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11 Returns to Within-Company Schooling of Employees: The Case of the Netherlands

Wim Groot, Joop Hartog, and Hessel Oosterbeek

11.1 Introduction

This paper adds to the existing literature on the returns to company training by using a self-selection model for calculating both the wage and welfare effects of within-company schooling in the Netherlands. Earlier research on the returns to within-company training includes Mincer (1988), Barron, Black, and Loewenstein (1989), Brown (1989), Holzer (1988), Lynch (1992), Lillard and Tan (1986), and Booth (1991). A survey of this research leads to the conclusion that the wage effects of within-company job training are between 4 and 16 percent. Within-company schooling is defined in this paper as courses and schooling organized by a company and accessible to employees of that company. These courses can be taken either within the company itself or at some outside training institution. Also, they can be organized either for employees of the company only or for employees of other companies as well. The outline of this paper is as follows: In section 11.2, we describe the model and the estimation method; the data are described in section 11.3; estimation results are presented in section 11.4; and section 11.5 concludes.

11.2 Model and Estimation Method

We assume that there are separate wage regimes for workers who have participated in within-company schooling and for workers who have not. Both wage equations have the usual semilogarithmic form, in which the log of the wage rate is a linear function of a vector of human capital variables (X) with coefficients (β). The wage rates for those who have participated and for those

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who have not are denoted by w_1 and w_2, respectively. We further assume that the decision whether to participate is governed by weighing the costs and benefits of the investment. The investment costs are assumed to be a linear function of individual characteristics (Y) and associated coefficients (β_3). The benefits of investing in within-company schooling are represented by the percentage wage gain: ($\log w_1 - \log w_2$). Finally, let I be an index function describing the investment decision. The model is summarized in equations (1)–(3).

$$\log w_1 = \beta_1 X + \varepsilon_1, \text{ if } I = 1, \tag{1}$$

$$\log w_2 = \beta_2 X + \varepsilon_2, \text{ if } I = 0, \text{ and} \tag{2}$$

$$I^* = (\log w_1 - \log w_2) - \beta_3 Y + \varepsilon_3, \tag{3}$$

where $I = 1$ iff $I^* > 0$, and $I = 0$ iff $I^* \leq 0$, and ε_1, ε_2, and ε_3 are identically and independently normal distributed random terms capturing unmeasured and unmeasurable variables.

Substitution of the wage equations into the selection equation (3) yields

$$\begin{aligned} I^* &= (\beta_1 - \beta_2)X - \beta_3 Y + \varepsilon_3 + \varepsilon_1 - \varepsilon_2 \\ &= (\beta_1 - \beta_2)X - \beta_3 Y + \mu. \end{aligned} \tag{3a}$$

The simultaneous equations system (1), (2), and (3a) will be estimated by maximum likelihood. Let ρ_1 be the correlation coefficient between ε_1 and μ, and ρ_2 the correlation coefficient between ε_2 and μ. Further, let $f(\varepsilon_1, \mu, \rho_1)$ be the bivariate density function of ε_1 and μ, and $f(\varepsilon_2, \mu, \rho_2)$ the bivariate density of ε_2 and μ. The likelihood function of the switching regression model is

$$L = \Pi_{I>0} \int_{-J}^{\infty} f(\varepsilon_1, \mu, \rho_1) d\mu \; \Pi_{I=0} \int_{-\infty}^{-J} f(\varepsilon_2, \mu, \rho_2) \, d\mu, \tag{4}$$

where $J = ((\beta_1 - \beta_2)\, X - \beta_3 Y) / \sigma_3$.[1] The distribution is characterized by $E(\varepsilon_1)^2 = \sigma_1^2$, $E(\varepsilon_2)^2 = \sigma_2^2$, $E(\mu)^2 = \sigma_3^2$, $E(\varepsilon_2 \mu) = \rho_1 \sigma_1$, and $E(\varepsilon_2 \mu) = \rho_2 \sigma_2$.

The wage gain to within-company schooling can be calculated by the difference between the expected log of the wage rate with company schooling and the expected value of the log wage rate without company schooling. Because of self-selection, the wage gains differ between participants and non-participants. First, we discuss the wage gain for participants. Let $E(\log w_1 | I = 1, X, \beta_1)$ be the expected value of the log wage rate with company schooling for those who have participated in within-company schooling ($I = 1$) for a worker with characteristics X, and let $E(\log w_2 | I = 1, X, \beta_2)$ be the expected wage rate a participant would have received if she had not participated in within-company schooling. The wage gain for participants in within-company schooling is

1. Usually in these types of switching regression models a coefficient for the wage differential is identified. However, since this coefficient has no natural interpretation in our model, we identify the variance of the cost/benefit equation, σ_3.

$$(5)\quad E(\log w_1 | I = 1, X, \beta_1) - E(\log w_2 | I = 1, X, \beta_2) = (\beta_1 - \beta_2)X + (\rho_1\sigma_1 - \rho_2\sigma_2)\varphi(-J)/(1 - \Phi(-J)),$$

where φ is the density function and Φ the distribution function of the standard normal.

The total wage gain or conditional wage gain can be decomposed into a participation effect $(\beta_1 - \beta_2)X$ and a self-selection effect $(\rho_1\sigma_1 - \rho_2\sigma_2)\varphi(-J)/(1 - \Phi(-J))$. The participation effect corresponds to the unconditional wage gain, i.e., the expected wage gain prior to the investment decision. The sign of the self-selection effect is determined by $(\rho_1\sigma_2 - \rho_2\sigma_2)$. If each group has an absolute advantage in the alternative it has chosen, i.e., if participants in within-company schooling are better off with company schooling and nonparticipants are better off without it, then $\rho_1 > 0$ and $\rho_2 < 0$. In this case, the self-selection term is positive, and the conditional wage gain for participants exceeds the unconditional wage gain.

In a similar way, we can determine the wage gain nonparticipants would have received, had they participated in within-company schooling. Let $E(\log w_1 | I = 0, X, \beta_1)$ be the expected value of the log wage rate nonparticipants $(I = 0)$ would have received had they participated in within-company schooling, and let $E(\log w_2 | I = 0, X, \beta_2)$ be the expected wage rate a nonparticipant receives without company schooling. The expected wage gain of within-company schooling for nonparticipants is now

$$(6)\quad E(\log w_1 | I = 0, X, \beta_1) - E(\log w_2 | I = 0, X, \beta_2) = (\beta_1 - \beta_2)X - (\rho_1\sigma_1 - \rho_1\sigma_2)\varphi(-J) / \Phi(-J).$$

Again, if each group has an absolute advantage in the alternative chosen, the self-selection effect is negative and the conditional wage gain for nonparticipants is less than both the unconditional wage gain and the wage gain for participants.

If we subtract the costs of within-company schooling from the wage gain, we have the net value of within-company schooling. This net value is termed the "welfare gain" by Bjorklund and Moffitt (1987). The costs of within-company schooling are represented by $\beta_3 Y$ in the selection equation. The balance of costs and benefits is denoted by I^*. As with wage gains, welfare gains differ between participants and nonparticipants. Let $E(I^* | I = 1, X, Y, \beta)$ be the expected welfare gains for participants $(I = 1)$, and $E(I^* | I = 0, X, Y, \beta)$ the expected welfare gains for nonparticipants $(I = 0)$. The welfare gains for participants are calculated by

$$(7)\quad E(I^* | I = 1, X, Y, \beta) = (\beta_1 - \beta_2)X - \beta_3 Y + \sigma_3\varphi(-J)/(1 - \Phi(-J)).$$

The expected welfare gains for nonparticipants are

$$(8) \quad E(I^* \mid I = 0, X, Y, \beta) = (\beta_1 - \beta_2)X - \beta_3 Y - \sigma_3 \varphi(-J)/\Phi(-J).$$

11.3 The Data

The data are taken from the Brabant survey of 1983. This data set contains information on 2,587 individuals who were in the sixth grade of primary school in the Dutch province of Brabant in 1952. These individuals were interviewed in 1952 and in 1983. The 1952 records include information on IQ and social background. The 1983 questionnaire included questions about postprimary (i.e., postcompulsory) schooling careers, enterprise-related schooling, present job status, earnings, etc. (details of the survey can be found in Hartog 1989).

From this data set we have taken a subsample of wage earners. After eliminating observations with missing values on essential variables, 1,057 observations were available for analysis. So, the data are a cohort of employees who were approximately 43 years old in 1983.

The human capital variable (X) in the wage equation includes years of education after primary school, years of work experience, work experience squared, and IQ. In the wage equation, we further include job level (1 = low, 7 = high) and gender (1 = female, 0 = male). The cost of the investment in enterprise-related schooling (Y) is assumed to be a linear function of work experience, four dummy variables for the highest educational level attained, IQ, gender, and a dummy variable indicating whether the highest education attained was general education. The four education dummy variables are coded as follows: (1) school after primary school but no certificate was obtained (dropout); (2) lower vocational and lower general education (low); (3) intermediate vocational and intermediate general education (intermediate); and (4) higher vocational education and university (high).

Table 11.1 contains some sample characteristics. For the entire sample, the following conclusions can be drawn from the descriptive statistics: (1) About a quarter of the workers have invested in within-company schooling. (2) An average worker in our sample has about four and a half years of postcompulsory education. About 60 percent have a general education. (3) Almost 82 percent of the workers are male.

From a comparison of the participants and nonparticipants, the following conclusions can be drawn: (1) On average, participants in within-company schooling earn about 11 percent more than nonparticipants. (2) Participants have invested less in formal education than nonparticipants. Workers with general education are underrepresented among the participants. (3) The average IQ of participants is higher than that of nonparticipants. (4) Women are underrepresented among the participants. (5) On average, participants have higher job levels than nonparticipants.

Table 11.1 Sample Means (standard deviation in parentheses)

	Total Sample	Participants	Nonparticipants
N	1,057	268	789
Participate in within-company schooling	0.25	1	0
Log wage rate	2.71	2.79	2.68
	(0.43)	(0.36)	(0.45)
Years of education after primary school	4.61	4.37	4.69
	(3.79)	(2.96)	(4.03)
Years of work experience	25.28	26.11	25.00
	(4.42)	(3.60)	(4.63)
IQ	103.38	105.35	102.70
	(13.38)	(12.52)	(13.84)
Gender	0.18	0.05	0.23
Education			
Dropout	0.49	0.63	0.45
Low	0.16	0.16	0.17
Intermediate	0.15	0.12	0.16
High	0.05	0.01	0.06
General education	0.61	0.57	0.62
Job level	4.60	4.82	4.52
	(1.69)	(1.44)	(1.77)

11.4 Estimation Results

Table 11.2 contains the estimation results. The most interesting findings in the selection equation are those on educational levels. The reference category consists of workers with primary school only. For the lowest category (dropout) the coefficient is significantly positive, for the middle categories (low and intermediate) the coefficients are insignificant, and for the highest category (high) the coefficient is significantly negative. These results imply that within-company schooling and educational dropout are complements, that within-company schooling and low or intermediate education are independent, and that within-company schooling and higher education are substitutes.

Capabilities, measured by IQ, and within-company schooling are complements. The investment in within-company schooling increases with experience as well. Finally, women invest less in within-company schooling than do men. Comparing the two schooling regimes according to the coefficients in the wage equations gives an impression of the productivity-augmenting effects of enterprise-related schooling.

The returns to postcompulsory formal education are not affected by the investment in enterprise-related schooling. The rate of return to a year of postcompulsory schooling is 2.5 percent for those without company schooling. The rather low estimate of the rate of return to formal schooling is partly due to the inclusion of IQ and of demand-side variables (i.e., job level) in the wage equation. Somewhat surprisingly, the coefficient of the schooling variable is measured somewhat imprecisely in the post-company-schooling wage equation.

Table 11.2 **Parameter Estimates (*t*-values in parentheses)**

Parameter	Wage Equation		Selection Equation, β_3
	With Company Schooling, β_1	Without Company Schooling, β_2	
Intercept	−0.061	1.684**	−3.805**
	(0.079)	(6.108)	(4.402)
Experience	0.143*	0.019	0.035*
	(2.040)	(0.842)	(2.066)
(Experience)²/100	−0.296	−0.036	
	(1.854)	(0.698)	
Years of education	0.021	0.025**	
	(1.540)	(5.219)	
Education			
Dropout			0.476**
			(3.079)
Low			0.180
			(0.968)
Intermediate			0.043
			(0.206)
High			−1.259**
			(4.047)
General education			−0.025
			(0.274)
Gender	−0.501**	−0.221**	−1.158**
	(3.580)	(5.996)	(4.029)
IQ[a]	0.607*	0.463**	0.018**
	(1.972)	(3.505)	(3.725)
Job level	0.026	0.073**	
	(1.148)	(5.682)	
σ	0.407**	0.427**	1.246
	(26.005)	(40.680)	(0.995)
ρ	0.751**	−0.758**	
	(22.598)	(23.999)	
Log likelihood		−943.037	

[a]IQ was divided by 100 in the wage equations.

*Significant at the 5 percent level.

**Significant at the 1 percent level.

Only in the post-company-schooling wage equation is there a pronounced experience/wage profile; in the wage equation without company schooling both experience variables are insignificant. Moreover, in absolute terms, the magnitude of the coefficients of the experience variables are larger in the post-company-schooling wage equation, implying a steeper experience profile. These findings corroborate the human capital hypothesis that the concave experience profile is caused by investments in on-the-job training.

The returns to job level decrease with participation in within-company

Table 11.3 **Wage and Welfare Gains of Participation in Within-Company Schooling**

	Wage Gain	Welfare Gain
Unconditional	−0.408	0.353
Participants	0.212	1.891
Nonparticipants	−0.803	−0.421

schooling. Without company schooling, the wage rate increases with each job level by approximately 7.3 percent; with enterprise-related schooling this increase is only about 2.6 percent. The male-female wage differential is much larger in the wage equation with company schooling than in that without. Without company, schooling women earn 22 percent less than men; with company schooling the differential is 50 percent. The findings imply that the rate of return to enterprise-related schooling for women is less than the return for men. This lower rate of return explains why women invest less in within-company schooling.

The signs of the correlation coefficients, $\rho_1 > 0$ and $\rho_2 < 0$, imply that the allocation of workers into within-company schooling is determined by absolute advantage. Those who participate in company schooling have an absolute advantage in doing so over those who do not participate: participants earn more than nonparticipants would have received had they also participated. Similarly, nonparticipants have an absolute advantage in nonparticipation over participants: nonparticipants earn more than participants would have earned had they not invested in within-company schooling.

In table 11.3, the wage and welfare gains of participation in within-company schooling are calculated for a representative individual in the sample. This representative individual, defined by the sample means and modal values, is a male with 4.6 years of postcompulsory education, a little over 25 years of work experience, and an average IQ.

The unconditional rate of return is defined by $(\beta_1 - \beta_2)X$. The unconditional wage effect of participation in within-company schooling is −40.8 percent.[2] The interpretation of the unconditional rate of return is quite different from the interpretation of the rate of return conditional on (non)participation. The unconditional rate of return corresponds to the expected rate of return, for a randomly chosen individual in our sample, prior to the investment decision. As we do not account for the outcome of the investment decision, the unconditional rate of return gives the returns to observable characteristics only. The conditional rate of return includes the returns to unobserved characteristics as

2. Based on separate OLS wage equations (not presented here) for participants and nonparticipants (i.e., neglecting the self-selection effects), the unconditional wage effect of participating for the representative individual is 8 percent.

well, as far they are revealed by the outcome of the investment decision. For a participant, these returns represent the wage gains that the participating representative worker receives from participating, over the situation in which this representative worker would not have participated. For a nonparticipant the calculated rate of return represents the wage gain this nonparticipating representative worker would have received had he participated in enterprise-related schooling.

The wage effect for participants is 21.2 percent; that is, a representative participant in our sample earns 21.2 percent more after within-company schooling. The wage effect for nonparticipants is −80.3 percent. This implies that a nonparticipant with the observable characteristics of a representative individual earns 80.3 percent more than he would have earned had he participated in within-company schooling.

For participants, the welfare gains are greater than the wage gains. For a nonparticipant, the welfare gains are negative, but less negative than the wage gains. Unlike the unconditional wage gains, the unconditional welfare gains are positive. The interpretation of this outcome is that the costs of participation in within-company schooling are negative; ignoring pecuniary compensation, workers enjoy participating in within-company schooling.

11.5 Conclusions

In this paper we have calculated the wage and welfare gains of participation in within-company schooling. The main findings are the following: (1) On average, participants in within-company schooling earn 11 percent more than nonparticipants. (2) Within-company schooling and educational dropout are complements; within-company schooling and low or intermediate education are independent; within-company schooling and higher education are substitutes. (3) The allocation of workers into within-company schooling is based on absolute advantages: participants are better off with company schooling, while nonparticipants are better off without it. (4) For a representative worker in the sample, the wage effect for participants is 21.2 percent, and the wage effect for nonparticipants is −80.3 percent. (5) The welfare effects are greater than the wage effects. This implies that the costs of participation in within-company schooling are negative.

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