What Do We Know About Firm-Paid General Training? The Case of Microsoft Certification

Abstract

Human capital theory predicts that, in a competitive environment, employers will not subsidize general training. However, a number of examples exist that point to the fact that firms routinely do provide such support. Several hypotheses have emerged to explain these observations. This paper investigates the selection argument suggested by Cappelli (2002) which attempts to explain why some firms finance general skills training taught by a third party. Using the individual data from the Microsoft Certified Professional Survey, this situation is analyzed from the perspective of a joint decision for a firm to invest in general skills and for an individual to participate.

I find that a firm's financial support, both partial and full, does have a large positive effect on the incidence of certification. However, the evidence does not seem to support Cappelli's argument. The workers who obtain financial assistance for seeking certification seem to get certified in response to the firm's offer to cover or share the costs and are not likely to become certified otherwise, everything else being equal. This finding is observed at all certification levels. At the same time, contrary to Cappelli's results, a 6.3% wage reduction was found to be associated with a firm's financial assistance for obtaining Microsoft certification after correcting for the endogeneity bias.

1.1 Introduction

Becker's (1962) model predicts that in a competitive environment with perfect information, a firm will never pay for general training. The only way a firm would provide such training is by lowering an employee's initial wage so that the difference between the worker's wage and productivity would cover the cost of training. However, a number of examples challenge Becker's predictions. Arguably, a German apprenticeship system is the most celebrated case of a firm's sponsored general training. A number of studies documented this phenomenon in the USA as well.[1]

Several different hypotheses have recently emerged in the literature to explain why firms may subsidize general training. The first approach is based on the possible complementarity between general and firm-specific skills. This complementarity may arise from particularities of the training process, when general and specific training cannot be separately provided, or when specific training cannot be fully productive without employees possessing general skills (Franz and Soskice, 1995). In addition, even if no technological link exists between these two types of skills, returns from either type of investment may be interdependent. For example, the presence of rent from firm-specific training that depends on the level of general human capital or incentives complementarity may stimulate the firm's investment in general training (Kessler and Lülfesmann, 2000; Brunello and Medio, 2001).

The second argument points to imperfections in the labor market for skilled workers that compress the wage structure in such a way that firms can acquire part of the returns on the investments in their employees' general human capital (Acemoglu and Pischke, 1999b). Frictions in the labor market have been shown to lead to some monopsonistic power on the side of the employer, which, in turn, results in necessary wage compression. The list of such factors includes: asymmetric information about training (Katz and Ziderman, 1990; Chang and Wang, 1996); asymmetric information about the productivity of a worker (Franz and Soskice, 1995; Acemoglu and Pischke, 1998; Autor, 2000); synergy effects of a good workforce (Booth and Zoega, 2000); wage

1 Barron et al. (1997, 1999), Loewenstein and Spletser (1998), Bishop (1996), Cappelli (2002).

regulation (Loewenstein and Spletzer, 1998; Acemoglu and Pischke, 1999a), mobility costs (Harhoff and Kane, 1997), a worker's search costs (Acemoglu, 1997), and a firm's screening costs (Clark, 2002). Most of those hypotheses lead to different tests for the wages of workers-movers and workers-stayers. Recently Gersbach and Schmutzler (2001) developed another model in which imperfect product market competition and individual wage bargaining with each skilled worker might also generate an incentive for a firm to invest in the workers' general skills.

The Katz and Zidermen's (1990) line of argument, which states that firms may pay for general skills due to information asymmetry about workers' trainings, does not seem to apply to Microsoft certification. The whole idea behind certification is to reduce the information asymmetry about the holder's expertise and to reveal it not only to the current employer but to outside firms as well.

A mobility cost hypothesis that emphasizes the possibility for a firm to recover training costs by setting the wage of its trained workers below their marginal productivity is also very questionable. This hypothesis implies that mobility costs increase with the level of training offered to enable firms to extract a higher rent for more intensive training (Clark, 2002). Since that requirement is indeed difficult to justify, one would expect to observe a significantly lower number of firms sponsoring higher-level certifications. This issue is addressed later.

Clark (2002) argues that firms may pay for training since screening of the skilled workers is more costly compared to unskilled ones. This cost difference allows firms to set the wages of trained workers below their marginal productivity in order to recover a training investment. Clark compares his results to alternative explanations such as asymmetric information (Acemoglu and Pischke, 1998) and skills complementarity (Acemoglu and Pischke, 1999) hypotheses. The author argues that tests based upon wage levels (Acemoglu and Pischke, 1998; Euwals and Winelmann, 2001) instead of wage changes are biased due to unobserved heterogeneity of workers correlated with the decision to stay or move. In addition, the test of the information asymmetry hypothesis requires a comparison of wage changes when it is extended to multiple periods. Clark also argues that Acemoglu and Pischke's (1998) work suffers from the use of current wages to draw inferences about retrospective events, sometimes 30 years old. The papers

by Euwals (1998) and Werwatz (1996) estimating switching regression models are criticized for poor determined selection equations.

Certification, however, differs from training in several ways. Unlike training, certification is not assumed to generate new skills. Rather, certification serves to verify a worker's existing human capital, whether it was generated through training or by prior experience. In addition, certification can be received in a package with or without training. While firms may pay for their employees to receive training, they often may not be interested paying an additional fee for employees to obtain the title as well unless the title is needed for external signaling to a firm's clients. However, as Acemoglu and Pischke (2000) demonstrate, a firm may offer certification to get workers more interested in skills accumulation. In addition, previous studies have examined training that is available only through a firm. In the case of firm-financed Microsoft certification, as Capelli (2002) notes in his discussion of tuition assistance, workers receive training and credentials outside the firm.

Moreover, while one must attend classes to receive other types of certification, in the case of Microsoft certification, one is not required to complete any courses with Microsoft in order to take its certification exams. The fact that firms are willing to sponsor this external training and certification makes Microsoft certification the clearest case of firm-financed general skills training in the existing training literature.

Additionally, other models usually characterize firm-sponsored training as being provided in the initial employment period during which employers pay a below-productivity "training" wage to recoup training costs. However, in the case of firm-financed Microosoft certification, similar to tuition assistance, several factors mitigate against compressing starting wages, among them job tenure requirements to qualify for financial assistance and state and federal regulations.

Microsoft certification in some ways bears a greater resemblance to post-secondary degrees than to workforce training. The aforementioned requirements for receiving financial assistance for Microsoft certification are similar to those for workers who obtain tuition assistance for post-secondary education. Cappelli (2002) suggests that employee self-selection contributes to such firm-sponsored tuition assistance. A strong foundation exists, he argues, for a separating equilibrium in which higher quality workers

with abilities and motivation to succeed in post-secondary education select themselves into firms that provide such a benefit. This paper is an attempt to investigate his hypothesis further. However, contrary to Cappelli's approach, the model estimated in this paper analyzes certification incidence as the result of a joint decision between a firm and a worker; the firm decides to invest or not to invest in general skills training or education and individual decides whether to participate. Worker-level data allows us to observe individuals who are willing to receive skills even if the firm is not willing to pay for them. Such information is usually missing in firm-provided training data.

This paper also aims to contribute to the literature by being able to investigate the questions at different levels of skills complexity. Measuring training intensity in hours (days) of training, as it is usually done, provides no information about the level of skills acquired with this training. Empirical obsevations and theory suggest that factors causing firms to cover the costs of the basic level skills may vary from the rationale to sponsor very advanced training. With the data from Microsoft Certified Professional Survey, I am able to differentiate the various levels of training by the number of certificates as well as by the complexity of skills they verify. The model is estimated separately for each skill level.

The paper is organized as follows: a data description is followed by the presentation of the model and the discussion of empirical estimations. The last section concludes.

1.2 The Data

The data set used for this research was collected by the Wilson Research Group in 2001 on behalf of Microsoft Certified Professional Magazine. Using every *n*th name from a Microsoft-supplied list of all Microsoft Certified Professionals in the continental U.S., 33,000 respondents were selected, contacted by email and invited to a password-protected web site to complete the survey. The response rate was about 20%. For this study, only surveys with complete answers on all questions of interest were selected. Respondents in the resulting data set are very comparable in age, education, earnings and working hours to a subsample of respondents with information technology occupations

drawn from the March 2001 Current Population Survey[2]. Summary statistics are presented below in Table 0-1.

Table 0-1. Descriptive Statistics

Variables	Means (Std. Dev.)
Age	35.6 (8.45) min=16.5 max=60
Female	0.099
Education:	
Less then high school	0.005
High school	0.039
College, no degree	0.241
2-yr college	0.137
4-yr college	0.342
Master	0.138
Ph.d. or professional[3]	0.012
Firm size:	
Self-employed	0.037
Medium or small firm (0-499 employees)	0.400
Large firm (500-999 employees)	0.078
Extra large firm (over 1000 employees)	0.484
Tenure, years	3.9 (3.83) min=1 max=15
Time cost of last certificate, months	6.6 (4.03) min=0.5 max=13
Encourage certification	0.362
Fringe benefits, % of earnings	0.066 min=0 max=0.727
Plans	5.2 (2.69) min=1 max=15
Sample size	4498

In 2000 Microsoft offered eight specific certificates which varied by the field of expertise and by skill level. The basic skill level credential is MCP (Microsoft Certified Professional). The next skill group is represented by two intermediate-level credentials, MCP+I (Microsoft Certified Professionals with Internet proficiency) and MCP+SB (Microsoft Certified Professionals with Site-building proficiency). Advanced credentials comprise the remaining five: MCSE (Microsoft Certified Systems Engineers), MCSE+I

2 For the list of those occupations and more detailed comparison see Vakhitova and Bollinger, 2005.

3 For example, MD, DDS, or JD.

(Microsoft Certified Systems Engineers with Internet proficiency), MCSD (Microsoft Certified Solution Developers), MCDBA (Microsoft Certified Database Administrator), and MCT (Microsoft Certified Trainer). Appendix B presents more details about the specific certificate requirements. In summary, there are: one basic certificate (I call it here MCP_basic), two intermediate (MCP+I and MCP+SB), four advanced (MCSE, MCSE+I, MCSD, and MCDBA) certificates and one certificate for Microsoft trainers (MCT), which is conditional on holding other advanced certificates. All certificates can be grouped into three tracks in which skills of a similar type but of a different level are verified. The first track is called "Systems Engineering track" and includes MCP, MCP+I, MCSE and MCSE+I certificates. The second type of skills can be built up along the "Developer track", which includes MCP, MCP+SB and MCSD certificate. The "Database administrator track" connects MCP and MCDBA. The last certificate, MCT, goes on the top of any track.

Based on that information, the following variables were generated to differentiate the level of skills complexity:

Cert 2 – equal to 0 for individuals with only basic certification, 1 otherwise;

Cert 3 - equal to 0 for individuals with basic or intermediate certificates, 1 otherwise;

Cert 4 – equal to 0 for individuals with basic, intermediate, or, at most, one advanced certificates, 1 otherwise; and

Cert 5 – equal to 1 for individuals who hold advanced certificates in all three major tracks, 0 otherwise.

Workers with one advanced credential dominate the distribution of the respondents by certification levels as shown in Table 0-2. Based upon theoretical arguments and the existing training literature other factors, such as age, gender, education level and firm size, are used as additional controls in the analysis of the certification incidence.

Table 0-2. Distribution of respondents by certification level

Certification level	Number of respondents	%
Basic	412	9.16
Intermediate	50	1.11
Advanced certificate in one track	2,828	62.87
Advanced certificate in two track or MCT	991	22.03
Advanced certificates in all tracks	217	4.82
Total	4,498	100

I use three "firm paid" variables: *paidlsc* – firm sponsored the full costs of the last certification or training program[4] attended; *paidlsb* – firm shared the costs with an individual; *paidlscb* – firm paid the full costs or shared some, the sum of the previous two variables. About 65% of respondents received full or partial financial support from their firms. Table 0-3 shows the earnings of the respondents by the source of certification funding. The data is consistent with Cappelli's selectivity argument[5] that workers who are offered financial assistance also receive higher wages.

Table 0-3. Income of Microsoft certificants by the source of certification funding

Who paid for the last certification or training program	N	%	Average Earnings, $	Std. Dev.	Min	Max
Firm	2283	50.8%	64,149.15	21,520.49	27,500	150,000
Self	1584	35.2%	59,324.49	26,575.91	27,500	150,000
Both	631	14%	60,942.95	22,431.16	27,500	150,000

The survey asks a number of questions about workplace conditions and practices that could possibly influence a firm's decision to provide financial assistance for training and certification. I have included the following variables:

- the number of additional compensation plans that the company offers to a worker, including bonuses, car allowance, college education reimbursement, high-speed internet connection, paid training, paid

4 Here, training program related to certification, such as courses, for example.

5 Cappelli, 2002.

conference attendance, mileage reimbursement, profit sharing, etc. The full list of benefits is shown in Table 0-4.

- the dollar value of profit-sharing, retirement, commissions, stock options, training or education allowances and other non-direct compensation received in 2000 (not including bonuses) relative to the wage;
- the availability of the formal program in place to encourage and reward technical certification efforts (monetary or otherwise).

Tenure and time cost of the last certificate earned, measured as the number of months taken to prepare for and complete the latest Microsoft certificate, are included as a proxy for the match between a job and a worker.

Table 0-4. Fringe Benefits

Types of Benefits		Frequency
1	Bonuses	48.8%
2	Car allowance	6.1%
3	College education reimbursement	37.8%
4	Expense account	14.5%
5	401(k) without firm match	16.1%
6	401(k) with firm match	62.2%
7	High-speed Internet connection	13.6%
8	Paid medical/dental	60.7%
9	Paid training	59.4%
10	Paid technical conference attendance	35.1%
11	Practice equipment (computers, switchers)	34.9%
12	Profit-sharing	17.0%
13	Stock option program	27.5%
14	Stock purchase program	22.3%
15	Miles reimbursement	40.5%
16	Other	4.9%

It is interesting to note that the firm's financial assistance does not vary with the level of skill (Table 0-5). These findings cast doubt on the mobility costs hypothesis as a likely explanation for why firms pay for certification.

Table 0-5. Firm's financial assistance by the level of certification

Certification level	Number of respondents			
	Total	By the source of financing		
		self	firm	both
Basic	412	194	160	58
		47.1%	38.8%	14.1%
Intermediate	50	25	18	7
		50.0%	36.0%	14.0%
Advanced certificate in one track	2,828	1,452	985	391
		51.3%	34.8%	13.8%
Advanced certificate in two track or MCT	991	502	345	144
		50.7%	34.8%	14.5%
Advanced certificates in all tracks	217	110	76	31
		50.7%	35.0%	14.3%
Total	4,498	2,283	1,584	631
		50.8%	35.2%	14.0%

1.3 The Model

Following Cappelli's (2002) approach, I first estimate a reduced form relationship to establish a positive correlation between the certification incidence and firms offering to cover the costs, partially or in full.

$$Cert_i = \alpha + F_{i\ i}\beta + X_i\gamma + \varepsilon_i$$

eq. 0-1

where

Cert – the indicator of advanced certification. The model was estimated separately for each levels of certification, from *Cert2* to *Cert5*;

F – "firm paid" variables;

X – age, female, education dummies, firm size dummies.

The results of this regression should be viewed as a partial correlation: firms that offer certification assistance are correlated with workers that take up the program. Clearly, potential endogeneity exists here: it may be that firms offer training when the typical worker is unlikely to participate, causing a downward bias. Alternatively, workers who are predisposed to obtain certification may seek employers who will pay for it, thus causing a positive bias. This result simply establishes a positive association.

Appendix

Table 0-6 in the Appendix demonstrates that when a firm pays all costs of certification, the individual is more likely to hold only an advanced certificate at the first two levels (*Cert2* and *Cert3* model specifications). Moreover, this effect is only weakly significant. In all other cases, firms' financial assistance was not found to be a significant factor for the incidence of certification.

Such a result can be affected by the fact that the firm's decision to pay is endogenous. Since we cannot identify individuals who decided not to apply for certification, even if the firm offered to pay for them, the estimated probability that a firm will cover certification expenses in the observed sample may be biased. Another important issue is that of self-selection. For a firm, a decision to pay for certification is a question of choosing between "raising" its own workers and "buying" an unknown (in terms of productivity) product at the market. A high-skilled worker also must decide how he wants to finance his human capital investment. While indeed, as noted by Cappelli (2002, p.2) "tuition assistance … is a ubiquitous and crucial element in the resources that support students," there is no reason to assume that whose who pay tuition out of their own pocket do so only because they could not get a position in a firm providing tuition assistance.

To investigate these problems I used a maximum likelihood model to evaluate the system of equations which describes a joint decision by a firm to pay and by an individual to participate.

$$\begin{cases} 1)\ Cert_i = \alpha_1 + F_i\beta_1 + X_i\gamma_1 + \varepsilon_i \\ 2)\ F_i = \alpha_2 + Z_i\gamma_2 + u_i \end{cases}$$

eq. 0-2

where

Z – firm size dummies, tenure, number of employees benefits (*plans*), time taken to prepare and to complete the latest title (*timetl*), the dollar value of non-direct compensation relative to earnings (*fringe0_rel*), indicator of whether the firm has a formal program in place to encourage and reward technical certification efforts (*encourgy*).

"Firm paid" variable F in the second equation (*paidlscb*) is the sum of two "firm paid" variables from the first equation (*paidlsc* and *paidlsb*).

This system of equations is estimated with a maximum likelihood function.

$$(\varepsilon, u) \sim N(0, 0, 1, 1, \rho)$$

eq. 0-3

$$\Pr(Cert = 1, F = 1) = \Pr(\mu_1 + u \geq 0, \mu_1 + \varepsilon \geq 0) = \Pr(u \geq -\mu_1, \varepsilon \geq -\mu_1) =$$
$$= 1 - \Pr(u < -\mu_1, \varepsilon < -\mu_1) = 1 - binorm(-\mu_1, -\mu_1, \rho) = binorm(\mu_1, \mu_1, \rho)$$

$$\Pr(Cert = 1, F = 0) = \Pr(\mu_1 + u \geq 0, \mu_1 + \varepsilon < 0) = \Pr(u \geq -\mu_1, -\varepsilon \geq \mu_1) =$$
$$= 1 - \Pr(u < -\mu_1, -\varepsilon < \mu_1) = 1 - binorm(-\mu_1, \mu_1, -\rho) = binorm(\mu_1, -\mu_1, -\rho)$$

$$\Pr(Cert = 0, F = 1) = \Pr(\mu_1 + u < 0, \mu_1 + \varepsilon \geq 0) = \Pr(-u \geq \mu_1, \varepsilon \geq -\mu_1) =$$
$$= 1 - \Pr(-u < \mu_1, \varepsilon < -\mu_1) = 1 - binorm(\mu_1, -\mu_1, -\rho) = binorm(-\mu_1, \mu_1, -\rho)$$

$$\Pr(Cert = 0, F = 0) = \Pr(\mu_1 + u < 0, \mu_1 + \varepsilon < 0) = \Pr(u < -\mu_1, \varepsilon < -\mu_1)$$
$$= binorm(-\mu_1, -\mu_1, \rho)$$

eq. 0-4

$$\ln L = \sum \begin{Bmatrix} Cert_i F_i \ln[binorm(\mu_1, \mu_2, \rho)] \\ + (1 - Cert_i) F_i \ln[binorm(-\mu_1, \mu_2, -\rho)] \\ + (1 - Cert_i)(1 - F_i) \ln[binorm(-\mu_1, -\mu_2, \rho)] \\ + Cert_i (1 - F_i) \ln[binorm(\mu_1, -\mu_2, -\rho)] \end{Bmatrix}$$

eq. 0-5

1.4 Estimation Results

Certain concerns about the data need to be addressed. For each individual I have information on F (whether the firm paid for certification, partially or in full). However, information on Z (vector of the independent variables in the "firm paid" equation) refers to the individual's current firm. Obviously, if the person changed employers after

obtaining the last certificate, the current firm is not the one that sponsored the credential. This situation raises the question of causality and interpretation of the estimated parameters in the "firm paid" equation.

To investigate how the results are sensitive to that problem, I also estimated the model only for the workers who received their last title in their current firm. I identify them as those who held the most recently attained Microsoft title for a time shorter then they have worked for their current employer or been self-employed. In this way, I assume that it is the current firm that paid for the last certification or training program attended. Other workers are assumed to have received their last title while working for another employer. Table 0-7 in the Appendix presents the result for all workers, while the results in Table 0-8 refer only to current workers.

I also noticed that some employees identified above as "workers who received their last title in the current firm" answered the following question positively: *Was this increase* [in earnings] *in 2000 because you changed employers?* At the same time, the recorded tenure for that group varies along the entire spectrum: from one to 15 years. More than 100 of 266 respondents who either did not answer this question or said "yes" reported tenure above one year. I presume this information can still be consistent if those workers are either self-employed or contracted workers (given the wording of the tenure question), or if the job change occurred some time before 2000. Nevertheless, I cannot be sure that firm's information these workers report still refers to a company that shared certification costs. In addition, I presume that the answer was positive whenever the worker re-located, even if the earnings did not increase. This assumption is reasonable given that 9% of those who changed their employers in 2000 and 4% of those who expected to change the employers in 2001 reported no increase in their earnings. The share of workers whose earnings did not increase in 2000 or are not expected to increase in 2001 is 10% and 6% correspondingly. Thus, I also estimated the model separately for the workers whose current firm presumably paid for the last certification and who either did not change employers in 2000 or will not do so in the 2001, or both. Table 0-9 through Table 0-11 respectively demonstrate the results for these specifications.

The obtained results for all specifications are qualitatively the same. The difference in significance is likely to be explained by the large reduction in sample size. Thus from hereafter, I will proceed with the full data set.

Incidence of Certification and Firm's Assistance

In all specifications, the firm's financial support, both partial and full, has a large positive effect on the incidence of certification. However, the correlation between the unobservables from the "firm-paid" and "incidence" equations is always negative. This implies that,

> *Workers get certified in response to the firm's offer to cover or share the costs and are not likely to get certified otherwise, everything else equal. Certification here is rather an external verification that a worker receives/holds a required qualification.*

Self-employed individuals, as expected, are more likely to hold credentials and to cover the costs of certification themselves. Workers from firms with up to 500 employees are only marginally more likely to receive financial assistance from their current employers and tend to obtain only the two lower levels of certification. At the upper levels of certification, firm size is not found to be an important determinant of the firm's willingness to finance certification[6]. At the same time, certified workers are significantly more likely to be employed at small and medium firms. This finding supports previous results and "monitoring story"[7] as an explanation for a firm size effect on the incidence of certification.

While women are overall less likely to be certified, this gender disparity disappears after women receive advanced credentials. Similar results were found for the age variable. Age has a standard rainbow-shaped effect on the incidence of lower level certification.

Education has an increasing effect. Workers with a Master's or Ph.D. degree are more likely to get certified compared to 4-year college graduates. Workers with other

6 When model is estimated for all workers, including those, for whom the costs of certification were covered by a previous employer, firm size has no significant effect at all certification levels.

7 Vakhitova and Bollinger, 2005.

degrees are significantly less likely to hold Microsoft certificates. This, again, is consistent with the previous findings that workers with more education are more likely to hold advanced credentials.

These results also support arguments that a firm's willingness to pay for general skills training is a part of the "best performance" practice. I find the structure of labor remuneration, to have the strongest effect for the firm's willingness to financially support certification. Components of this structure include the number of fringe benefit plans provided by the firm, the weight of the monetary value of the fringe benefits relative to the earnings, and the firm's human resource policy (whether or not the company has "a formal program in place to encourage and reward technical certification efforts"). As previously mentioned, firm size does not have a significant effect on the incidence of certification sponsorship.

Tenure and worker time-effectiveness, measured as time needed to prepare for and complete a worker's latest title, have a significant though relatively small effect on a firm's decision to pay for certification.

Wage Compression and Firm's Financial Support

The next step in the analysis is to investigate the relationship between wage and a firm's willingness to pay certification expenses. Cappelli (2002) used the wage test and the firm's sponsorship test to analyze the relevance of wage compression as a possible explanation for the existence of tuition reimbursement plans. He found that the wage level in firms that offer tuition benefits is higher than that of firms that do not offer tuition benefits, and that higher wages were associated with provision of these plans. Cappelli interprets this result as evidence that companies that provide tuition assistance attract more productive workers, so employers can earn a margin when still paying a market wage. Such a company can even pay a higher wage to its employers by sharing the rent with the workers (efficiency wage argument). I follow Cappelli's approach by using these two tests. In addition, I estimate a customized version of each test to account for possible occupation differences. Since Vakhitova and Bollinger (2005) found earlier that the return to certification depends upon the match between the occupation

requirements and certified skills, I modified both the wage equation and probit model for the firm's sponsorship incidence.

The first test is based on the examining wage regression augmented with the firm's certification sponsorship indicator to investigate if such assistance is associated with lower wages.

$$W_i = \alpha + X_i\gamma + F_i\beta + \varepsilon_i$$

eq. 0-6

where W is annual earnings, X includes major demographic variables (i.e. age, education, and female), firm size indicators, and a set of Microsoft certification indicators; F is an indicator of the firm's full or partial financial assistance in getting the last certificate; α, γ, and β are the corresponding coefficients, and ε is an error term.

I used two modifications of this test. In the first case, I included the *Ccert* variable, used before, to represent the level of certification. Four model specifications are estimated with *Ccert* taking the value of *Cert2, Cert3, Cert4* and *Cert5*. The results are available in Table 0-12 in the Appendix, column 1-4 respectively. Table 0-13 in the Appendix presents wage equation results estimated separately by occupations. The occupations are similar to those used in Vakhitova and Bollinger (2005) and include programmers, network engineers, IT trainers, web designers and data base developers or administrators, user support specialists, and IT managers. Respondents who defined themselves as students or unemployed together with those unable to identify themselves by any of the above-mentioned occupations are put into the "others" group. In each case, the wage premium associated with a firm's willingness to cover certification expenses is positive and very significant. Only for two occupational groups, programmers and IT managers, was the coefficient insignificant but still positive

The second test refers to the possibility of the reverse causality. The literature suggests that the presence of wage compression generates the opportunity for the firm to recover investments into general skills. The residual from the wage regression (the firm's financial assistance indicator is excluded here) represents the measure of the wage compression. The following equation is estimated:

$$F_i = \alpha + Z_i\gamma + Wr_i\beta + u_i$$

eq. 0-7

where F indicates the firm's full or partial certification sponsorship; Z is a vector of variables that control for firm size, the dollar value of non-direct compensation relative to earnings (*fringe0_rel*), an indicator of whether the firm has a formal program in place to encourage and reward technical certification efforts (*encourgy*), number of employee benefits (*plans*), tenure, and time taken to prepare and to complete the latest title (*timetl*); Wr is a residual from the corresponding wage regression, and u is an error term.

Table 0-14 presents five model specifications used to estimate this equation. In the first column Wr is the residual received from the wage regression with a certification indicator being equal to *Ccert2*. In the second column Wr is the residual corresponding to the wage regression with a certification indicator being equal to *Ccert3*. The same rule applies to column three and four. Column 5 includes Wr constructed so that each observation comes from the corresponding occupational wage regression similar to those in Table 0-13 (excluding indicator of the firm's certification sponsorship). The results of the probit analysis for all specifications demonstrate that wage residual is positively related to the probability that firm will finance certification.

This supports the Cappelli's findings that, independent of whether wage or certification assistance comes first, the later one seems to be associated with higher wages. This evidence conflicts with the suggestion that wages are artificially held down to allow an employer to recoup certification expenses.

Wage Differential and Endogeneity: is there a Wage Compression?

There is one big issue with results presented in the previous section. As shown by Hwang and others (1992), the estimated coefficient on a firm's assistance in the wage regression is biased due to unobserved productivity. Since I am averaging over workers with different levels of human capital (productivity), the coefficient on "firm paid" variable does not show the trade-off between firm's assistance and wage, but rather

demonstrates that higher-paid workers also more likely to receive more fringe benefits, including certification financial support.

Hwang and others (1992) demonstrate that the bias depends on three factors:

- the proportion of wage dispersion due to the workers' difference in tastes, $\tau = E[\text{var}(w \mid K)] / \text{var}(w)$, where K is the productivity level;
- the degree of unobserved productivity heterogeneity, $\gamma = \text{var}(K_u) / \text{var}(K)$;
- the average share of total remuneration taken in the form of wages, $\varpi = E(w / K)$.

They estimated the probability limit of the ratio of estimated coefficient to the true value as

$$p\lim\left(\frac{\hat{\beta}}{\beta}\right) = \frac{\tau\varpi^2 - \gamma(1-\tau)\varpi(1-\varpi)}{\tau\varpi^2 + \gamma(1-\tau)(1-\varpi)^2}$$

eq. 0-8

If $\gamma > \tau\varpi/[(1-\tau)(1-\varpi)]$, the estimated coefficient $\hat{\beta}$ takes a wrong positive sign.

Using the available information about the dollar amount spent on certification in 2000, I followed Hwang and coauthors to correct the estimated trade-off between certification financial assistance and earnings. The degree of unobserved productivity heterogeneity, γ, is proxied by *1-R^2*, as suggested by Hwang and colleagues (1992), and is equal to 0.772. The average certification expenses amount to $2,251, which is a relatively small part of earnings. Thus, the average share of total remuneration in the form of wages, ϖ, is equal to 0.961 here. The proportion of wage dispersion due to the workers' difference in tastes, $\tau = \text{var}(w/K)[(E(K))^2 + \text{var}(K)] / \text{var}(w)$ [8], is equal to 0.011. While number is smaller than Hwang's calibrations. This results is expected and reflects the homogeneity of the sample. The corrected coefficient is negative 0.063. It implies that workers who obtain firm's financial assistance receive a wage that is 6.3% lower than what they would get otherwise. This finding is consistent with classical economic theory and the wage compression story.

8 See also Hwang and others (1992) for details.

Summary and Conclusions

This paper has used the Microsoft Certified Professional 2001 Survey to further investigate the selection hypothesis offered by Cappelli (2002) to explain the role of a firm's financial assistance in providing its employees general training taught by a third party. Microsoft certification has some characteristics that make this phenomenon an especially interesting example of firm-financed general skills. In particular, any employer has easy access to information about skills, which are verified by the means of Microsoft certification. Applicants have to fulfill the same requirements and take the same tests all over the world, which makes skills of a given level uniform. In this situation, in a standard human capital settings, it is surprising that any firm would finance the certification. Nevertheless, the percentage of respondents receiving such support is very high. About 65% of individuals in my sample reported receiving some kind of monetary certification assistance from the firm. Since, in addition, the main users of this assistance are not new hires, a promising hypothesis arises that emphasizes the role of selection mechanism, which would sort more-productive workers into the firms offering certification sponsorship.

Worker-level data used for this study allows us to identify individuals who are willing to receive skills even if the firm is not willing to pay for them. This information is usually missing from data on firm-provided training. This feature of the dataset allowed me to formulate a better model that could analyze certification incidence as a joint decision of a firm to invest in general skills training and of an individual to participate. The model is estimated separately for each level of skills complexity.

Carefully estimating various specifications, I find that a firm's financial support, both partial and full, has a large positive effect on the incidence of certification. However, the selection mechanism, if it exists, does not appear to correspond to the pattern suggested by Cappelli (2002). The workers who obtain financial assistance in receiving certification seem to get certified in response to the firm's offer to cover or share the costs and are not likely to become certified otherwise, everything else equal. This result is observed at all levels of skills complexity. Certification here rather serves as an external verification that a worker has received or holds a required qualification.

After correcting for unobserved productivity bias, I also found that certification assistance is associated with lower wages. This implies that some form of wage compression exists. How employers that cover certification costs, are able to pay less than a market wage to their workers remains an open question.

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Appendix

Table 0-6. Probit Estimates of Microsoft Certification Incidence as a Function of Firm's Sponsorship

Variable	cert2	cert3	cert4	cert5	certall
age	0.049 **	0.050 **	0.013	0.031	0.029 ***
	(0.023)	(0.022)	(0.018)	(0.030)	(0.015)
age2	-0.00066 **	-0.00066 **	-0.00015	-0.00044	-0.00038 ***
	(0.00030)	(0.00029)	(0.00023)	(0.00039)	(0.00020)
female	-0.188 **	-0.189 **	-0.009	-0.079	-0.083
	(0.083)	(0.081)	(0.070)	(0.116)	(0.060)
edu_lhs	-0.205	-0.135	0.205	-0.173	0.036
	(0.333)	(0.333)	(0.263)	(0.460)	(0.243)
edu_hs	-0.363 *	-0.315 *	-0.259 **	-0.272	-0.296 *
	(0.122)	(0.121)	(0.113)	(0.186)	(0.093)
edu_colnd	-0.145 **	-0.145 **	-0.165 *	-0.310 *	-0.173 *
	(0.066)	(0.063)	(0.053)	(0.089)	(0.043)
edu_col2	-0.129	-0.139 ***	-0.236 *	-0.502 *	-0.218 *
	(0.079)	(0.076)	(0.066)	(0.132)	(0.051)
edu_m	0.349 *	0.348 *	0.482 *	0.196 **	0.404 *
	(0.098)	(0.094)	(0.061)	(0.088)	(0.053)
edu_pd	0.750 ***	0.812 **	0.861 *	0.591 *	0.773 *
	(0.412)	(0.412)	(0.171)	(0.216)	(0.142)
firm_se	0.062	0.048	0.806 *	0.641 *	0.581 *
	(0.144)	(0.139)	(0.105)	(0.143)	(0.104)
firm_ms	0.200 *	0.183 *	0.298 *	0.277 *	0.254 *
	(0.058)	(0.056)	(0.044)	(0.070)	(0.036)
firm_l	0.057	0.054	0.020	-0.040	0.026
	(0.100)	(0.096)	(0.082)	(0.144)	(0.062)
paidlsc	0.107 ***	0.101 ***	0.073	0.040	0.080 **
	(0.058)	(0.056)	(0.046)	(0.073)	(0.037)
paidlsb	0.047	0.046	0.068	0.028	0.057
	(0.083)	(0.080)	(0.065)	(0.104)	(0.053)

Table 0-6. (Continue)

Variable	cert2	cert3	cert4	cert5	certall
_cut1					-0.695 **
					(0.284)
_cut2					-0.629 **
					(0.284)
_cut3					1.317 *
					(0.284)
_cut4					2.409 *
					(0.285)
_cons	0.391	0.294	-1.102 *	-2.279 *	
	(0.427)	(0.411)	(0.337)	(0.552)	
N	4498	4498	4498	4498	4498

Notes. Standard errors are given in the parentheses. All unmarked estimates are insignificant,
* - significant at 1%, ** - significant at 5%, *** - significant at 10%.
Firm size: 1 000+ employees (firm_xl) is the base category.
Education: 4-yr college degree is the base category.

Table 0-7. ML Estimation of the Incidence of Microsoft Certification and Firm's Sponsorship, All Workers

Variable	MLE2	MLE3	MLE4	MLE5
eq1: Incidence of Certification				
age	0.047 **	0.048 **	0.011	0.026
	(0.022)	(0.021)	(0.017)	(0.028)
age2	-0.00063 **	-0.00064 **	-0.00012	-0.00039
	(0.00029)	(0.00028)	(0.00022)	(0.00036)
female	-0.190 **	-0.191 **	-0.009	-0.079
	(0.081)	(0.079)	(0.065)	(0.107)
edu_lhs	-0.196	-0.129	0.180	-0.190
	(0.329)	(0.329)	(0.259)	(0.438)
edu_hs	-0.348 *	-0.303 **	-0.227 **	-0.224
	(0.121)	(0.120)	(0.108)	(0.177)
edu_colnd	-0.138 **	-0.140 **	-0.152 *	-0.288 *
	(0.064)	(0.063)	(0.050)	(0.085)
edu_col2	-0.128	-0.138 ***	-0.226 *	-0.478 *
	(0.078)	(0.076)	(0.063)	(0.123)
edu_m	0.347 *	0.346 *	0.461 *	0.197 **
	(0.097)	(0.094)	(0.058)	(0.082)
edu_pd	0.742 ***	0.805 **	0.826 *	0.574 *
	(0.397)	(0.398)	(0.167)	(0.193)
firm_se	0.205	0.172	1.017 *	0.873 *
	(0.153)	(0.148)	(0.106)	(0.139)
firm_ms	0.216 *	0.197 *	0.320 *	0.309 *
	(0.058)	(0.056)	(0.043)	(0.067)
firm_l	0.068	0.063	0.053	-0.003
	(0.099)	(0.096)	(0.079)	(0.137)
paidlsc	0.472 *	0.416 *	0.710 *	0.768 *
	(0.164)	(0.156)	(0.105)	(0.143)
paidlsb	0.426 **	0.374 **	0.735 *	0.795 *
	(0.179)	(0.171)	(0.118)	(0.164)
_cons	0.158	0.100	-1.459 *	-2.580 *
	(0.421)	(0.409)	(0.327)	(0.525)

Table 0-7. (Continued)

Variable	MLE2	MLE3	MLE4	MLE5
eq2: Incidence of Firm's Certification Sponsorship				
firm_se	-0.708 *	-0.709 *	-0.732 *	-0.725 *
	(0.112)	(0.112)	(0.111)	(0.112)
firm_ms	0.039	0.039	0.014	0.028
	(0.044)	(0.044)	(0.045)	(0.045)
firm_l	-0.007	-0.007	-0.021	-0.015
	(0.078)	(0.078)	(0.077)	(0.078)
timetl	-0.011 **	-0.012 **	-0.026 *	-0.021 *
	(0.005)	(0.005)	(0.005)	(0.005)
fringe0_rel	1.236 *	1.231 *	1.170 *	1.114 *
	(0.279)	(0.279)	(0.272)	(0.277)
encourgy	0.270 *	0.271 *	0.289 *	0.279 *
	(0.044)	(0.044)	(0.043)	(0.044)e
plans	0.149 *	0.149 *	0.143 *	0.147 *
	(0.009)	(0.009)	(0.009)	(0.009)
tenure	0.040 *	0.040 *	0.035 *	0.040 *
	(0.006)	(0.006)	(0.006)	(0.006)
_cons	-0.586 *	-0.584 *	-0.431 *	-0.499 *
	(0.069)	(0.069)	(0.075)	(0.071)
rho	-0.248 **	-0.215 **	-0.453 *	-0.517 *
	(0.102)	(0.097)	(0.069)	(0.088)
N	4498	4498	4498	4498

Notes. Standard errors are given in the parentheses. All unmarked estimates are insignificant, * - significant at 1%, ** - significant at 5%, *** - significant at 10%.
Firm size: 1 000+ employees (firm_xl) is the base category.
Education: 4-yr college degree is the base category.

Table 0-8. ML Estimation of the Incidence of Microsoft Certification and Firm's Sponsorship, Current Workers

Variable	cur2	cur3	cur4	cur5
eq1: Incidence of Certification				
age	0.012	0.031	0.021	0.036
	(0.035)	(0.033)	(0.024)	(0.038)
age2	-0.00012	-0.00037	-0.00024	-0.00049
	(0.00046)	(0.00043)	(0.00031)	(0.00049)
female	-0.059	-0.072	-0.160	0.020
	(0.148)	(0.141)	(0.106)	(0.151)
edu_lhs	-0.052	0.014	0.729 **	-0.103
	(0.513)	(0.510)	(0.335)	(0.483)
edu_hs	-0.491 *	-0.410 **	-0.277	-0.326
	(0.190)	(0.188)	(0.173)	(0.297)
edu_colnd	-0.119	-0.172	-0.123 ***	-0.223 ***
	(0.101)	(0.095)	(0.072)	(0.115)
edu_col2	-0.053	-0.010	-0.095	-0.278 ***
	(0.128)	(0.125)	(0.089)	(0.151)
edu_m	0.227	0.264 ***	0.411 *	0.236 **
	(0.141)	(0.137)	(0.082)	(0.114)
edu_pd	0.471	0.538	0.767 *	0.317
	(0.429)	(0.426)	(0.202)	(0.260)
firm_se	0.095	0.204	1.005 *	0.810 *
	(0.225)	(0.221)	(0.156)	(0.202)
firm_ms	0.266 *	0.273 *	0.366 *	0.314 *
	(0.091)	(0.087)	(0.064)	(0.092)
firm_l	0.044	0.080	0.138	-0.058
	(0.161)	(0.156)	(0.119)	(0.194)
paidlsc	0.610 **	0.671 *	0.836 *	0.871 *
	(0.257)	(0.244)	(0.141)	(0.188)
paidlsb	0.468 ***	0.534 **	0.871 *	0.831 *
	(0.278)	(0.264)	(0.158)	(0.218)
_cons	0.616	0.153	-1.744 *	-2.768 *
	(0.673)	(0.636)	(0.457)	(0.715)

Table 0-8. (Continued)

Variable	cur2	cur3	cur4	cur5
eq2: Incidence of Firm's Certification Sponsorship				
firm_se	-0.678 *	-0.677 *	-0.718 *	-0.718 *
	(0.167)	(0.167)	(0.169)	(0.170)
firm_ms	0.134 ***	0.135 ***	0.091	0.114
	(0.070)	(0.070)	(0.070)	(0.070)
firm_l	0.107	0.104	0.093	0.100
	(0.127)	(0.127)	(0.126)	(0.127)
timetl	-0.009	-0.008	-0.029	-0.021
	(0.008)	(0.008)	(0.008)	(0.008)
fringe0_rel	1.030 **	1.048 **	0.936 **	0.847 **
	(0.422)	(0.421)	(0.397)	(0.416)
encourgy	0.269 *	0.268 *	0.269 *	0.287 *
	(0.069)	(0.068)	(0.064)	(0.067)
plans	0.166 *	0.166 *	0.155 *	0.162 *
	(0.014)	(0.014)	(0.014)	(0.014)
tenure	0.021 *	0.022 *	0.011	0.020 *
	(0.008)	(0.008)	(0.008)	(0.008)
_cons	-0.518 *	-0.524 *	-0.269 *	-0.397 *
	(0.109)	(0.108)	(0.120)	(0.114)
rho	-0.303 **	-0.345 **	-0.606 *	-0.563 *
	(0.154)	(0.146)	(0.091)	(0.118)
N	1964	1964	1964	1964

Notes. Standard errors are given in the parentheses. All unmarked estimates are insignificant, * - significant at 1%, ** - significant at 5%, *** - significant at 10%.
Firm size: 1 000+ employees (firm_xl) is the base category.
Education: 4-yr college degree is the base category.

Table 0-9. ML Estimation of the Incidence of Microsoft Certification and Firm's Sponsorship, Current Workers, did not Change Employer in 2000.

Variable	cur0_2	cur0_3	cur0_4	cur0_5
eq1: Incidence of Certification				
age	0.026	0.046	0.032	0.033
	(0.037)	(0.035)	(0.025)	(0.041)
age2	-0.00028	-0.00055	-0.00038	-0.00044
	(0.00048)	(0.00046)	(0.00032)	(0.00053)
female	-0.024	-0.054	-0.115	0.064
	(0.161)	(0.152)	(0.107)	(0.158)
edu_lhs	-0.165	-0.086	0.627 ***	0.048
	(0.526)	(0.524)	(0.338)	(0.494)
edu_hs	-0.574 *	-0.487 **	-0.315 ***	-0.303
	(0.192)	(0.191)	(0.176)	(0.294)
edu_colnd	-0.136	-0.202 **	-0.164 **	-0.360 *
	(0.109)	(0.103)	(0.075)	(0.132)
edu_col2	-0.115	-0.043	-0.140	-0.465 **
	(0.137)	(0.135)	(0.092)	(0.183)
edu_m	0.135	0.173	0.365 *	0.210 ***
	(0.151)	(0.147)	(0.086)	(0.123)
edu_pd	0.345	0.422	0.674 *	0.337
	(0.429)	(0.427)	(0.204)	(0.261)
firm_se	0.283	0.390	1.257 *	0.818 *
	(0.285)	(0.280)	(0.180)	(0.243)
firm_ms	0.152	0.157 ***	0.323 *	0.305 *
	(0.097)	(0.092)	(0.068)	(0.100)
firm_l	-0.041	0.000	0.138	-0.100
	(0.167)	(0.163)	(0.123)	(0.211)
paidlsc	0.794 *	0.814 *	1.016 *	0.951 *
	(0.281)	(0.265)	(0.141)	(0.205)
paidlsb	0.694 **	0.705 **	1.096 *	0.923 *
	(0.302)	(0.286)	(0.156)	(0.241)
_cons	0.267	-0.184	-2.097 *	-2.758 *
	(0.716)	(0.674)	(0.472)	(0.773)

Table 0-9. (Continued)

Variable	cur0_2	cur0_3	cur0_4	cur0_5
eq2: Incidence of Firm's Certification Sponsorship				
firm_se	-0.728 *	-0.727 *	-0.771 *	-0.786 *
	(0.195)	(0.195)	(0.199)	(0.199)
firm_ms	0.137 ***	0.138 ***	0.081	0.115 **
	(0.075)	(0.075)	(0.075)	(0.075)
firm_l	0.097	0.095	0.086	0.092
	(0.134)	(0.133)	(0.132)	(0.134)
timetl	-0.005	-0.004	-0.029 *	-0.018 **
	(0.008)	(0.008)	(0.008)	(0.008)
fringe0_rel	0.827 ***	0.851 ***	0.694 ***	0.672
	(0.446)	(0.445)	(0.404)	(0.438)
encourgy	0.253 *	0.251 *	0.268 *	0.263 *
	(0.074)	(0.074)	(0.067)	(0.073)
plans	0.159 *	0.159 *	0.143 *	0.155 *
	(0.015)	(0.015)	(0.016)	(0.015)
tenure	0.014	0.014 ***	0.004	0.014
	(0.009)	(0.009)	(0.008)	(0.009)
_cons	-0.417 *	-0.423 *	-0.106	-0.285 **
	(0.117)	(0.117)	(0.131)	(0.123)
rho	-0.409 **	-0.426 *	-0.717 *	-0.609 *
	(0.159)	(0.151)	(0.091)	(0.126)
N	1698	1698	1698	1698

Notes. Standard errors are given in the parentheses. All unmarked estimates are insignificant, * - significant at 1%, ** - significant at 5%, *** - significant at 10%.
Firm size: 1 000+ employees (firm_xl) is the base category.
Education: 4-yr college degree is the base category.

Table 0-10. ML Estimation of the Incidence of Microsoft Certification and Firm's Sponsorship, Current Workers, do not Plan to Change Employer in 2001.

Variable	cur1_2	cur1_3	cur1_4	cur1_5
eq1: Incidence of Certification				
age	0.021	0.042	0.048***	0.028
	(0.037)	(0.035)	(0.027)	(0.041)
age2	-0.00020	-0.00049	-0.00057***	-0.00041
	(0.00049)	(0.00045)	(0.00035)	(0.00053)
female	-0.019	-0.049	-0.197	-0.089
	(0.159)	(0.149)	(0.117)	(0.174)
edu_lhs	3.083	4.047	0.624	-3.215
	(52.382)	(458.566)	(0.405)	(49.750)
edu_hs	-0.474**	-0.382***	-0.203	-0.268
	(0.209)	(0.205)	(0.191)	(0.314)
edu_colnd	-0.130	-0.160	-0.123	-0.193
	(0.108)	(0.101)	(0.079)	(0.122)
edu_col2	-0.148	-0.074	-0.141	-0.271***
	(0.133)	(0.130)	(0.099)	(0.164)
edu_m	0.140	0.181	0.387*	0.185
	(0.148)	(0.142)	(0.091)	(0.127)
edu_pd	0.386	0.465	0.717*	0.352
	(0.425)	(0.421)	(0.215)	(0.272)
firm_se	0.293	0.392	1.127*	0.853*
	(0.256)	(0.248)	(0.175)	(0.226)
firm_ms	0.285*	0.271*	0.380*	0.314*
	(0.101)	(0.096)	(0.071)	(0.100)
firm_l	-0.028	-0.007	0.189	-0.036
	(0.166)	(0.161)	(0.127)	(0.201)
paidlsc	0.962*	1.011*	0.781*	0.748*
	(0.308)	(0.287)	(0.182)	(0.237)
paidlsb	0.885*	0.943*	0.837*	0.748*
	(0.326)	(0.304)	(0.197)	(0.265)
_cons	0.110	-0.388	-2.248*	-2.517*
	(0.738)	(0.686)	(0.515)	(0.773)

Table 0-10. (Continued)

Variable	cur1_2	cur1_3	cur1_4	cur1_5
eq2: Incidence of Firm's Certification Sponsorship				
firm_se	-0.789 *	-0.787 *	-0.831 *	-0.837 *
	(0.183)	(0.183)	(0.186)	(0.186)
firm_ms	0.156 **	0.156 **	0.099	0.126
	(0.078)	(0.077)	(0.078)	(0.078)
firm_l	0.184	0.175	0.177	0.192
	(0.140)	(0.140)	(0.140)	(0.142)
timetl	-0.006	-0.005	-0.028 *	-0.021 **
	(0.009)	(0.009)	(0.009)	(0.009)
fringe0_rel	0.542	0.580	0.444	0.384
	(0.447)	(0.444)	(0.425)	(0.444)
encourgy	0.219 *	0.219 *	0.236 *	0.230 *
	(0.075)	(0.074)	(0.071)	(0.074)
plans	0.158 *	0.157 *	0.146 *	0.153 *
	(0.016)	(0.016)	(0.016)	(0.016)
tenure	0.023 *	0.023 *	0.012	0.022 **
	(0.009)	(0.009)	(0.009)	(0.009)
_cons	-0.391 *	-0.402 *	-0.127	-0.245 ***
	(0.121)	(0.120)	(0.138)	(0.129)
rho	-0.540 *	-0.578 *	-0.595 *	-0.529 *
	(0.162)	(0.149)	(0.115)	(0.150)
N	1651	1651	1651	1651

Notes. Standard errors are given in the parentheses. All unmarked estimates are insignificant, * - significant at 1%, ** - significant at 5%, *** - significant at 10%.
Firm size: 1 000+ employees (firm_xl) is the base category.
Education: 4-yr college degree is the base category.

Table 0-11. ML Estimation of the Incidence of Microsoft Certification and Firm's Sponsorship, Current Workers, No Changes of Employer in 2000 and 2001.

Variable	cur01_2	cur01_3	cur01_4	cur01_5
eq1: Incidence of Certification				
age	0.039	0.060 ***	0.054 **	0.027
	(0.033)	(0.035)	(0.027)	(0.044)
age2	-0.00044	-0.00072	-0.00065 ***	-0.00041
	(0.00043)	(0.00046)	(0.00035)	(0.00056)
female	-0.039	-0.079	-0.184	-0.069
	(0.147)	(0.154)	(0.116)	(0.184)
edu_lhs	1.530	3.031	0.452	-3.237
	(3.653)	(46.665)	(0.421)	(138.220)
edu_hs	-0.404 **	-0.435 **	-0.257	-0.234
	(0.191)	(0.207)	(0.192)	(0.311)
edu_colnd	-0.111	-0.191 ***	-0.160 **	-0.342 **
	(0.102)	(0.107)	(0.081)	(0.141)
edu_col2	-0.179	-0.120	-0.168 ***	-0.502 **
	(0.121)	(0.135)	(0.099)	(0.203)
edu_m	0.050	0.113	0.356 *	0.184
	(0.133)	(0.147)	(0.093)	(0.134)
edu_pd	0.306	0.386	0.649 *	0.374
	(0.394)	(0.419)	(0.215)	(0.272)
firm_se	0.792 *	0.689 **	1.383 *	0.797 *
	(0.258)	(0.298)	(0.194)	(0.269)
firm_ms	0.161 ***	0.176 ***	0.316 *	0.279 **
	(0.097)	(0.099)	(0.076)	(0.109)
firm_l	-0.121	-0.045	0.179	-0.088
	(0.157)	(0.166)	(0.131)	(0.218)
paidlsc	1.701 *	1.200 *	1.003 *	0.885 *
	(0.154)	(0.289)	(0.170)	(0.261)
paidlsb	1.602 *	1.100 *	1.108 *	0.866 *
	(0.179)	(0.306)	(0.182)	(0.296)
_cons	-0.868	-0.821	-2.502 *	-2.570 *
	(0.622)	(0.701)	(0.516)	(0.833)

Table 0-11. (Continued)

Variable	cur01_2	cur01_3	cur01_4	cur01_5
eq2: Incidence of Firm's Certification Sponsorship				
firm_se	-0.876 *	-0.832 *	-0.890 *	-0.903 *
	(0.207)	(0.208)	(0.213)	(0.213)
firm_ms	0.150 ***	0.162 ***	0.084	0.125
	(0.081)	(0.083)	(0.083)	(0.084)
firm_l	0.141	0.166	0.170	0.183
	(0.141)	(0.146)	(0.147)	(0.149)
timetl	-0.004	-0.004	-0.029 *	-0.019 **
	(0.008)	(0.009)	(0.009)	(0.009)
fringe0_rel	0.468	0.455	0.243	0.248
	(0.434)	(0.461)	(0.423)	(0.461)
encourgy	0.200 *	0.218 *	0.246 *	0.220 *
	(0.075)	(0.079)	(0.072)	(0.079)
plans	0.132 *	0.148 *	0.130 *	0.143 *
	(0.016)	(0.016)	(0.018)	(0.017)
tenure	0.015 ***	0.017 ***	0.006	0.015 ***
	(0.008)	(0.009)	(0.009)	(0.009)
_cons	-0.190	-0.295 **	0.050	-0.128
	(0.126)	(0.128)	(0.148)	(0.139)
rho	-0.866 *	-0.655 *	-0.731 *	-0.583 *
	(0.044)	(0.139)	(0.109)	(0.165)
N	1455	1455	1455	1455

Notes. Standard errors are given in the parentheses. All unmarked estimates are insignificant, * - significant at 1%, ** - significant at 5%, *** - significant at 10%.
Firm size: 1 000+ employees (firm_xl) is the base category.
Education: 4-yr college degree is the base category.

Table 0-12. OLS Wage Regressions as a Function of Firm's Certification Sponsorship, by the Level of Skills Complexity

Variable	wage_2 (more then basic)	wage_3 (1-3 advanced)	wage_4 (2-3 advanced)	wage_5 (3 advanced)
	(1)	(2)	(3)	(4)
age	0.046 *	0.046 *	0.047 *	0.047 *
	(0.005)	(0.005)	(0.004)	(0.005)
age2	-0.00055 *	-0.00055 *	-0.00056 *	-0.00056 *
	(0.00006)	(0.00006)	(0.00006)	(0.00006)
female	-0.118 *	-0.118 *	-0.123 *	-0.122 *
	(0.016)	(0.016)	(0.016)	(0.016)
edu_lhs	0.061	0.059	0.041	0.058
	(0.073)	(0.073)	(0.068)	(0.075)
edu_hs	-0.073 *	-0.075 *	-0.072 *	-0.080 *
	(0.027)	(0.027)	(0.027)	(0.027)
edu_colnd	-0.091 *	-0.091 *	-0.086 *	-0.089 *
	(0.013)	(0.013)	(0.013)	(0.013)
edu_col2	-0.123 *	-0.123 *	-0.114 *	-0.118 *
	(0.015)	(0.015)	(0.015)	(0.015)
edu_m	0.113 *	0.113 *	0.088 *	0.114 *
	(0.016)	(0.016)	(0.015)	(0.016)
edu_pd	0.155 *	0.155 *	0.108 **	0.142 *
	(0.052)	(0.052)	(0.051)	(0.051)
firm_se	0.267 *	0.268 *	0.217 *	0.248 *
	(0.043)	(0.043)	(0.042)	(0.044)
firm_ms	0.005	0.005	-0.007	0.004
	(0.011)	(0.011)	(0.010)	(0.011)
firm_l	-0.021	-0.020	-0.020	-0.018
	(0.018)	(0.018)	(0.018)	(0.018)
ccert	0.187 *	0.170 *	0.189 *	0.263 *
	(0.017)	(0.016)	(0.012)	(0.026)
paidlscb	0.112 *	0.112 *	0.111 *	0.114 *
	(0.011)	(0.011)	(0.011)	(0.011)
_cons	9.843 *	9.861 *	9.959 *	9.985 *
	(0.086)	(0.086)	(0.083)	(0.085)
N	4498	4498	4498	4498

Notes. Standard errors are given in the parentheses. All unmarked estimates are insignificant, * - significant at 1%, ** - significant at 5%, *** - significant at 10%.
Firm size: 1 000+ employees (firm_xl) is the base category.
Education: 4-yr college degree is the base category.

Table 0-13. OLS Wage Regressions as a Function of Firm's Certification Sponsorship, by Occupations

Variable	wageocc2 (programmers)	wageocc3 (network)	wageocc4 (trainers)	wageocc5 (web and DBA)	wageocc6 (support)	wageocc7 (managers)
age	0.059 *	0.040 *	0.051 *	0.041 *	0.021 **	0.033 **
	(0.010)	(0.007)	(0.019)	(0.014)	(0.009)	(0.013)
age2	-0.00070 *	-0.00046 *	-0.00062 *	-0.00044 **	-0.00021 ***	-0.00035 **
	(0.00013)	(0.00009)	(0.00023)	(0.00019)	(0.00012)	(0.00016)
female	-0.137 *	-0.081 *	-0.127 **	-0.127 *	-0.068 **	-0.157 *
	(0.037)	(0.023)	(0.062)	(0.042)	(0.032)	(0.047)
edu_lhs	0.326 **	0.083	0.000	0.034	-0.011	-0.068
	(0.135)	(0.099)	(0.000)	(0.111)	(0.078)	(0.067)
edu_hs	0.060	0.007	-0.056	-0.120	-0.056 **	-0.098
	(0.067)	(0.036)	(0.129)	(0.082)	(0.060)	(0.066)
edu_colnd	-0.109 *	-0.048 *	-0.022	-0.027	-0.040	-0.048
	(0.035)	(0.016)	(0.066)	(0.043)	(0.026)	(0.037)
edu_col2	-0.136 **	-0.067 *	-0.056	-0.018	-0.075	-0.025
	(0.056)	(0.018)	(0.059)	(0.056)	(0.029)	(0.046)
edu_m	0.005	0.098 *	0.045	0.093 **	0.022	0.036
	(0.026)	(0.028)	(0.061)	(0.041)	(0.047)	(0.038)
edu_pd	0.066	-0.020	-0.422 ***	-0.030	-0.132 *	0.100 *
	(0.070)	(0.141)	(0.238)	(0.087)	(0.038)	(0.101)
firm_se	0.153	0.156 ***	0.332 *	0.334 *	-0.283 *	0.377
	(0.093)	(0.080)	(0.076)	(0.108)	(0.077)	(0.109)
firm_ms	0.027	-0.095 *	-0.036	-0.013	-0.088 *	0.026
	(0.023)	(0.014)	(0.047)	(0.033)	(0.026)	(0.029)
firm_l	-0.023	-0.056 **	-0.085	-0.080 ***	-0.031	0.019
	(0.041)	(0.025)	(0.073)	(0.045)	(0.040)	(0.057)
paidlscb	0.043	0.074 *	0.102 **	0.071 **	0.123 *	0.042
	(0.027)	(0.015)	(0.048)	(0.032)	(0.022)	(0.030)
_cons	9.851 *	10.125 *	9.803 *	10.130 *	10.182 *	10.343 *
	(0.190)	(0.132)	(0.359)	(0.256)	(0.186)	(0.267)
N	721	1915	302	444	564	613

Notes: Standard errors are given in the parentheses.
All unmarked estimates are insignificant, * - significant at 1%, ** - significant at 5%, *** - significant at 10%.
Firm size: 1 000+ employees (firm_xl) is the base category.
Education: 4-yr college degree is the base category.
Each regression also includes various Microsoft certificates not shown here. Respondents who defined themselves as students or unemployed together with those unable to identify themselves with any of the above-mentioned occupations are put into the "others" group. Results for this group are available upon requests.

Table 0-14. Probit Estimates of the Firm's Certification Sponsorship as a Function of Wage Premium, by the Level Of Skills Complexity

Variable	paidlscb_2 (more then basic)	paidlscb_3 (1-3 advanced)	paidlscb_4 (2-3 advanced)	paidlscb_5 (3 advanced)	paidlscb_occ (occupations)
	(1)	(2)	(3)	(4)	(5)
firm_se	-0.739 *	-0.739 *	-0.742 *	-0.742 *	-0.812 *
	(0.115)	(0.115)	(0.115)	(0.115)	(0.118)
firm_ms	0.030 *	0.030 *	0.028 *	0.028 *	0.003
	(0.044)	(0.044)	(0.044)	(0.044)	(0.045)
firm_l	-0.012 *	-0.012 *	-0.014 *	-0.013 *	-0.016
	(0.078)	(0.078)	(0.078)	(0.078)	(0.078)
timetl	-0.011 *	-0.011 *	-0.012 *	-0.012 *	-0.014 *
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
fringe0_rel	1.292 *	1.292 *	1.297 *	1.292 *	1.275 *
	(0.300)	(0.300)	(0.300)	(0.300)	(0.302)
encourgy	0.255 *	0.255 *	0.255 *	0.254 *	0.265 *
	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)
plans	0.140 *	0.140 *	0.140 *	0.140 *	0.143 *
	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)
tenure	0.040 *	0.040 *	0.040 *	0.040 *	0.040 *
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
wage_er_2	0.235 *				
	(0.065)				
wage_er_3		0.234 *			
		(0.065)			
wage_er_4			0.253 *		
			(0.066)		
wage_er_5				0.250 *	
				(0.065)	
wage_er_occ					0.188 *
					(0.058)
_cons	-0.529 *	-0.529 *	-0.520 *	-0.522 *	-0.553 *
	(0.070)	(0.070)	(0.071)	(0.071)	(0.070)
N	4498	4498	4498	4498	4498

Notes: Standard errors are given in the parentheses, all unmarked estimates are insignificant,
* - significant at 1%, ** - significant at 5%, *** - significant at 10%.
Firm size: 1 000+ employees (firm_xl) is the base category.
Education: 4-yr college degree is the base category.