and industry. Hourly wages presented in the survey result are gross hourly wages (that is before tax). Table I contains descriptive statistics pertaining to the variables used in the empirical analysis.

Table I shows that 37.8 percent of the employees in the sample work with computer at least a small part of the time. There is no big difference between men and women who use their computers at work. From table I, we also see that people with higher education level are more likely to use computers at work. For instance, 26.5 percent of the employees with less than high school education level work with computer, while 62 percent of the employees with post college diploma use computers at work. Data presented in table I also shows no difference between different age levels. Since miniaturization and mass-production of computers started in the 70's and 80's, this indicates old people are equally adaptive with computers at work to young people in Sweden and studies suggest that it is the case [ISA, 2003]. Here, I would like to mention that no individual in my data is younger than 25 years. At last, computer use seems to be less frequent in public sector than in private sector.

Now, I would like to describe data properties of computer dummies according to education level. The overview of table II indicates clearly that the higher the education level, the larger the percentage of people who use computer at work. At each education level, the largest proportion of people who use computer at work are those who work with computer only a small part of the time. For all from Post College, those who work with computer only a small part of the time take the largest part.

5-Regression Results

Based on regression models motivated in section 3, table III reports results of estimating equation (3.01), (3.02) and (3.03). Here, I will report the wage differentials in percents, which is exp(β)-1[3].

In column (1), computer-use dummy variable is the only right-hand-side variable. The result suggests that the wage differential between computer use and non-use exists. The differential in hourly pay between workers who use computers at work and those who do not is 15 percent (exp (0.144)-1). It is lower than Krueger's result (31.8 in 1984 and 38.4 in 1989). Here, the computer dummy variable has a statistically significant effect on wages at a 10 percent of significance level.

In column (2), three computer dummy variables are included since the data I got provides more information about the degree of computer use at work. The wage differential between employees who use a computer most of the time and those who do not use computer at work is 3.5 percent (exp (0.034)-1) in 1991. Those who work with their computers half of the time gain a 10 percent of wage premium and those who work with their computers only a small part of the time have a 20 percent of wage premium relative to those who do not use computer at all.

The wage differential between those who work with a computer most of the time and those who do not use computer at all is small while those who work with a computer only a small part of the time acquire the largest wage premium. Comparing the results in column (2) with column (1), it is obvious that those who work with computers only a small part of the time have a higher premium than the overall return to computer use. Under this circumstance, the overall return to computer use conceals the fact that there are higher returns to using a computer only a small part of the time. In column (2), the coefficient estimates for computer use most of the time is insignificantly different from zero.

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3)footnote: since $\ln w|_D=\beta_0+\beta_1$

For those who use a computer at work, the wage level is $\exp(\beta_0+\beta_1)$.

For those who do not use a computer at work, the wage level is $\exp(\beta_1)$.

So the difference in wage level between those who use a computer at work and who do not is, in percentage, $\Delta w/w=(\exp(\beta_0+\beta_1)-\exp(\beta_0))/\exp(\beta_0)=\exp(\beta_1)-1$

Further analyses presented in column (3) introduce variables as gender, schooling, working experience, working experience-square and sector. By controlling these newly introduced variables, returns to computer use most of time, approximately half of the time and a small part of the time drop to 2.5, 5.3 and 9.3 percent respectively. And also in column (3), coefficient estimates for computer use most of the time is insignificantly different from zero.

The result obtained after including dummy variables for industry are reported in column (4). They indicate that the wage of those who use a computer most of the time is about 2.1 percent lower than those who do not use computer at all. Those who use their computers approximately half of the time have a 2.3 percent higher wage than non-computer-users. And those who use their computers only a small part of the time gain 7.9 percent higher wage than non-computer-users. Here, the dummy variables for computer use most of the time and half of the time do not have significant effects on wages.

5.1-Computer effects on wage differentials to years of schooling and working experience

Table IV reports the results by analyzing equation (3.04) and (3.05) in section 3. The interaction terms are employed to address potential heterogeneity in the wage differential due to observable characteristics. Column (1) table IV reports the regression results by fitting equation (3.04):

In column (1), the coefficient estimates of β_6, β_7 and β_8 are –0.013, -0.004 and –0.003.

This indicates that, to those who use a computer most of the time at work, the marginal return to years of schooling is 2.5 percent. And to those who work with a computer half of the time, to those who work with a computer a small part of the time and those who do not work with computer at all, marginal returns to years of schooling are 3.4, 3.5 and 3.8 respectively. The largest differential between the returns to years of schooling is between those who work with a computer most of the time and those who do not use computer at all. Marginal return to years of schooling for those who work with a computer most of the time is 52 percents lower than those who do not use computer at all. Based on 10 percent significance level, the coefficient estimates, β_7 and β_8, are not sufficiently different from zero. The coefficient estimate, β_6 however, is significantly different from zero. This means the interaction term should be included in the regression model.

Column (2) in table IV reports regression results by fitting equation (3.05). In column (2), the coefficient estimates for β_6, β_7 and β_8 are 0.001, 0.003 and 0.004. This indicates that, to those who use a computer most of the time at work, return to working experience is 1.5 percent. And to those who work with a computer half of the time, to those who work with a computer a small part of the time and those who do not work with computer at all, returns to working experience are 1.7, 1.8 and 1.4 respectively. The largest differential between working experience is between those who work with a computer only a small part of time and those who do not work with computer at all. The marginal return to working experience for those who work with a computer a small part of the time is 22 percents higher than those who do not use computer at all. The t-values for β_6, β_7 and β_8 are 0.8, 1.7 and 3.9 respectively. Notice that β_6 is insignificant based on 10 percent significance level. T-values for β_7 and β_8 are significant. So these two interaction terms should also be in the regression model.

5.2-Heteroskedasticity and heteroskedasticity-consistent stardard errors

Traditional problem that influences the efficiency of analysis is heteroskedasticity. It may also influence the conclusion of some results that is sensitive when the t-value is close to critical value. Plots of computer-use dummies against residuals suggest strong heteroskedasticity. So column (1) table V reports the results with heteroskedasticity-consitent standard errors. In column (1), standard errors for computer dummies are smaller than those in column (4) table III. The calculated t-values for estimates of those who work with a computer most of the time, half of the time and small part of the time at work are -1.04, 1.34 and 6.08. Unfortunately, the first two t-values are still not large enough for significance. However, it is more likely that coefficient estimate for those who work with a computer most of time might be negative.

6-Comments on the results

The regression results in table III suggest that wage premiums to computer use in Sweden exist. However, my study of wage premiums to computer use with different intensity suggests a large variation in the returns. Column (4) indicates that those who work with their computer most of time gain negative premium to non-computer users even though the overall premium to computer use shown in column (1) exhibit a positive premium. On the other hand, those who work with a computer only a small part of the time win the largest premium as shown in column (4). One interpretation of this phenomenon is that computers substitute for some tasks and complement for others. In this case, those who work with computers most of the time may be deskilled due to the introduction of computers while those who use their computers only a small part of the time may probably be upskilled. Since the demand for upskilled workers increases and deskilled workers decreases, labour demand curves for upskilled workers and deskilled workers will shift in different directions. The rightward shifting of demand curve for upskilled workers will cause the increase in wages for these workers while the leftward shifting of demand curve for deskilled workers will lead to the decrease of wages for them.

Krueger had stated a good example about this phenomenon. He mentioned that those who work with their computer only a small part of their working time are probably managers and senior administrators. Mostly, they use computers to process email and word processing programs complement their knowledge and communication skills. As a result, these managers and senior administrators can deal with a variety of tasks and gain higher wages. In contrast, clerical workers use word processing programs to deal with their routine tasks and these tasks can be prepared quicker and with fewer skills. These changes may result in the decrease of wages and even lead to a negative premium as shown in column (4).

Coming to the issue of computer use to education, I got heterogeneity in the returns to computer use suggest that the highest returns to years of schooling are those people who do not work with a computer at all. However, table II indicates that the higher the education level, the higher the proportion of people who use a computer at work. For example, at post college level, 62 percent of them use computers at work. 72.6 percent of them use computers only a small part of time. Why highly educated people try to use computers when the returns are low? One possible reason is that, without education, those who work with a computer have higher wages than those who do not use computer at work. Even though returns are lower, the wage may still be higher for those who use a computer at work than those who do not at a certain same degree of education[4].

The results I got also suggest that returns to working experience for those who work with computer a small part of the time are highest among all categories under working experience column.

7- Additional sensitivity test

Regression results in previous sections suggest that wage premium to computer use exists. Coeffecient estimates for the three computer dummies provide information about wage premium to intensity of computer use. However, two of the computer dummies display statistical insignificance. Potential reason for this problem is that the inclusion of control variables in the regression model need larger sample size. Given this consideration, I merge data from 'those who work with a computer most of the time' and 'those who use computer approximately half of the time' into 'those who work with a computer no less than half of their working time'. The newly designed model is:

$$\ln w_i=\beta_1+\beta_2 X_i+\beta_3 Dab_i+\beta_4 Dc_i+e_i \qquad (7.01)$$

Where Dabi is the computer dummy variable equalling one when an individual work with a computer no less than half of their working time. With this model I hope to get larger t-values for β_3 than β_3 and β_4 in equation (3.03).

Fitting equation (7.01), result in column (2) table V is rather surprising. β_3 has even smaller t-value than β_3 and β_4 in column (4) table III. At the same time, wage premium to computer use is more close to zero. Possible interpretation to this result is that effects of those who work with a computer most of the time and those who use a computer approximately half of the time are cancelled out. This indicates that the positive β_3 and negative β_4 in column (4) table III might be possible. The problem now is that the data I have is not large enough to provide information about the coefficient estimates β_3 and β_4. The limitation of my sample can not provide more information about how much is the wage premium to different intensity of computer use.

4(footnote: the function of marginal return to education of equation (3.03) is

$\partial \ln wt/\partial s=0.038-0.013Da-0.004Db-0.003Dc$ (7.02)

From function (7.02), we see when Da=1, Db=0 and Dc=0, $\partial \ln Wt/\partial s=0.025$

When Da=0, Db=1 and Dc=0, $\partial \ln Wt/\partial s=0.034$

When Da=0, Db=0 and Dc=1, $\partial \ln Wt/\partial s=0.035$

Marginal return to education is larger than zero and the largest marginal return to years of schooling is 0.038 (when Da=Db=Dc=0). However, these marginal returns do not mean that they can obtain higher wages since the wages is unknown to the people without education.

8-Conclusion

In this paper, I have investigated the wage premium to computer use with intensity in Sweden. The database I used contains specific questions about intensity of computer use during work. With this database, it is possible for me to check the effects of wage differentials among various intensity of computer use. I use the commonly used log-linear model in my regression analysis and the results show there is a positive relationship between computer use and wages. Although there is only a small premium to computer use comparing with results from other countries.

Further analysis of differentials between computer use and wage premium suggests that those who work with a computer only a small part of the time at work get higher returns than the overall returns to computer use. The analysis boils down to a conclusion that wage premium are positively related to degree of computer use at work.

With respect to the wage premium to education, regression results suggest that people who do not use computer at work have the highest return to years of schooling. Computer use also has positive joint effects with working experience. People who use a computer most of the time at work win the highest return to working experience.

One contribution of my thesis is the potential findings of wage premium on high intensity of computer use. My results suggest a negative premium to high intensity of computer use. However, the coefficient estimates are also insignificantly different from zero. Although I try several approaches to get significant results, the data I have still resist providing information about high intensity of computer use.

In my future study, I will try to collect larger sample or make simulations to get more informative results.

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TABLE I

Percent of Workers In Various Categories

Group	*Percentage of workers who use computer*	*Percentage of workers who do not use computer*
All workers	37,8	62,2
<u>Gender</u>		
Men	40,8	59,2
Women	34,9	65,1
<u>Education</u>		
Less than high school	26,5	73,5
High school	36,3	63,7
College	44,3	55,7
Postcollege	62,0	38,0
<u>Age</u>		
18-24	0	0
25-39	38,7	61,3
40-54	38,6	61,4
55-65	33,3	66,7
<u>Sector</u>		
Public	30,9	69,1
Private	44,2	55,8

TABLE II

Conditional percentage of workers who work with computer under different education level on

Group	Da	Db	Dc
Education			
Less than high school	17,3	22,3	60,1
High school	19,0	19,0	62,0
College	12,2	19,0	68,8
Postcollege	11,3	16,0	72,6

Da: computer use most of time during work
Db: computer use approximately half of time during work
Dc: computer use only a small part of working time

Table III

OLS estimates of the returns to computer use

Specification	*(1)*	*(2)*	*(3)*	*(4)*
Use computer most of the time		0.034 (0.023)	0.025 (0.020)	-0.021 (0.021)
Use computer half of the time	0.144*** (0.011)	0.094*** (0.021)	0.052** (0.018)	0.023 (0.018)
Use computer a small part of the time		0.185*** (0.013)	0.089*** (0.011)	0.076*** (0.012)
Intercept	-	4.321*** (0.007)	3.565*** (0.028)	3.734*** (0.163)
Male	-	-	0.150*** (0.010)	0.146*** (0.011)
Years of schooling	-	-	0.038*** (0.002)	0.036*** (0.002)
Working experience	-	-	0.017*** (0.002)	0.016*** (0.002)
Working experience square	-	-	***	***
Private	-	-	0.071*** (0.010)	0.102*** (0.014)
Industry dummies [a]	No	No	No	Yes
R^2-Adjusted	0.059	0.073	0.346	0.376
Number of individuals	2683			

Notes: Dependent variable: Natural logarithm of gross hourly wage in 1991. OLS standard errors in parentheses. * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level and *** indicates significance at the 1 percent level.
(a) Based on two-digit-industry codes.

Table IV.
OLS estimates of the returns to computer use allowing for an effect of computer use on the returns to schooling

Specification	*(1)*	*(2)*
	(S)[e]	*(E)*[f]
*Interacted variable 1 (Da*col)*[a]	-0.013* (0.006)	0.001 (0.002)
*Interacted variable 2 (Db*col)*[b]	-0.004 (0.005)	0.003** (0.002)
*Interacted variable 3 (Dc*col)* [c]	-0.003 (0.003)	0.004*** (0.001)
	(1)	*(2)*
Use computer most of the time	0.130** (0.075)	-0.052 (0.039)
Use computer half of the time	0.074 (0.066)	-0.034 (0.036)
Use computer a small part of the time	0.117* (0.039)	-0.006 (0.024)
Intercept	3.715*** (0.163)	3.743*** (0.162)
Male	0.148*** (0.011)	0.147*** (0.011)
Years of schooling	0.038*** (0.002)	0.036*** (0.002)
Working experience	0.015*** (0.002)	0.014*** (0.002)
Working experience square	-0.000*** (0.000)	-0.000*** (0.000)
Private	0.102*** (0.014)	0.102*** (0.014)
Industry dummies [d]	Yes	Yes
R^2-Adjusted	0.376	0.379
Number of individuals	2683	

Notes: Dependent variable: Natural logarithm of gross hourly wage in 1991. OLS standard errors in parentheses. * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level and *** indicates significance at the 1 percent level.
(a) Interacted terms: the product of dummy variable Da, which represent an individual who use a computer most of the time when equalling one, and col, which represent column variables (S or E).
(b) Interacted terms: the product of dummy variable Da, which represent an individual who use a computer half of the time when equalling one, and col, which represent column variables (S or E).
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(c) Interacted terms: the product of dummy variable Da, which represent an individual who use a computer a small part of the time when equalling one, and col, which represent column variables (S or E).
(d) Based on two-digit-industry codes.
(e) Years of schooling.
(f) Working experience.

Table V.

Regression estimates of the returns to computer use with heteroskedasticity-consistent standard errors and analysis with combination of data according to first two rows

Specification	*(1)*	*(2)*
Use computer most of the time	-0.021 (0.020)	0.004 (0.015)
Use computer half of the time	0.023 (0.017)	
Use computer a small part of the time	0.076 (0.013)	0.076 (0.012)
Intercept	3.73 (0.163)	3.733*** (0.163)
Male	0.146 (0.011)	0.147*** (0.011)
Years of schooling	0.036 (0.002)	0.036*** (0.002)
Working experience	0.016 (0.002)	0.016*** (0.002)
Working experience square	-0.000 (0.000)	-0.000*** (0.000)
Private	0.102 (0.016)	0.101*** (0.014)
Industry dummies [a]	Yes	Yes
R^2-Adjusted	-	0.375
Number of individuals	2683	

Notes: Dependent variable: Natural logarithm of gross hourly wage in 1991. OLS standard errors in parentheses. * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level and *** indicates significance at the 1 percent level.
(a) Based on two-digit-industry codes.