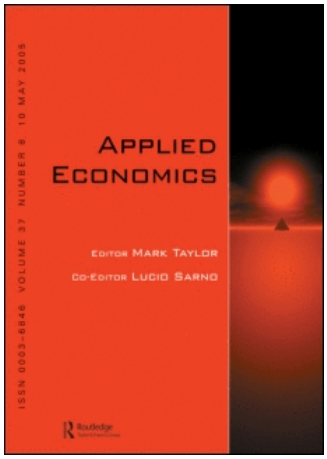

Applied Economics
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713684000

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Online Publication Date: 01 July 1996
To cite this Article: Oosterbeek, Hessel (1996) 'A decomposition of training probabilities', Applied Economics, 28:7, 799 - 805
To link to this article: DOI: 10.1080/000368496328236
URL: http://dx.doi.org/10.1080/000368496328236

Applied Economics, 1996, **28**, 799–805

A decomposition of training probabilities

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The determinants of workers' training probabilities are analysed. A distinction is made between the unconditional probability that a worker is employed by a firm that provides any training opportunities at all, and the conditional probability that the worker receives training given that s/he works for a firm that provides training. For this analysis a censored version of the bivariate probit model is applied. The results indicate that establishment size, industry dummies, type of schooling, age and experience affect only the unconditional probability, whereas the type of labour contract, working hours and job level affect only the conditional probability. Years of formal schooling affect both probabilities; more highly educated workers are both more likely to work for training-providing firms and, given that they work for such a firm, to be selected for training programmes.

I. INTRODUCTION

In many western countries, it is recognized that a well-educated workforce is a prerequisite to maintaining a high level of wealth. At the same time, it is acknowledged that systems of formal education fail to provide the workforce with all the required productive skills. Consequently, attention is shifting to other forms of human capital formation, including firm-based training of employees. In her introduction to a recent international comparison of private sector training, Lynch (1994) notes that '. . . employer-provided training creates significant gains for both workers and firms. Productivity is higher in firms with a better-trained work force, and wages are higher for individuals who acquire post-school training, especially general training.'

If training is so profitable, it is important to know which factors determine who receives training and who does not. Several studies have addressed this question (Altonji and Spletzer, 1991; Barron *et al*., 1987; Booth, 1991; Greenhalgh and Stewart, 1987; Groot *et al*., 1994; Lillard and Tan, 1986; Lynch, 1992). The general picture that emerges is that younger and more highly educated workers are more likely to receive training, as are workers who are employed in larger firms. Furthermore, training probabilities differ from one industry to another. Most studies employ micro data on individual workers. An exception is that by Alba-Ramirez (1994), who analysed the issue from the perspective of firms. In his (Spanish) dataset, 41% of the firms indicated that they did not provide training for their workers in 1988 (the survey year).[1] He reports that the probability of a firm providing firm-based training increases in line with (among other factors): the number of workers, the fraction of output exported, the fractions of high-level managers and clerical workers and the fraction of employees sharing profits.

The findings of both the employee-based and firm-based studies are broadly consistent with theoretical notions. Workers who are supposed to have a comparative advantage in their costs and/or benefits to human capital acquisition are more likely to receive training, and training is more likely in large firms, where staff turnover is lower and there is, accordingly, less probability of a loss of human capital to the firm.

One important insight to be gained from Alba-Ramirez is that it appears that not all firms provide firm training. Whether a particular employee receives training depends therefore upon two mechanisms. First, the employer has to provide training opportunities and, second, if the employer provides training opportunities, the particular employee has to be selected for a training programme. The literature published so far does not distinguish between these two mechanisms. The present study attempts to fill this gap by

[1] This percentage is probably an underestimate of the figure for all Spanish firms as the dataset only includes firms with at least 200 employees.

using information from a survey of employees, who were asked the following two questions:

1. Does the company you work for organize courses or programmes for its own employees?
2. Have you participated in such a course or programme over the past two years, or are you participating in one at present?

Whereas previous studies analysed the determinants of training using only the second question, information from both questions is used here.

The distinction between the two mechanisms might be important from a policy perspective. It is sometimes argued that the high rate of return to training points to a failure in the training market. If we know which of the two mechanisms is the cause of low investment in training, this might suggest that certain policy instruments are more or less useful.

Section II outlines the statistical model employed in the empirical analysis. Section III describes the data source. Section IV presents and discusses the estimation results. Section V summarizes and concludes.

II. STATISTICAL MODEL

The two dependent variables in the analysis are both binary: whether or not the employee works for a firm that provides training, and whether or not the worker has participated/is participating in a training programme. One of the dependent variables, however, is censored. We cannot observe whether employees who work for a firm that does not provide training would have participated had they worked for a firm that did so. The bivariate probit model with censoring was first proposed by Van de Ven and Van Praag (1981), and is described in Greene (1990, p. 664).

Let y_1^* be a latent variable that measures the net gains from training provision by the firm, and let y_2^* be a latent variable that measures the net gains from a worker's participation in a training programme. y_i^* is affected by a vector of observed explanatory variables x_i and a disturbance term ε_i. The latent variables y_1^* and y_2^* are not observed. Instead, we observe the dichotomous realizations y_1 and y_2. The following model structure is proposed:

$$y_1^* = \beta_1' x_1 + \varepsilon_1, \quad y_1 = 1 \text{ if } y_1^* > 0, 0 \text{ otherwise}$$

$$y_2^* = \beta_2' x_2 + \varepsilon_2, \quad y_2 = 1 \text{ if } y_2^* > 0, 0 \text{ otherwise}$$

The disturbance terms ε_1 and ε_2 are assumed to follow a joint normal distribution with $E[\varepsilon_1] = E[\varepsilon_2] = 0$, $Var[\varepsilon_1] = Var[\varepsilon_2] = 1$ and $Cov[\varepsilon_1, \varepsilon_2] = \rho$.

With these assumptions, the log-likelihood function reads

$$\begin{aligned} LogL = {} & \Sigma_{y_1=0} \log[1 - \Phi(\beta_1' x_1)] \\ & + \Sigma_{y_1=1,\, y_2=0} \log \Phi_2(\beta_1' x_1, -\beta_2' x_2, -\rho) \\ & + \Sigma_{y_1=1,\, y_2=1} \log \Phi_2(\beta_1' x_1, \beta_2' x_2, \rho), \end{aligned}$$

where Φ is the distribution function of the univariate normal and Φ_2 is the distribution function of the bivariate normal. The first term on the right-hand side relates to the censored observations for employees who work with firms that do not provide training slots. The second and third term relate, respectively, to the untrained and the trained workers in firms that do provide training opportunities.

It is tempting to interpret the two mechanisms in terms of a supply and demand framework, in which the provision of training by firms is related to supply and the participation in training by employees in related to demand. However, such an interpretation is false. Both dependent variables are influenced by supply-side and demand-side relations. Firms may decide whether or not to provide any training opportunities, and employees decide whether or not to work for a particular firm. Also, whether or not a particular employee enrols in a training programme can best be seen as a joint decision by the firm and the employee; enrolment has to be beneficial (*ex ante*) for both parties. With cross-section observations there is no scope to disentangle the influences of the two sides of the training market.[2] At best, the estimated equations are interpreted in a hedonic vein.

III. DATA

The data are taken from the OSA labour supply survey. This is a panel survey among Dutch households that had its first wave in 1985. Subsequent waves relate to 1986, 1988, 1990 and 1992. About 4000 persons were interviewed for each wave, but, due to panel attrition, only 1115 respondents participated in all five waves. The two questions about training cited above were included in the 1990 and 1992 questionnaires. For the present analysis, the information from the 1992 wave is used.

After deleting all respondents who were not in employment and all cases with missing values for at least one of the dependent or explanatory variables, 2171 observations remain. Of these, 1391 work for an employer who organizes training. Of these, 632 had actually participated in a training programme during the period 1990–92. Hence, the three terms of the log-likelihood function relate to 780, 759 and 632 cases respectively.

The explanatory variables used in the analysis can be divided into four categories: personal attributes, education, firm characteristics and job characteristics.

[2] Although the dataset used relates to a panel, the information about training is included in two waves only (see Section III).

The personal attributes are the continuous variables of age, tenure and experience and dummy variables for non-Dutch, married and male. The level of education of the respondent's father is also included. Age is included since the potential benefits of training vary directly in line with the worker's age. The younger the worker, the longer the payoff period. Tenure and experience are included as indices of the firm and labour market attachment of the worker. Workers with longer tenure (experience) are more likely to remain with the firm (labour market) and are, therefore, a less risky object for the firm to invest in. This effect may be countered by the fact that it is worthwhile for firms to train recently hired workers because they have a lot to learn about their job and firm. Females may receive less training than males because of their presumed weaker attachment to the labour market. However, as Booth (1991) points out, a lower training probability for females may also result from discrimination. The same effect may emerge for non-Dutch workers. The father's level of education is included as it is assumed to proxy the worker's individual discount rate. Those from lower social backgrounds are believed to have higher discount rates. Since enrolment in a training programme may place workers on a steeper tenure-earnings profile, workers with high discount rates may be less inclined to choose such a track.

The inclusion of years of formal schooling in the list of explanatory variables is motivated by the idea that a higher level of schooling reflects a higher learning ability and, therefore, better trainability. Furthermore, dummy variables relating to the type of formal schooling in which the worker obtained his/her highest qualification are included. This reflects the idea that certain types of formal schooling have a higher probability of leading to lifelong learning than other types.

The firm characteristics that are included are the size of the establishment at which the employee works, and a series of industry dummies. The size of the establishment is likely to be related to the worker's career opportunities within the firm. The better these opportunities, the lower the probability of the training investment being wasted because the worker leaves the company. Moreover, large firms are likely to have a cost advantage over small firms in the provision of firm training. It would have been worthwhile to include indicators of the firm's (physical) capital intensity or the degree to which it is exposed to competition. However, such information is not included in the dataset, so it has to be assumed that the industry dummies capture such effects.

Finally, three job characteristics are included in the list of regressors. These are: (i) a dummy variable that equals one if the worker has a permanent contract (and zero otherwise); (ii) the number of working hours per week; and (iii) the level of the position that the respondent occupies, measured on a scale from one (lowest) to seven (highest). Workers with a permanent contract are assumed to have a higher training probability as they are less likely to leave or to be dismissed. Workers with longer working hours are also more likely to receive training as the amount of time available to reap the training returns is larger. With regard to the effect of job level on the training probability, Altonji and Spletzer (1991) argue that higher job-skill requirements increase both the marginal productivity of knowledge and the effect of training activities on knowledge (p. 73); they, therefore, predict that employees in high-level jobs are more likely to receive training.

Appendix A describes each of the variables and also reports the mean values and standard deviations for each variable separately for each of the three groups of workers ($y_1 = 0$; $y_1 = 1$ and $y_2 = 0$; $y_1 = 1$ and $y_2 = 1$).

IV. RESULTS

The estimation results are presented in Table 1. The first column contains the estimates for the univariate probit equation in which the dependent variable is whether or not the worker obtained firm training, irrespective of whether or not the firm provided training opportunities. These results are comparable with the usual analyses about the determinants of firm training.

The results of the univariate model are in line with earlier findings. Older and less highly educated workers have a lower training probability, as do workers in small establishments. Other things being equal, workers with only primary education are 46 percentage points less likely to receive firm training than university graduates. This positive correlation between formal schooling and firm training has implications for studies on the rate of return to formal schooling. Just as this rate of return may be biased due to the omission of ability or due to self-selection effects (see, for example, Willis 1986), there may also be a training bias. To the extent that the worker contributes to the costs of firm training in forms other than reduced earnings – leisure, for instance – but receives returns to training in the form of higher earnings, omission of firm training in the list of regressors in an earnings equation biases the return to formal education in an upward direction.

The training probability is influenced not only by the number of years of schooling, but also by the type of schooling. Employees with a background in economics are more likely to receive further training than those specialized in the technical field (the reference category). It is also influenced by the sector of industry, number of working hours, type of contract (permanent *versus* temporary) and job level. Employees in the agricultural sector, the textiles/clothing industry and the trade sector are less likely to receive training than those in non-commercial services (the reference category).

The estimation results regarding the effects of job characteristics confirm the theoretical predictions. A larger number of working hours per week increases the training

Table 1. *Estimation results*

	Univariate probit	Bivariate probit	
		Firm provides training	Worker receives training
constant	− 1.658 (5.51)**	− 0.073 (0.26)	− 1.275 (2.35)**
personal characteristics			
age	− 0.019 (2.83)**	− 0.016 (2.60)**	− 0.014 (1.56)
non-Dutch	− 0.048 (0.27)	0.425 (2.16)**	− 0.292 (1.37)
married	0.090 (1.16)	0.114 (1.44)	0.036 (0.37)
female	− 0.030 (0.34)	− 0.090 (1.02)	0.002 (0.02)
education father	0.000 (0.03)	0.006 (0.31)	− 0.004 (0.17)
experience	0.002 (0.30)	0.011 (1.82)*	− 0.007 (0.85)
tenure	0.000 (1.25)	0.000 (0.01)	0.001 (1.47)
education			
years of schooling	0.065 (4.71)**	0.042 (3.16)**	0.058 (2.94)**
general	− 0.071 (0.82)	0.003 (0.04)	− 0.105 (1.03)
agricultural	− 0.008 (0.04)	0.163 (0.76)	− 0.151 (0.61)
transport	− 0.119 (0.51)	− 0.233 (0.99)	0.065 (0.21)
medical	0.095 (0.58)	0.317 (1.71)*	− 0.072 (0.36)
economics	0.187 (2.03)**	0.112 (1.19)	0.167 (1.46)
social	0.268 (1.64)	0.269 (1.50)	0.134 (0.66)
home economics	0.018 (0.14)	− 0.068 (0.55)	0.044 (0.26)
other	0.118 (0.52)	0.671 (2.31)**	− 0.182 (0.63)
firm characteristics			
agricultural	− 0.613 (1.77)*	− 0.993 (3.22)**	0.027 (0.05)
textiles/clothing	− 0.215 (1.86)*	− 0.125 (1.10)	− 0.203 (1.48)
electronic industry	− 0.170 (1.39)	− 0.092 (0.72)	− 0.178 (1.22)
public utilities	0.220 (1.00)	0.498 (1.71)*	− 0.004 (0.02)
building/construction	− 0.116 (0.88)	− 0.365 (2.80)**	0.138 (0.70)
trade	− 0.267 (2.63)**	− 0.315 (3.25)**	− 0.102 (0.64)
transport	0.075 (0.58)	− 0.096 (0.71)	0.180 (1.15)
commercial services	− 0.038 (0.36)	− 0.005 (0.05)	− 0.029 (0.23)
sector missing	− 0.188 (1.18)	− 0.236 (1.53)	− 0.103 (0.54)
firm size/1000	0.138 (3.87)**	0.556 (23.6)**	− 0.006 (0.07)
job characteristics			
permanent contract	0.538 (4.34)**	0.090 (0.84)	0.644 (4.47)**
working hours	0.009 (2.04)**	0.002 (0.50)	0.010 (1.81)*
job level	0.045 (1.98)**	0.025 (1.11)	0.052 (1.84)*
ρ		− 0.026 (0.05)	
Log-likelihood	− 1214.28	− 2183.69	
number of observations	2171	2171	

Note: ** Indicates significance at the 5% level; * indicates significance at the 10% level.

probability; evaluated at the mean values of the explanatory variables, a one hour increase in the working week increases the training probability by 0.3 percentage points. Workers with a permanent contract are more likely to receive training; again evaluated at the mean values of the explanatory variables, the training probability of workers with a permanent contract is 17 percentage points higher than that of temporary workers. Workers who occupy high-level jobs are more likely to enrol in training programmes than workers in low-level jobs.

Contrary to earlier results, there appears to be no significant gender effect. However, if the model is estimated without the job characteristics, job level, permanent contract and working hours in the list of regressors, the gender effect reappears. Females are then less likely to enrol in a training programme. This result modifies earlier findings which hint that training probabilities for otherwise identical men and women differ considerably (for example, Booth, 1991, p. 287). It suggests that women are not less likely to receive training *per se*, but that they hold jobs offering fewer training opportunities.

No effect was found to result from either tenure or total working experience. Since age, tenure and experience are correlated, experiments were carried out with different

combinations of these variables. If tenure or experience are excluded, the age coefficient remains significantly different from zero and the experience or tenure coefficient has no significant coefficient. If age is excluded from the equation, the coefficient of experience catches the age effect. The model was also estimated with the squared values of these variables added. Especially with regard to the effect of tenure, a parabolic relation with the training probability seems likely. In that view, workers with very short or long tenures are those who obtain training. The estimations, however, gave no support for this hypothesis.

The results in the last two columns of Table 1 represent the model described in Section II. The results in the second column relate to the probability of the firm for which the employee works offering training opportunities. The results in the third column relate to the conditional probability that the worker receives training given that his/her employer offers training opportunities.

The results reveal some pleasing regularities. The characteristics of the firm affect only the probability that the worker is employed by a training-providing firm, while job characteristics change only the conditional probability that the worker receives training, given that s/he is employed by a training-providing firm. With the exception of years of formal schooling, the personal and schooling variables with significant coefficients affect only the probability of working for a training-providing firm.

Older workers have a lower probability of working for a firm that offers training opportunities, but given that a worker is employed by a firm that provides training, the worker's age has no influence on the probability of his/her being selected for a training programme. A similar result holds for non-Dutch and more experienced workers. For these variables, however, the joint effect of the two mechanisms (as measured in the first column) is apparently zero.

The variable years of schooling enters both the unconditional and the conditional probit with a positive coefficient. Workers who are more highly educated have a higher probability of working for a firm that provides training and, given that they work for such a firm, they are more likely to receive training. Two dummy variables for type of education (medical and 'other') have a significant coefficient in the second column, while none of the type dummies enters the conditional probit in the third column with a significant coefficient. Hence, the type of schooling may affect whether a worker is employed by a training-providing firm, but does not influence the training probability given that a worker works for such a company.

Whether or not a firm offers training opportunities varies across industries and in line with firm size. Large firms are more likely to offer training opportunities than small firms. Training is also less likely in the agricultural sector, the textiles/clothing industry, building and construction, the trading sector and the transport sector, than it is in non-commercial services. Training provision is more likely in the public utilities sector. Training differentials between industries have been analysed in Boot (1989) and OECD (1991). Boot finds that technological diffusion and the proportion of small and medium-sized firms are important determinants of an industry's training effort. The higher the level of technological diffusion, the higher the training effort, and the higher the proportion of small and medium-sized firms, the lower the training effort. Those industries with lower training probabilities are, typically, industries that are associated with a low degree of technological progress and/or a high proportion of small and medium-sized firms (see, for example, Aalders, 1994).

The fact that the variables measuring firm characteristics have coefficients that differ significantly from zero only in the second column and not in the third, implies that the probability of a firm providing any training at all differs in line with the firm characteristics, but that the probability of a particular worker receiving training, given that s/he works with a training-providing firm, does not vary in response to these characteristics. This, in turn, implies that, among the training-providing firms, the training intensity is constant across firm size and industries.

Employees with a permanent contract have higher training probabilities than non-permanent workers. This is because they are more likely to receive training if their employer provides any, and not because they are more likely to be employed in firms offering training opportunities. The same is true for workers with longer working hours and for those in high-level jobs. These job attributes do not increase the probability of working for a training-providing firm, but do increase the probability of being selected for a training programme.

The correlation coefficient between the error terms of the two-probit equations (ρ) does not differ significantly from zero. The two mechanisms that determine whether a worker receives training operate independently. This implies that almost identical results would have been obtained from two separate probit equations (one on the full sample, and the other on the sub-sample of employees of training-providing firms). This is a quite valuable result since it indicates that to obtain unbiased estimates of the training equation only requires conditioning on employment with a firm that provides training opportunities.

V. CONCLUSION

In this analysis of the determinants of workers' training probabilities a distinction was made between two different components of this probability. First, the unconditional probability that a worker is employed by a firm that provides any training opportunities at all. Second, the conditional probability that the worker receives training given that s/he works for a firm that provides training.

The results indicate that establishment size, industry dummies, type of schooling, age and experience affect only the probability of working for a firm that provides training, whereas the type of labour contract, working hours and job level affect only the conditional probability of receiving training given that the firm provides it. Years of formal schooling is the only variable that affects both probabilities; more highly educated workers are more likely to work for training-providing firms and, given that they work for such a firm, they are more likely to be selected for training programs. Furthermore, the two mechanisms that determine whether a worker receives training appears to operate independently.

These results give some hints as to what kind of government policies might be most effective with regard to firm training. First, firms with small establishments are unlikely to provide training, but if they do so, they provide it with the same intensity as firms with large establishments. This suggests that firms with small establishments have problems with starting the provision of training. Government could help to solve these problems by providing special starting subsidies to small firms which do not have training programmes. Second, workers with more years of formal schooling have a higher training probability. Apparently, more highly educated workers have a cost and/or benefit advantage in training. The result is that the unequal distribution of formal schooling among the workforce is aggravated through the distribution of training by firms. A sensible policy for governments wishing to combat this inequality would be to issue vouchers that could be used for both formal schooling and firm training, as proposed by Levin (1983). Workers with only a small amount of formal schooling would then have a substantial remaining package of vouchers, which would give them a cost advantage in firm training. Finally, if the aim of government was to increase the training intensity within firms that already provide training, the results described above suggest that policy instruments should be directed towards particular jobs rather than particular types of workers or firms.

ACKNOWLEDGEMENTS

The author gratefully acknowledges helpful comments by Carsten Folkertsma, Joop Hartog, Coen Teulings and an anonymous referee.

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APPENDIX A: DESCRIPTION OF VARIABLES; MEANS AND (IN BRACKETS) STANDARD DEVIATIONS

	$y_1 = 0, y_2 = 0$	$y_1 = 1, y_2 = 0$	$y_1 = 1, y_2 = 1$
Personal characteristics			
Age	37.6 (10.8)	38.7 (10.5)	36.6 (9.4)
Non-Dutch (dummy)	0.019 (0.14)	0.042 (0.20)	0.025 (0.16)
Married: dummy equal to 1 if the respondent is married or living with a partner; 0 otherwise	0.76 (0.43)	0.80 (0.40)	0.78 (0.42)
Female (dummy)	0.38 (0.49)	0.35 (0.48)	0.32 (0.48)
Education father: level of education of the head of the household when the respondent was aged 12 (scale 1–6)	3.41 (1.48)	3.51 (1.53)	3.62 (1.57)
Experience: actual labour market experience in years	17.3 (11.1)	18.7 (11.1)	16.8 (9.9)
Tenure: tenure with the present employer in months	86.7 (110.2)	93.5 (109.9)	92.5 (104.4)
Education			
Years of schooling: years nominally required to obtain the respondent's highest certificate	9.94 (2.79)	10.49 (2.79)	11.4 (2.43)
General (dummy)	0.268 (0.44)	0.269 (0.44)	0.217 (0.41)
Agricultural (dummy)	0.024 (0.15)	0.025 (0.16)	0.021 (0.14)
Transport (dummy)	0.022 (0.15)	0.016 (0.12)	0.017 (0.13)
Medical (dummy)	0.024 (0.15)	0.050 (0.22)	0.049 (0.22)
Economics (dummy)	0.159 (0.37)	0.163 (0.37)	0.237 (0.43)
Social (dummy)	0.019 (0.14)	0.038 (0.19)	0.062 (0.24)
Home economics (dummy)	0.088 (0.28)	0.070 (0.26)	0.066 (0.25)
Other (dummy)	0.006 (0.08)	0.024 (0.15)	0.020 (0.14)
Firm characteristics			
Agricultural (dummy)	0.024 (0.15)	0.007 (0.08)	0.005 (0.07)
Textiles/clothing (dummy)	0.087 (0.28)	0.111 (0.31)	0.085 (0.28)
Electro-technical (dummy)	0.072 (0.26)	0.096 (0.30)	0.082 (0.28)
Public utilities (dummy)	0.008 (0.09)	0.021 (0.14)	0.025 (0.16)
Building/construction (dummy)	0.097 (0.30)	0.051 (0.22)	0.066 (0.25)
Trade (dummy)	0.214 (0.41)	0.138 (0.35)	0.108 (0.31)
Transport (dummy)	0.071 (0.26)	0.065 (0.25)	0.082 (0.28)
Commercial services (dummy)	0.088 (0.28)	0.105 (0.31)	0.123 (0.33)
Sector missing (dummy)	0.050 (0.22)	0.042 (0.20)	0.036 (0.19)
Establishment size: in persons	105 (459)	458 (903)	476 (898)
Job characteristics			
Permanent contract: dummy equal to 1 if the respondent has a permanent contract; 0 otherwise	0.906 (0.29)	0.896 (0.31)	0.959 (0.20)
Working hours: number of contractual working hours per week	33.9 (10.7)	34.2 (9.14)	36.0 (7.90)
Job level: job level measured on a scale from 1 (lowest) to 7 (highest)	3.56 (1.68)	3.83 (1.64)	4.20 (1.55)
Number of observations	780	759	632