The Impact of Training on Earnings - Differences between Participant Groups and Training Forms[1]

Anja Kuckulenz and Thomas Zwick
Centre for European Economic Research (ZEW) Mannheim, Germany

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Abstract

Using the "Qualification and Career Survey", a rich German data set with information on 0.1 percent of all individuals employed in Germany in 1998/1999, the authors calculate the earnings effect of training for different "types" of employees and employers and for different training forms. Interacting the training dummy with all explanatory variables in the earnings equation allows us to calculate heterogeneous training returns, depending on employee and firm characteristics, and an unbiased estimation of the average treatment effect. The separate analysis of internal and external training reveals that the significantly positive earnings returns of training is mainly driven by external training. The correction for selection into training using supply-side changes as external instruments leads to an increase in the training coefficients and a decrease of their significance.

JEL classification: C31, J24, J31

Key words: continuing training, returns to training, endogeneity, employee heterogeneity, training forms

1 Introduction

Training after entering the labor force constitutes a major part of human capital investments and explains individual variation in wages and wage profiles. While the literature on the returns to schooling has recognized that returns may vary across schooling types and schooling participants, heterogeneous earnings returns to continuing training have been analyzed much less. Therefore, the main emphasis of this paper is on the heterogeneity of the effects of different post school training types and for different groups of training participants.

Trainability increases with qualification and tenure and the effect of training on productivity seems to be larger for higher educated employees. Therefore, it can be assumed that the qualification level and tenure as well as other employee characteristics might have an impact on the earnings effects of training. Nevertheless, only few empirical studies discriminate earnings effects of training for different groups of employees. Those studies find significant interaction effects of training with experience, company tenure, gender, education level, and union membership. They only calculate one interaction effect at once, however, or estimate separate regressions for different groups. In addition, they do not take into account that also employer characteristics and the type of training attended might have an impact on training effects. This paper jointly interacts the earnings effect of training with all covariates included in the earnings regression. This means that besides a broad range of individual employee characteristics, also firm size, economic sector, and other employer characteristics may have an impact on training returns. Our approach therefore compares the earnings effects of many subgroups of employees and obtains more reliable estimates of the average treatment effect of training. In addition, it reduces unobserved heterogeneity and separates the correlation of earnings with training from potential correlations of training with other covariates.

This approach is also used to calculate the earnings impacts of different training types.

It is frequently argued that the group of employees participating in training is different from the group that does not obtain training with respect to observable and unobservable characteristics. Therefore, adequate instrumental variables have to be found that explain the selection into training participation in order to correct for treatment selection. This paper uses restructurings in the firm as identifying variables. Firms have a stronger need to train their employees after restructuring, irrespective of employee characteristics. This identification strategy therefore has the advantage that the identifying variables explain why some employees have a higher probability of participating in training, but they do not capture unobserved characteristics of the employees that may be correlated with their capacity to earn money.

For our analysis, we use a rich and representative German data set with information on 0.1 percent of all individuals employed in 1998/1999 - the "Qualification and Career Survey". The data allow an assessment of the impact of training measures in 1996/98 on wages in 1998/1999. We distinguish between the effects of participation in internal and external training. Our sample contains more than 10,000 male employees from West Germany. We include about 110 explanatory variables that capture the salient employer and employee characteristics for earnings determination.

2 Background Discussion and Econometric Methods

In order to explain individual earnings, economists traditionally use the so-called Mincer equation, a standard tool in human capital theory (Mincer, 1974; Heckman, Lochner and Todd, 2003). Here,

earnings are explained by schooling, experience, experience-squared, and a constant:

$$lnY = \mu_0 + \beta_1' S + \beta_2 Exp + \beta_3 Exp^2 + e, \tag{1}$$

where ln Y is the natural logarithm of earnings, S a schooling vector[1], Exp experience, Exp^2 experience-squared, while μ_0, β_2, and β_3 are parameters and β_1a vector to be estimated. The error term is labelled $e \sim$N(0, σ^2). Experience enters as a squared term in order to allow earnings to increase with experience with a decreasing rate. In the standard Mincer equation, the growth of earnings over working life, i.e. the experience wage profile, reflects worker returns to investments in human capital.[2] This means that postschool human capital investments are proxied by work experience or, in other words, are left as a black box. In order to open the black box, we use a dummy for participation in continuing vocational training T in the previous two years as an additional explanatory factor for current earnings:

$$lnY = \mu_0 + \alpha T + \beta_1' S + \beta_2 Exp + \beta_3 Exp^2 + e, \tag{2}$$

where α is the estimated impact of training on earnings.

Our data set allows us to capture part of the individual heterogeneity left in standard Mincer equations by using a large variety of additional explanatory variables in vector X, such as workplace characteristics, professional career and personal characteristics of the employee:

$$lnY = \mu_0 + \alpha T + \beta_1' S + \beta_2 Exp + \beta_3 Exp^2 + \beta_4' X + e, \tag{3}$$

where β_4 is a vector of parameters to be estimated.

It is well known that training participants differ from those employees who do not receive training (Card, 1999; Heckman, 1999). In order to validate these differences in the wage equation, we

use a Chow test for the equality of the two sets of coefficients for participants and non-participants in training in equation (3). The test reveals that participants and non-participants not only differ with respect to their earnings but also in several other aspects and therefore the earnings equations should be estimated separately for both groups.[3] An alternative way to separate the estimation equations for training and non-training participants is to add interaction terms of the training dummy with all covariates S, Exp, Exp^2, and vector X. Adding the interaction terms allows us to identify heterogeneous wage returns of training for different groups of employees and firm characteristics, i.e. the training effect on earnings may vary, for example, for employees with different experience, workplace characteristics, school attainment, professional status, sector, and firm size. This approach satisfies the suggestion by Card (2000) that the effects of many subgroups of employees should be compared jointly in order to obtain more reliable estimates on the average treatment effect of training. In the literature, mainly single differences between employees with different educational backgrounds (Lynch, 1992; Blundell, Dearden and Meghir, 1996; OECD, 1999), tenure or experience (Pannenberg, 1998) or union membership (Lynch, 1992) have been studied so far, while there are no analyses on the joint effects of several impact factors.

We expand the possible heterogeneity in training returns to job characteristics, such as working overtime, incentive wages or computer usage. In addition, our approach allows for differences in training returns stemming from employer heterogeneity, such as firm size, sector or the economic situation of the employer. Although training returns may depend on the bargaining power of the employer concerning the distribution of the training rents (Arulampalam, Booth and Bryan, 2004), according to our knowledge no paper has analyzed the impact of employer heterogeneity on training returns so far.

The sample averages are subtracted from the interaction terms of training with the explanatory variables in order to ensure that the estimated interaction coefficients are the average treatment effect. This specification, suggested by Wooldridge (2002, p. 613), directly demonstrates the effects of deviations from the mean, reduces unobserved heterogeneity as far as possible, and separates the correlation of wages with training from potential correlations of training with other covariates (Bertschek and Spitz, 2003). In addition, it allows us to calculate the average treatment effect of training α if we assume that all differences between training participants and employees without training during the observation period are captured by the interaction terms with the observables:

$$\begin{aligned} lnY &= \mu_0 + \alpha T + \beta_1' S + \beta_2 Exp + \beta_3 Exp^2 + \beta_4' X + \delta_1' T(S - \overline{S}) \\ &\quad + \delta_2 T(Exp - \overline{Exp}) + \delta_3 T(Exp^2 - \overline{Exp^2}) + \delta_4' T(X - \overline{X}) + e, \end{aligned} \tag{4}$$

where the upper bars indicate sample averages of the explanatory variables and δ_2 and δ_3 are parameters and δ_1 and δ_4 are vectors of parameters to be estimated.

Employees who participate in training may not be randomly selected and therefore the ignorability of treatment assumption implicit in equation (4) may be violated. Permanent differences among individuals and transitory fluctuations in the determinants of training may be correlated with earnings and the returns to training (Blundell, Dearden and Meghir, 1999). This means that the impact of training included as a dummy variable in an OLS earnings equation might be biased because the error term of the earnings equation is correlated with the probability of receiving company training. The cross-section data do not allow us to control for time-invariant unobserved heterogeneity in wages that are correlated with training by taking individual-specific fixed effects. This proviso is to some extent outweighed by the fact that the data set contains an exceptionally extensive set of time-invariant explanatory variables that are potentially correlated with training

participation and earnings.

In order to consider the transitory effect of an endogenously chosen binary treatment (training), we estimate a treatment effects model that is conditional on a vector of independent variables explaining $ln\ Y$ and T. The treatment equation measures the unobserved net benefit T^* from training. Assuming that firms offer training only if the net benefit is positive, we find:

$$\begin{aligned} T^* &= \gamma_0 + \gamma_1^{'} S + \gamma_2 Exp + \gamma_3 Exp^2 + \gamma_4^{'} X + \gamma_5^{'} Z + u \qquad (5) \\ T &= 1, \text{ if } T^* > 0 \\ T &= 0, \text{ if } T^* \leq 0, \end{aligned}$$

where γ_0, γ_2, and γ_3 are coefficients while γ_1, γ_4, and γ_5 are vectors of coefficients to be estimated. Z is a vector of employer characteristics not included in X, determining whether an individual takes part in training or not, and the error term $u \sim$N(0,1), corr$(e, u) = \rho$. We estimate the binary response model by Probit.

We use external instruments Z that intuitively explain the selection process in the establishment and are correlated with training incidence but not with earnings[4] (Griliches and Mairesse, 1998) and adopt the identifying strategy proposed by Card (2000) by using supply-side sources of variation in training as external instrumental variables: information whether the employer restructured the establishment during the period in which training was offered (technical and organizational restructuring). It is well known that firms have to offer more training after restructuring in order to update the skills of their employees to match new skill demands (Acemoglu and Pischke, 1999; Zwick, 2004). Therefore, participation in training is higher if restructuring has taken place in a firm, irrespective of individual employee characteristics. It can be assumed that some employees partic-

ipate in training only because the firm restructured recently and training therefore comes close to a random eligibility variable. As a consequence, our variations in training supply variables satisfy the assumption that the instruments are uncorrelated with other latent employee characteristics that may affect earnings (Card, 2000; Wooldrige, 2002).

Then the fitted probabilities of training participation $\widehat{T}^* = \widehat{P}(T^* > 0 \mid S, Exp, Exp^2, X, Z)$ are calculated from equation (5). According to Wooldridge (2002), the earnings equation (4) should be estimated by IV using a constant, $\widehat{T}^*, S, Exp, Exp^2, X$, and the interactions of $\widehat{T}^*$ with all demeaned covariates in (4) as instruments for T and the interaction terms $T(S-\overline{S}), T(Exp-\overline{Exp}), T(Exp^2-\overline{Exp^2})$, and $T(X-\overline{X})$.[5] Therefore, T and the interaction terms are estimated by:

$$\begin{aligned} T^{**} &= \gamma_0 + \gamma_1' S + \gamma_2 Exp + \gamma_3 Exp^2 + \gamma_4' X + \gamma_5 \widehat{T}^* + \delta_1' \widehat{T}^*(S-\overline{S}) \\ &\quad + \delta_2 \widehat{T}^*(Exp-\overline{Exp}) + \delta_3 \widehat{T}^*(Exp^2-\overline{Exp^2}) + \delta_4' \widehat{T}^*(X-\overline{X}) + u \\ T &= 1, \text{ if } T^{**} > 0 \\ T &= 0, \text{ if } T^{**} \leq 0. \end{aligned} \tag{6}$$

This procedure deviates from simply using the fitted values $\widehat{T}^*$ as an explanatory variable or estimating T in a one-step IV estimation including $S, Exp, Exp^2, X,\ Z$, and the interactions of $\widehat{T}^*$ with all demeaned covariates in (4) as instruments for T and the interaction terms of T. For consistency, we must assume that the covariance conditional on (S, Exp, Exp^2, X, Z) is constant, which might not be exactly but approximately true. It can be shown that the usual 2SLS standard errors and the test statistics are asymptotically valid. In addition, the model for training participation (equations (5) and (6)) does not have to be correctly specified. Both properties would not be obtained, if $\widehat{T}^*$ was simply used as a regressor instead of estimating T^{**} as an instrument for T

and the interaction terms (Wooldridge, 2002).

The earnings equation therefore is estimated as follows:

$$\begin{aligned} lnY &= \mu_0 + \alpha\widehat{T}^{**} + \beta_1' S + \beta_2 Exp + \beta_3 Exp^2 + \beta_4' X + \delta_1' \widehat{T}^{**}(S - \overline{S}) \\ &\quad + \delta_2 \widehat{T}^{**}(Exp - \overline{Exp}) + \delta_3 \widehat{T}^{**}(Exp^2 - \overline{Exp^2}) + \delta_4' \widehat{T}^{**}(X - \overline{X}) + e, \end{aligned} \tag{7}$$

where $\widehat{T}^{**} = \widehat{P}(T^{**} > 0)$ is the estimated participation in training and $\widehat{T}^{**}(S - \overline{S})$ etc. are the interaction variables from equation (6). The interaction terms with $\widehat{T}^{**}$and $\widehat{T}^{**}$ are estimated in one step together with equation (7). Wooldridge (2002) shows that the IV estimator is asymptotically efficient in the class of estimators where the IVs are functions of S, Exp, Exp^2, X, and Z. The one-step full-information maximum likelihood estimator (FIML) is based on the entire system of equations (6) and (7) and treats all equations and all parameters jointly. With normally distributed disturbances, the estimator is more efficient than the two-stage least squares (2SLS) estimator[6].

In order to take heterogeneity in the earnings effect of different training types into account, we additionally differentiate between training forms. A factor analysis (see below) shows that there are two independent bundles of training forms that can intuitively be labeled internal training, T_i and external training, T_e. In additional estimations, we therefore replace the training dummy T by T_i and T_e, respectively.

3 Data

In order to analyze the impact of training on earnings empirically, we use a rich data set, compiled from a representative sample of 0.1 percent of all individuals employed in Germany. The "Qualification and Career Survey" of the German Federal Institute for Vocational Training (BIBB) and

the Federal Employment Service (IAB) is implemented every seven years. It is not a panel, but consists of independent cross-sections. We use the latest wave, which is from the survey in 1998/99. It comprises more than 34,000 employees. We use the following variables:

- The variable we want to explain is log midpoints of monthly earnings in 1998/99 from 18 categories. This variable has the advantage that earnings of highly paid workers are not censored from above.

- The key explanatory variable is participation in training during the years 1996 - 1998. On the one hand, it is asked whether the individual participated in courses or seminars. On the other hand, participation in different training categories is ascertained, such as participation in trade fairs, lectures, on-the-job training, specific company training, or taking over special tasks as well as reading technical literature.[7] By combining both questions, we obtain a dummy for participation in training. This dummy might stand for quite substantial amounts of training, because the employees might participate in various courses during 48 months and we frequently observe several training spells in the same category (Gerfin, 2004). In addition, only formal training courses are included in the data set and short or informal training spells are explicitly excluded.

- The external identifying variables for training participation originate from questions on changes in the workplace during the period in which training took place (1996 - 1998). We use two variables: technical restructuring (introduction of new production techniques, machines, production materials or computer programs) and organizational restructuring (re-organization of departments or work groups).

- Further determinants of earnings are those found in the Mincer equation, i.e. actual work experience[8], job tenure, and dummies for the highest educational achievement. These variables are related to the situation in 1998/99.

- Together with these standard variables, we also include 11 dummies capturing the professional status, such as blue-collar or white-collar worker, civil servant or different sophistication levels of tasks for 1998/99.

- In addition, we use the following current job characteristics: computer use, profit-sharing, bonus payments, overtime work, whether a job is temporary, and 13 dummies for main job contents. These variables allow us to control a large part of the individual heterogeneity between the employees.[9] Some of these variables (for example working overtime) can be interpreted as indicators of intrinsic motivation.

- Additional control variables explaining earnings are sociodemographic attributes. We include a dummy for children, former unemployment, and non-German nationality.

- Finally, we use some employer characteristics: seven dummies for firm size, 46 dummies indicating the economic sector of the employer, 11 dummies for the federal state the firm is located in and a dummy indicating whether the firm is in a good economic situation in 1998/99.

Only full-time[10] employees (without the self-employed) in West Germany are included, because in 1998/99 there were still large differences in the labor market structures of the two parts of the country. The analysis is restricted to male employees, because the data do not allow us to model participation in the labor market simultaneously, which would be important for examining

earnings effects for women[11]. In order to obtain clean evidence on the earnings effects of employer-provided training, we exclude those training participants where we cannot be sure whether they were employed or unemployed while being trained (about 450 cases). The reason for this restriction in our sample is that we want to exclude training provided by government aimed at unemployed. This reduces the sample to 9,800 individuals. The descriptive characteristics of the variables used can be found in table I in the appendix.

4 Empirical Evidence

4.1 Descriptive Statistics

In total, 55 percent of male employees participated in some kind of training in 1996 - 1998. Individuals often take part in several kinds of training, and therefore some training forms are highly correlated with each other. Specifically, those employees who read technical literature are rather likely to also visit trade fairs and attend seminars and presentations. This means that we cannot discern the earnings influences of all individual training measures.

Participation in training depends on the qualification of the employee. Analogously to the literature (Blundell, Dearden and Meghir, 1996; Heckman, 1999; Pischke, 2001), we find that individuals with higher education participate more often in continuing training, and private sector training mainly excludes low-skilled persons. Attendance at training of employees without a professional degree is lowest, only 28 percent have participated in some kind of training. In contrast, 85 percent and more of the employees with a university degree have taken part in continuing vocational training in the period 1996-1998 (table 1).

Table 1: Participation in Training (sorted by qualification)

Education	**Share in %**
School Attainment	
Without School Leaving Certificate	42.19
Lower Secondary School	44.49
Intermediate Secondary School	64.25
Entrance Examination for University of Applied Sciences	83.20
High School Diploma	80.11
Professional/Vocational Training	
Without Professional Degree	31.14
Full-Time Vocational School	53.93
Apprenticeship	52.42
Master Craftsman	77.80
University for Applied Sciences	88.01
University	86.17

Source: BIBB-IAB 1998/99, own calculations
Full-time working males, N=9,800

4.2 Earnings Effect of Training Participation

In order to check the robustness of our results with respect to the estimation specification, we first estimate equation (2), with log earnings as the endogenous variable and training participation, experience, experience-squared and a set of dummy variables for school and professional education as controlling variables. The results of the Mincer equation are in line with similar studies for Germany (Franz, 2003). As expected, income is higher for workers with more experience, but it increases at a decreasing rate since the coefficient for experience-squared is negative. With more school attainment and higher professional degrees income increases. The coefficient of the variable indicating whether an individual participated in training is 0.16 and hence, training has a positive (and significant) impact on earnings (table 2).

With a large number of variables controlling for firm and job characteristics and some other attributes, the coefficients of experience and experience-squared are almost unchanged, while the measured earnings effects of school and vocational education decrease. Also company tenure leads

to a concave earnings profile. Earnings increase with professional status. Employees who work with a computer, who work overtime and receive incentive wages or participate in profit sharing earn more. Employees with previous unemployment spells, with a temporary work contract and foreigners earn less. Larger firms and firms in a good economic situation pay more. The earnings impact of training in the extended Mincer equation is lower than in the baseline equation. Also employer characteristics play an important role for individual wages: employees in larger firms and in firms in a good economic situation earn more. In addition, the economic sector and the region where the employer is located play a role (Doms, Dunne, and Troske, 1997). The adjusted R^2 rises from 0.34 to 0.50 if we estimate equation (3), which indicates that the variables controlling for workplace, socio-economic and employer characteristics uncover part of sample heterogeneity, which is not observed in the standard Mincer equation (see column 3 in table 2).

In order to evaluate the average treatment effect of training on earnings properly, we have to take the endogeneity of training and heterogeneity in the treatment effects into account. Heterogeneity in the training effects on earnings is captured by interaction terms between all demeaned explanatory variables and the training dummy. With the interaction variables we identify the usually neglected heterogeneous earnings effects of training for different groups of employees and employers. The estimated average treatment effect of training participation increases slightly if we estimate equation (4). Column 4 of table 2 reports selected interaction effects. The impact of training on earnings is smaller for employees with a low school education. Heckman (1999) stresses that trainability of higher skilled people is higher. Therefore, it is not surprising that the training earnings mark-up is smaller for the less skilled. Lynch (1992) does not find differences in the earnings effects of training between different school education groups in the US, however. The OECD (1999) even reports

larger wage gains from training for employees with lower education for France, the Netherlands, and Great Britain[12], while for Germany, the interaction effects between training and less than upper secondary education and upper secondary education are negative but insignificant.

Another result of this study is that employees with a long work experience gain more from training than persons who have just entered the labor market. These workers may have more bargaining power than unexperienced workers and therefore can capture a larger share if there are rents to divide. As already indicated by Lazear (1979), earnings and productivity at a given point in the career do not have to correspond. He notes that employees may first receive wages that are lower than their productivity and at a later stage of their professional career, they can profit from early investments in their human capital. We show that long job tenure diminishes the impact of training on earnings in Germany, however (compare Pannenberg, 1998). One reason for these findings may be that training provided to entrants in the firm increases productivity substantially since their need for specific training is strong.

A further indication that the bargaining position between employer and employee plays a role are the following significant interaction effects: larger firms can afford to pay a lower training earnings mark-up while firms with profit-sharing and firms in a good economic situation pay their trained employees a higher mark-up. Employees with former unemployment spells experience a lower training earnings mark-up, while computer usage at work increases the training earnings mark-up. Civil servants receive a lower earnings mark-up. Also workers with temporary contracts obtain a lower earnings mark-up. The reason for this is that employers cannot expect to profit from the increased productivity since the employees will probably change their job soon and share the rent from investment in human capital with their next employer. Including the interaction terms

does not change the coefficients of most explanatory variables, while some interaction terms take over their explanatory power. The R^2 slightly increases if we include the interaction terms.

.

Table 2: Earnings Equation with Training

Variable	Mincer (OLS)	Extended Mincer (OLS)	Extended Mincer with Interaction Terms (OLS)	Extended Mincer with Interaction Terms (IV)
Training	0.156***	0.045***	0.057***	0.161*
	(0.008)	(0.008)	(0.009)	(0.084)
Education and Vocational Training				
School Attainment				
Without School Leaving Certificate	-0.055**	-0.009	0.012	0.031
	(0.027)	(0.022)	(0.031)	(0.049)
Lower Secondary School	-0.074***	-0.023***	0.004	0.031
	(0.009)	(0.009)	(0.014)	(0.027)
Entrance Examination for	0.132***	0.059***	0.030	0.025
University of Applied Sciences	(0.018)	(0.015)	(0.039)	(0.066)
High School Diploma	0.164***	0.074***	0.069**	0.083
	(0.017)	(0.015)	(0.029)	(0.056)
Professional Education				
Without Professional Degree	-0.130***	-0.058**	-0.079**	-0.178**
	(0.027)	(0.026)	(0.039)	(0.088)
Apprenticeship	-0.012	-0.010	-0.020	-0.057
	(0.025)	(0.024)	(0.036)	(0.085)
Master Craftsman	0.131***	0.035	-0.010	-0.074
	(0.027)	(0.025)	(0.041)	(0.097)
University of Applied Sciences	0.177***	0.105***	0.082	-0.063
	(0.030)	(0.029)	(0.061)	(0.145)
University	0.288***	0.207***	0.133**	-0.032
	(0.031)	(0.031)	(0.055)	(0.146)
Professional Career				
Professional Experience	0.022***	0.013***	0.011***	0.004
	(0.001)	(0.001)	(0.002)	(0.004)
Professional Experience^2	-0.000***	-0.000***	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Company Tenure		0.006***	0.010***	0.016***
		(0.001)	(0.002)	(0.003)
Company Tenure^2		-0.000**	-0.000**	-0.000***
		(0.000)	(0.000)	(0.000)
Unemployment		-0.035***	-0.022*	-0.002

Table 2: Earnings Equation with Training (continued)

Variable	Mincer (OLS)	Extended Mincer (OLS)	Extended Mincer with Interaction Terms (OLS)	Extended Mincer with Interaction Terms (IV)
		(0.008)	(0.013)	(0.021)
Professional Status				
Skilled Blue-Collar Worker		0.069***	0.072***	0.049
		(0.013)	(0.017)	(0.033)
Assistant Foreman		0.077***	0.079***	0.077
		(0.019)	(0.030)	(0.089)
Master/Foreman		0.164***	0.119**	0.175**
		(0.024)	(0.049)	(0.081)
Unskilled White-Collar Worker		0.062***	0.089***	0.091*
		(0.021)	(0.027)	(0.054)
White-Collar Worker with Simple Tasks		0.032*	0.042*	0.063
		(0.020)	(0.025)	(0.054)
White-Collar Worker with Difficult Tasks		0.108***	0.155***	0.182***
		(0.017)	(0.026)	(0.062)
High-Skilled White-Collar Worker		0.228***	0.204***	0.072
		(0.017)	(0.027)	(0.081)
Executive White-Collar Worker		0.313***	0.284***	0.123
		(0.025)	(0.049)	(0.125)
Civil Servant in Clerical Grade		0.054**	0.167***	0.125
		(0.022)	(0.038)	(0.079)
Civil Servant in Higher Service		0.141***	0.249***	0.052
		(0.025)	(0.070)	(0.400)
Civil Servant in Senior Service		0.311***	0.612***	0.558
		(0.029)	(0.065)	(0.528)
Workplace Characteristics				
Computer Work Station		0.042***	0.027*	0.001
		(0.009)	(0.015)	(0.036)
Temporary Work		-0.070***	-0.043	-0.011
		(0.020)	(0.027)	(0.040)
Good Economic Situation		0.041***	0.029**	-0.008
		(0.008)	(0.012)	(0.020)
Overtime		0.048***	0.053***	0.064***
		(0.008)	(0.012)	(0.020)
Profit-Sharing		0.074***	0.059**	-0.053
		(0.014)	(0.026)	(0.060)
Incentive Wage		0.028***	0.059***	0.026*
		(0.008)	(0.014)	(0.009)
Individual Characteristics				
Children		0.067***	0.061***	0.045**

Table 2: Earnings Equation with Training (continued)

Variable	Mincer (OLS)	Extended Mincer (OLS)	Extended Mincer with Interaction Terms (OLS)	Extended Mincer with Interaction Terms (IV)
		(0.007)	(0.011)	(0.018)
Foreigner		-0.038**	-0.049***	-0.047
		(0.016)	(0.019)	(0.034)
Firmsize				
1-4		-0.045**	-0.071**	-0.099**
		(0.020)	(0.030)	(0.049)
5-9		-0.052***	-0.068***	-0.026
		(0.013)	(0.018)	(0.030)
50-99		0.039***	0.027	0.041
		(0.011)	(0.017)	(0.028)
100-499		0.064***	0.056***	0.063**
		(0.010)	(0.016)	(0.025)
500-999		0.084***	0.085***	0.133***
		(0.014)	(0.024)	(0.040)
1,000 and more		0.117***	0.109***	0.169***
		(0.011)	(0.019)	(0.032)
Selected Interaction Variables				
Professional Experience			0.005*	0.017***
			(0.003)	(0.006)
Professional Experience^2			-0.000	-0.000
			(0.000)	(0.000)
Company Tenure			-0.007***	-0.021***
			(0.002)	(0.005)
Company Tenure^2			0.000*	0.000***
			(0.000)	(0.000)
Firmsize: 1,000 and more			0.010	-0.092**
			(0.023)	(0.047)
Lower Secondary School			-0.058***	-0.111**
			(0.018)	(0.044)
Unemployment			-0.018	-0.059*
			(0.016)	(0.032)
Computer Work Station			0.031*	0.061
			(0.019)	(0.058)
Temporary Work			-0.066*	-0.126
			(0.039)	(0.093)
Good Economic Situation			0.019	0.081**
			(0.017)	(0.032)
Profit Sharing			0.016	0.151**
			(0.031)	(0.072)

Table 2: Earnings Equation with Training (continued)

Variable	Mincer (OLS)	Extended Mincer (OLS)	Extended Mincer with Interaction Terms (OLS)	Extended Mincer with Interaction Terms (IV)
White-Collar Worker with Difficult Tasks			-0.086**	-0.122
			(0.035)	(0.138)
Civil Servant in Clerical Grade			-0.177***	-0.100
			(0.048)	(0.154))
Civil Servant in Higher Service			-0.166**	0.048
			(0.077)	(0.455)
Civil Servant in Senior Service			-0.372***	-0.327
			(0.074)	(0.575)
Constant	7.958***	7.762***	7.842***	8.040***
	(0.030)	(0.051)	(0.074)	(0.128)
Observations	8325	8325	8325	8325
R^2	0.3457	0.4940	0.5090	0.4380

Significance levels: *: 10%, **: 5%, ***: 1%. Remarks: Between Brackets are the heterogeneity robust standard errors. Also included: 13 dummies for job content, 46 dummies for economic sector and 11 dummies for the federal state.

Finally, we have to take the possible endogeneity of training into account. A Durbin-Wu-Hausman test[13] reveals that the training dummy is endogenous in the wage regression. Therefore, in a first estimation step, we explain training participation and derive predicted training participation values according to equation (4). In a second step, we estimate an instrumental variables model by one-step full information maximum likelihood using the predicted training participation and all other explanatory variables as instruments (equations (5) and (6)). Explanatory variables in the first estimation step are the variables from the wage equation plus two identifying variables that explain training participation by technical and organizational restructuring in the firm. The determinants of training participation are shown in column 2 of table II in the appendix. Firms tend to invest in human capital of those employees (1) whose expected training returns are large, (2) whose training investment costs are low, and (3) who offer a long period of time to recoup

the investment (Heckman, 1999). The literature on participation in training accordingly shows that training incidence is positively correlated with years of schooling and professional status. In addition, employees with less job tenure and high work experience receive training more frequently, while part-time and temporary workers have a lower probability of participating in training. Larger firms and public employers offer training more frequently (Mincer, 1991; Lynch and Black, 1998; Shields, 1998; Goux and Maurin, 2000; Pischke, 2001; Booth, Francesconi and Zoega, 2003; Zwick, 2004). We also find that these variables are crucial determinants of training participation: employees with higher vocational training degrees and those employees who work with a personal computer and in larger firms receive training more often than others. Employees attend continuing vocational training more frequently with a longer company tenure (but on a decreasing scale), while work experience does not have an impact on training incidence. Furthermore, employees who work overtime or who receive incentive wages participate more often in training. These variables may be indicators of intrinsic motivation of the employee, which may also be positively correlated with training incidence (Heckman, 1999). Employees with a temporary labor contract have a lower expected tenure than their colleagues with a permanent contract. As a consequence, they are less likely to receive training. Employees of non-German nationality generally obtain continuing vocational training less frequently. Finally, employees in firms that introduced technical or organizational restructuring have a higher chance to be offered training. The identifying variables jointly have a strong correlation with training (the joint F-value is 36.81 and the partial R^2 is 0.01, compare Staiger and Stock (1997), Hansen's J statistic is 0.54 (p-value 0.46) and therefore overidentification is rejected). The results are very similar when we include only one of the two identifying variables. With a Pseudo R^2 of 0.27, a sizeable portion of the selection into training is

explained.

The results of the instrumental variables earnings regression are given in column 5 of table 2. Most explanatory variables have the same impact on earnings while the precision of the regression is generally lower. For work experience and tenure the instrumented interaction terms with training take over some of the explanation power of the direct coefficients. The average treatment effect of training, i.e. the difference in earnings for participants versus non-participants increases.[14] Hence, after instrumenting for the selection into training, the earnings effect of continuing vocational training is larger than in the OLS estimation. This result is in line with most[15] other studies (Bartel, 1995; Pannenberg, 1997; Blundell, Dearden and Meghir, 1999 ; Pischke, 2001; Carneiro, Heckman and Vyctlacil, 2003).

The higher coefficient of the IV estimation in comparison to the OLS estimation may be the consequence of two effects familiar from the returns to education literature (Card, 1999; Card, 2000; Carneiro, Heckman and Vyctlacil, 2003). First, there might be a negative selection into training. Individuals with lower earnings are more likely to take part in training, and training therefore is remedial. This is contrary to most of the literature, however: Goux and Maurin (2000) show that high-wage workers are more likely to be selected for training than other workers. The ability bias may be relatively small in our case with the extensive list of covariates and interaction terms (Angrist and Krueger, 1991). Second, training participation might be measured with errors, and the OLS earnings estimation may therefore be downward biased (Griliches and Hausman, 1986). If the instruments capture part of the measurement errors, this bias decreases when instrumenting the training variable and the training coefficient increases. In our case, the training dummy is indeed a rough measure, because a one-day course has the same value as a course that takes several weeks.

By using changes in the training supply side, we are able to avoid unobserved differences between treatment and control group implicit in the use of instrumental variables that may accentuate the bias between IV and OLS estimations and induce a further upward bias of the IV estimates (Bound and Jaeger, 1996).

4.3 Earnings Effects of Different Types of Training

In studies on the impact of training on wages, usually training incidence is measured and not the kind or specificity of training. Only few authors differentiate between on-the-job and off-the-job training (Lynch, 1992; Pischke, 2001), employer-provided and non-employer-provided training (Blundell, Dearden and Meghir, 1999), formal and non-formal training (Pfeiffer and Reize, 2001), and between general and specific training (Loewenstein and Spletzer, 1997). Assuming that no labour turnover costs exist, the wage effects of general and specific training should differ. Firm-specific training does not increase the productivity of workers in other firms, and therefore no wage increase is necessary to keep the worker in the present job. In contrast, general training increases the productivity of a worker in at least one other job. Therefore, employees may profit from general training by increased wages. As a consequence, it can be assumed that the impact of training on wages depends on the degree of specificity of the training received (Lynch, 1992 ; Blundell et al., 1999; Arulampalam, Booth and Bryan, 2004) . In practice, it is not trivial to distinguish between general and specific training, however, since continuing vocational training often comprises both and it is hard to measure the training content (Booth and Snower, 1996, chapter 3; OECD, 1999, p. 137). The classifications "on-the-job", "employer-provided" and "non-formal" are usually used as proxies for training with more firm-specific elements, while "off-the-job", "non-employer-provided"

and "formal" training may be more general and easier portable between jobs (Loewenstein and Spletzer, 1997). Overall, empirical studies find that training measures with higher general contents have a stronger earnings effect than training measures with higher firm-specific contents. Lynch (1992) finds significantly positive returns from previous off-the-job training, while previous on-the-job training does not lead to an earnings increase. Pischke (2001) also stresses that training during work hours has lower returns than training during leisure time. Loewenstein and Spletzer (1997) do not find differences between the interactions of the earnings effect of training with self-assessed dummies indicating whether all, most, some, or none of the skills were useful outside of the company, however. They attribute this result to measurement error and rent and cost sharing between employers and employees.

In order to analyze the earnings impact of different training forms, we replace our training dummy with dummies comprising different types of training. By introducing dummies for internal (the employee participated in on-the-job training, quality circles or took over special tasks) and external training (participation in courses and seminars, trade fairs, lectures and reading of specialist literature), we attempt to differentiate between the earnings effects of training forms with more or less specific contents[16]. Table III in the appendix shows the results of the simple OLS earnings equations including a dummy for internal or external training. The impact of external training is significantly positive and higher than that of internal training. Therefore, external training has a higher impact on the market value of the employee than internal training. This seems plausible if we assume that external training contains more general human capital contents. The coefficients of the other variables in the extended Mincer equation are as expected and similar to those found in the previous regression using the training dummy.

Analogously to the analysis above, also in this specification we have to take endogeneity of training into account. Hence, we estimate two regressions with instrumental variables for the two training dummies. Selection into the two types of training differs, as can be seen in table II in the appendix. Participation in external training is explained much better by the right-hand-side variables than participation in internal training, as indicated by the adjusted R^2 of 0.35 and 0.12, respectively. The estimated coefficients only vary slightly between the regressions determining internal and external training. The main difference is that internal training depends to a much lesser extent on school attainment, professional education, and professional status than external training (compare Altonji and Spletzer, 1991). Lynch (1992) finds in a specific sample for employees of age 14 - 21 an increasing training incidence with experience for company-provided training, while the incidence of off-the-job training decreases with tenure. Likewise, Bartel (1995) finds an increasing training incidence with length of services for core training, while the incidence of the other training forms decreases significantly. These differences between the training forms with respect to experience and training are not found in the German context. Workplace and individual characteristics have similar impacts on the training dummy as well as on the internal and external training dummy.

The results of the instrumental variable regression are shown in table III in the appendix.[17] The impact of external training on earnings increases after correcting for the selection bias, while the t-value decreases but nevertheless stays significant. The effect of participation in internal training on earnings also increases, but turns insignificant. Obviously the results in the earnings regressions including the training dummy are driven by the external training types. The coefficients of the other explanatory variables in the extended earnings equation including the two types of training do not

deviate from the model with the training dummy. The adjusted R^2 is lower for the IV regression including internal training (0.29) than that including external training (0.44). The interaction terms of external training with the covariates are better determined than those of internal training and similar to those of the training dummy. A joint IV estimation of internal and external training did not lead to satisfactory results because the predicted external and internal training variables and all interaction terms between internal and external training and all explanatory variables are used as instruments here. This increase in the number of instruments reduces the determination of the training variables and all other coefficients, because obviously the sample size was not sufficient for such a large number of instruments.

5 Results

This paper shows that the impact of participation in training in 1996 - 1998 on earnings in 1998/99 is significantly positive. The main addition to the literature is an elaboration on heterogeneous returns in the training earnings mark-up - this paper includes interaction terms between training and all other explanatory factors in the earnings equation. This has the advantage that the average treatment effect is not biased by training effects pertaining only to individual employee groups. We find that the effect of training on earnings differs between different groups of training participants and employers. High-skilled employees profit more from training than low-skilled workers, the training earnings mark-up increases with professional experience but decreases with company tenure. Employees with previous unemployment spells and employees with temporary contracts profit less from training. Smaller firms, firms in a good economic situation and firms that share profits with their employees pay a higher training earnings mark-up.

In order to correct endogeneity of training in the earnings regression, we use technical and organizational reorganization in the firm as identifying variables. Firms that reorganize usually also have to offer training to employees who otherwise would not participate in training courses. Therefore, reorganization provides a good supply-side instrument for training participation that has no impact on current earnings. Using estimated training participation, all explanatory variables and interactions as instruments increases the measured training earnings mark-up. This increase may mean that those employees who are affected by the increased training offer in the wake of reorganizations have higher training earnings mark-ups than those employees who would get training anyway. This effect should be negligible, however, because we control for about 110 employee and establishment characteristics and include all interaction effects between training and those characteristics. One important reason for the increase in measured training mark-up therefore is that our instrumental variables reduce the measurement error in the OLS regression and capture heterogeneous training returns more properly. The advantage of our supply-side instruments is that they are not related with unobserved employee characteristics that may bias the estimated IV coefficients.

Without controlling for endogeneity, external training (i.e. participation in trade fairs, lectures, courses and seminars, and reading specialist literature) and internal training (i.e. on-the-job training, quality circles, and special tasks) have a significant positive impact on earnings. Taking endogeneity into account and instrumenting the training decision, the coefficient of external training rises, while the internal training coefficient turns insignificant. Hence, participation in internal training does not translate into higher earnings, while external training mainly drives the result derived with a dummy for training participation. We argue that external training entails more

general training contents and therefore our results confirm that mainly general human capital leads to higher earnings.

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6 Appendix

Table I: List of Variables Used

Variable	Share/ Average	Notes
Earnings		
Less than 600 DM	0.07%	
Between 600 and 1,000 DM	0.16%	
Between 1,000 and 1,500 DM	0.56%	
Between 1,500 and 2,000 DM	1.25%	
Between 2,000 and 2,500 DM	4.31%	
Between 2,500 and 3,000 DM	7.69%	
Between 3,000 and 3,500 DM	11.87%	
Between 3,500 and 4,000 DM	14.87%	
Between 4,000 and 4,500 DM	14.48%	
Between 4,500 and 5,000 DM	12.28%	
Between 5,000 and 5,500 DM	7.59%	
Between 5,500 and 6,000 DM	6.93%	
Between 6,000 and 7,000 DM	7.58%	
Between 7,000 and 8,000 DM	4.10%	
Between 8,000 and 9,000 DM	2.52%	
Between 9,000 and 10,000 DM	1.37%	
Between 10,000 and 15,000 DM	1.73%	
15,000 DM and more	0.64%	
School Attainment		
Without School Leaving Certificate	2.52%	
Lower Secondary School	51.23%	
Intermediate Secondary School	24.74%	Reference category
Entrance Examination for University of Applied Sciences	7.60%	
High School Diploma	13.91%	
Vocational Training		
Without Professional Degree	12.63%	
Full-Time Vocational School	2.22%	Several years of professional training in school; reference category
Dual Apprenticeship	60.16%	Several years of professional training in school and on-the-job
Master Craftsman	11.34%	
University of Applied Sciences	5.79%	
University	7.85%	

Table I: List of Variables Used (continued)

Variable	Share/ Average	Notes
Training		
Courses and Seminars	26.72%	Participation in courses and seminars
Trade Fair	18.09%	Participation in trade fairs
Lecture	25.90%	Participation in lectures
On-The-Job	16.70%	Initial Training on-the-job
Quality Circle	14.07%	Participation in quality circles
Special Tasks	12.86%	Tasks aiming at extending skills
Specialist Literature	26.11%	Study of work-related literature
Any Kind of Training	57.50%	
External Training	46.74%	
Internal Training	33.74%	
Professional Career		
Professional Experience	22.69 years	Years from first job until today
Company Tenure	13.86 years	Years from starting to work for a company until today
Unemployment	27.43%	Dummy = 1 if a person was ever employed, otherwise 0
Professional Status		
Unskilled Blue-Collar Worker	15.63%	Worker without professional degree
Skilled Blue-Collar Worker	27.17%	Worker with degree from dual apprenticeship system or full-time vocational school; Reference category
Assistant Foreman	3.60%	
Master/Foreman	3.25%	
Unskilled White-Collar Worker	2.22%	
White-Collar Worker With Simple Tasks	3.98%	
White-Collar Worker With Difficult Tasks	11.36%	
High-Skilled White-Collar Worker	16.00%	
Executive White-Collar Worker	4.96%	
Civil Servant in Clerical Grade	4.55%	
Civil Servant in Higher Service	3.93%	
Civil Servant in Senior Service	2.06%	
Workplace Characteristics		
Computer Work Station	48.21%	Work routine includes using

Table I: List of Variables Used (continued)

Variable	Share/ Average	Notes
		the computer
Temporary Work	4.87%	
Overtime	78.34%	Dummy = 1 if a person works overtime, otherwise 0
Profit-Sharing	7.94%	
Incentive Wage	21.62%	
Job Content		13 Categories: training, testing, procurement, organisation, marketing, developing, manufacturing, negotiating, supervising, research, repairing, counselling, monitoring
Individual Characteristics		
Children	51.37%	Dummy = 1 if a person has at least one child, otherwise 0
Foreigner	5.43%	Dummy = 1 if a person does not have a German Nationality, otherwise 0
Identifying Variables		
Technical Restructuring	24.68%	
Organisational Restructuring	15.77%	
Employer Characteristics		
Size of Firm		7 Categories: number of employees is 1-4, 5-9, 10-49 (reference category), 50-99, 100-499, 500-999, and 1,000 and more
Residence Community		3 Categories: communities with 50000 and more inhabitants, hinterland of large cities and other communities with less than 50,000 inhabitants
Federal State		11 Categories: all Federal States of West Germany
Economic Sector		46 Categories
Good Economic Situation	59.04%	Dummy = 1 if the company is in a good good economic situation, otherwise 0

Table II: Selection into Training (Probit)

Endogenous Variables	Training	External Training	Internal Training
Identifying Variables			
Technical Restructuring	0.316***	0.311***	0.227***
	(0.039)	(0.038)	(0.034)
Organisational Restructuring	0.173***	0.100**	0.268***
	(0.046)	(0.045)	(0.040)
Education and Vocational Training			
School Attainment			
Without School Leaving Certificate	-0.016	-0.230**	0.097
	(0.105)	(0.114)	(0.100)
Lower Secondary School	-0.072*	-0.117***	-0.008
	(0.039)	(0.040)	(0.039)
Entrance Examination for	0.097	0.156**	-0.070
University of Applied Sciences	(0.070)	(0.068)	(0.060)
High School Diploma	-0.114*	-0.025	-0.088
	(0.067)	(0.066)	(0.058)
Professional Education			
Without Professional Degree	-0.140	-0.290***	-0.154
	(0.104)	(0.111)	(0.103)
Apprenticeship	0.035	0.030	-0.072
	(0.095)	(0.099)	(0.094)
Master Craftsman	0.285***	0.277**	-0.069
	(0.107)	(0.109)	(0.102)
University of Applied Sciences	0.285**	0.301**	-0.056
	(0.123)	(0.124)	(0.112)
University	0.246*	0.244*	-0.129
	(0.126)	(0.127)	(0.115)
Professional Career			
Professional Experience	0.000	0.001	-0.003
	(0.006)	(0.006)	(0.006)
Professional Experience^2	-0.000*	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Company Tenure	0.040***	0.044***	0.011**
	(0.005)	(0.006)	(0.005)
Company Tenure^2	-0.001***	-0.001***	-0.000*
	(0.000)	(0.000)	(0.000)
Unemployment	0.049	0.003	0.023
	(0.036)	(0.037)	(0.035)
Professional Status			
Skilled Blue-Collar Worker	0.168***	0.286***	0.101*

Table II: Selection into Training (Probit) (continued)

Endogenous Variables	Training	External Training	Internal Training
	(0.052)	(0.058)	(0.054)
Assistant Foreman	0.413***	0.398***	0.406***
	(0.091)	(0.093)	(0.089)
Master/Foreman	0.336***	0.568***	0.038
	(0.102)	(0.102)	(0.098)
Unskilled White-Collar Worker	0.095	0.212*	-0.121
	(0.101)	(0.109)	(0.109)
White-Collar Worker with Simple Tasks	0.127	0.141	0.020
	(0.081)	(0.087)	(0.086)
White-Collar Worker with Difficult Tasks	0.393***	0.486***	0.228***
	(0.065)	(0.068)	(0.066)
High-Skilled White-Collar Worker	0.580***	0.767***	0.170**
	(0.068)	(0.070)	(0.067)
Executive White-Collar Worker	0.465***	0.637***	0.007
	(0.095)	(0.095)	(0.086)
Civil Servant in Clerical Grade	0.354***	0.513***	0.299***
	(0.099)	(0.100)	(0.094)
Civil Servant in Higher Service	0.777***	0.877***	0.204*
	(0.127)	(0.122)	(0.107)
Civil Servant in Senior Service	0.981***	1.157***	0.008
	(0.176)	(0.172)	(0.128)
Workplace Characteristics			
Computer Work Station	0.285***	0.289***	0.243***
	(0.039)	(0.039)	(0.038)
Temporary Work	-0.268***	-0.226***	-0.209***
	(0.075)	(0.083)	(0.075)
Overtime	0.160***	0.129***	0.147***
	(0.036)	(0.038)	(0.036)
Incentive Wage	0.169***	0.052***	0.191***
	(0.038)	(0.058)	(0.035)
Individual Characteristics			
Children	0.134***	0.103***	0.097***
	(0.032)	(0.033)	(0.030)
Foreigner	-0.268***	-0.260***	-0.098
	(0.075)	(0.077)	(0.068)
Firmsize			
1-4	0.047	0.139*	-0.239***
	(0.074)	(0.078)	(0.079)
5-9	0.018	0.110*	-0.165***
	(0.056)	(0.059)	(0.058)

Table II: Selection into Training (Probit) (continued)

Endogenous Variables	Training	External Training	Internal Training
50-99	0.015	-0.041	0.049
	(0.050)	(0.052)	(0.048)
100-499	0.063	0.012	0.138***
	(0.044)	(0.045)	(0.041)
500-999	0.187***	0.181***	0.172***
	(0.062)	(0.065)	(0.057)
1,000 and more	0.111**	0.027	0.153***
	(0.051)	(0.052)	(0.047)
Number of Observations	9723	9723	9723
LR χ^2	2708.27	3149.59	1356.47
Pseudo R^2	0.2708	0.3252	0.1228

Significance levels: *: 10%, **: 5%, ***: 1%. Remarks: Between brackets are the heterogeneity robust standard errors. Also included: 13 dummies for job content, 46 dummies for economic sector and 11 dummies for the federal state.

Table III: Earnings Equations with External or Internal Training

Variable	External Training (OLS)	Internal Training (OLS)	External Training (IV)	Internal Training (IV)
Training	0.064***	0.014*	0.175*	0.080
	(0.010)	(0.008)	(0.095)	(0.139)
Education and Vocational Training				
School Attainment				
Without School Leaving Certificate	0.007	0.001	0.035	0.038
	(0.028)	(0.027)	(0.035)	(0.109)
Lower Secondary School	-0.007	0.000	0.020	0.049
	(0.012)	(0.011)	(0.019)	(0.076)
Entrance Examination for	0.027	0.083***	0.019	0.031
University of Applied Sciences	(0.033)	(0.021)	(0.048)	(0.159)
High School Diploma	0.063**	0.077***	0.060	0.104*
	(0.027)	(0.020)	(0.043)	(0.060)
Professional Education				
Without Professional Degree	-0.070**	-0.064*	-0.103*	-0.086
	(0.033)	(0.034)	(0.055)	(0.415)
Apprenticeship	-0.012	-0.006	-0.001	0.000
	(0.030)	(0.032)	(0.053)	(0.429)

Table III: Earnings Equations with External or Internal Training (continued)

Variable	External Training (OLS)	Internal Training (OLS)	External Training (IV)	Internal Training (IV)
Master Craftsman	0.041	0.046	-0.003	0.013
	(0.035)	(0.034)	(0.060)	(0.447)
University of Applied Sciences	0.067	0.111***	-0.014	0.145
	(0.054)	(0.040)	(0.116)	(0.389)
University	0.146***	0.201***	-0.016	0.146
	(0.052)	(0.041)	(0.115)	(0.360)
Professional Career				
Professional Experience	0.011***	0.012***	0.006**	0.005
	(0.002)	(0.002)	(0.003)	(0.004)
Professional Experience^2	-0.000***	-0.000***	-0.000**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Company Tenure	0.009***	0.008***	0.014***	0.014*
	(0.002)	(0.002)	(0.002)	(0.008)
Company Tenure^2	-0.000***	-0.000**	-0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment	-0.023**	-0.036***	-0.004	-0.009
	(0.011)	(0.010)	(0.015)	(0.053)
Professional Status				
Skilled Blue-Collar Worker	0.069***	0.076***	0.046*	0.072*
	(0.015)	(0.016)	(0.025)	(0.043)
Assistant Foreman	0.087***	0.070***	0.119**	0.011
	(0.025)	(0.026)	(0.051)	(0.090)
Master Craftsman	0.130***	0.160***	0.200***	0.185***
	(0.044)	(0.032)	(0.068)	(0.068)
Unskilled White-Collar Worker	0.068***	0.079***	0.075*	0.056
	(0.024)	(0.024)	(0.040)	(0.080)
White-Collar Worker with	0.042*	0.039**	0.048	0.046
Simple Tasks	(0.022)	(0.023)	(0.036)	(0.114)
White-Collar Worker with	0.140***	0.132***	0.170***	0.192**
Difficult Tasks	(0.023)	(0.020)	(0.044)	(0.089)
High-Skilled White-Collar Worker	0.198***	0.233***	0.092*	0.160*
	(0.024)	(0.021)	(0.054)	(0.091)
Executive White-Collar Worker	0.255***	0.335***	0.073	0.309***
	(0.044)	(0.031)	(0.109)	(0.089)
Civil Servant in Clerical Grade	0.145***	0.089***	0.106*	0.186*
	(0.034)	(0.028)	(0.063)	(0.102)
Civil Servant in Higher Service	0.240***	0.159***	-0.067	0.318*
	(0.059)	(0.033)	(0.416)	(0.163)

Table III: Earnings Equations with External or Internal Training (continued)

Variable	External Training (OLS)	Internal Training (OLS)	External Training (IV)	Internal Training (IV)
Civil Servant in Senior Service	0.576***	0.360***	0.484	0.442***
	(0.055)	(0.037)	(0.614)	(0.136)
Workplace Characteristics				
Computer Work Station	0.030**	0.041***	0.016	0.038
	(0.013)	(0.011)	(0.025)	(0.046)
Temporary Work	-0.041*	-0.060**	-0.029	-0.022
	(0.024)	(0.024)	(0.031)	(0.061)
Good Economic Situation	0.032***	0.041***	0.003	0.011
	(0.011)	(0.010)	(0.015)	(0.025)
Overtime	0.049***	0.050***	0.050***	0.064**
	(0.011)	(0.010)	(0.016)	(0.030)
Profit-Sharing	0.054**	0.073***	-0.009	0.067
	(0.022)	(0.020)	(0.035)	(0.185)
Incentive Wage	0.052***	0.037***	0.044***	0.069
	(0.012)	(0.011)	(0.017)	(0.043)
Individual Characteristics				
Children	0.056***	0.075***	0.049***	0.030
	(0.010)	(0.009)	(0.014))	(0.052)
Foreigner	-0.038**	-0.049***	-0.039)*	-0.096
	(0.017)	(0.019)	(0.022))	(0.090)
Size of Firm				
1-4	-0.072**	-0.049**	-0.099**	-0.033
	(0.028)	(0.023)	(0.040)	(0.101)
5-9	-0.062***	-0.059***	-0.039*	-0.073
	(0.016)	(0.015)	(0.023)	(0.105)
50-99	0.035**	0.022	0.040*	0.054
	(0.015)	(0.014)	(0.022)	(0.035)
100-499	0.058***	0.061***	0.071***	0.037
	(0.014)	(0.013)	(0.019)	(0.036)
500-999	0.096***	0.075***	0.124***	0.146**
	(0.021)	(0.019)	(0.033)	(0.061)
1,000 and more	0.123***	0.100***	0.160***	0.150***
	(0.016)	(0.014)	(0.023)	(0.042)
Selected Interaction Variables				
Professional Experience	0.005	0.004	0.017***	0.020
	(0.003)	(0.003)	(0.006)	(0.016)
Professional Experience^2	-0.000	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)

Table III: Earnings Equations with External or Internal Training (continued)

Variable	External Training (OLS)	Internal Training (OLS)	External Training (IV)	Internal Training (IV)
Company Tenure	-0.008***	-0.003	-0.021***	-0.015
	(0.003)	(0.003)	(0.005)	(0.011)
Company Tenure^2	0.000**	0.000	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Firmsize: 1,000 and more	-0.013	0.044**	-0.087**	-0.137
	(0.022)	(0.022)	(0.040)	(0.108)
Lower Secondary School	-0.048***	-0.070***	-0.112***	-0.205
	(0.017)	(0.018)	(0.037)	(0.149)
Unemployment	-0.019	0.012	-0.068**	-0.077
	(0.016)	(0.017)	(0.028)	(0.126)
Computer Work Station	0.027	0.020	0.048	0.014
	(0.018)	(0.018)	(0.044)	(0.143)
Temporary Work	-0.092**	-0.040	-0.095	-0.220
	(0.042)	(0.041)	(0.087)	(0.243)
Good Economic Situation	0.017	-0.002	0.080***	0.073
	(0.017)	(0.017)	(0.030)	(0.058)
Profit Sharing	0.023	0.002	0.101*	0.008
	(0.029)	(0.029)	(0.052)	(0.319)
White-Collar Worker with	-0.088**	-0.052	-0.115	-0.181
Difficult Tasks	(0.40)	(0.036)	(0.176)	(0.237)
Civil Servant in Clerical Grade	-0.176***	-0.078*	-0.072	-0.272
	(0.051)	(0.046)	(0.192)	(0.247)
Civil Servant in Senior Service	-0.181**	-0.049	0.179	-0.440
	(0.071)	(0.053)	(0.496)	(0.410)
Civil Servant in Higher Service	-0.360***	-0.124**	-0.262	-0.338
	(0.070)	(0.062)	(0.683)	(0.342)
Constant	7.803***	7.796***	7.945***	7.923***
	(0.063)	(0.062)	(0.094)	(0.328)
Observations	8325	8325	8325	8325
R^2	0.5094	0.4998	0.4443	0.2877

Significance levels: *: 10%, **: 5%, ***: 1%. Remarks: Between brackets are the heterogeneity robust standard errors. Also included: 13 dummies for job content, 46 dummies for economic sector and 11 dummies for the federal state.

Notes

[1]In the traditional Mincer equation, schooling is measured in years of schooling and is included as a linear term. We prefer a less restrictive functional form where we include dummies for the highest educational achievements.

[2]"The human capital earnings function contains, among other variables, years of (work) experience, (...), which enters in a nonlinear fashion. Its coefficients are interpretable as postschool human capital investment parameters" (Mincer, 1991, p. 32).

[3]The test statistic is: F(108, 8107) = 2.08, Prob > F = 0.00.

[4]We have tested for the relationship between wage and restructuring in the firm. Conditional on all covariates used here, there is no significant relationship. We suspect that restructuring in a firm might not lead to an immediate change in wages, but increases wages only later, when the investment pays off. With our cross-section data we are not able to test this hypothesis.

[5]Compare procedure 18.2 in Wooldrigde (2002), p. 626.

[6]To test the robustness of our specification, we alternatively use the vector of instruments Z directly as explanatory variables in the IV regressions (instead of $\widehat{T}^*$, where Z is included) to estimate $\widehat{T}^{**}$ and the interaction terms by IV.

[7]There are two questions referring to participation in continuing training. First, "Please think about the last five years, i.e. the time from 1994 until today. Did you attend during this time any seminars or courses which serve your continuous process of education?" We include only those workers who participated in training during the last two years. Second, "Which of the following possibilities of taking part in continuous training did you use during the last two years, i.e. from the beginning of 1997 onward, in order to aquire additional knowledge?" Here, eight training

categories are included. We chose not to use two of these categories, "internship" and "other kinds of training", because it is unclear what kind of training these variables capture.

[8]We know when the individual started his first job and we include a dummy for unemployment spells.

[9]Some of these variables may also be endogenous in the earnings equation. We do not control this, however, because the variables mainly serve as control variables for employee heterogeneity.

[10]We include only employees working 30 hours and above per week. Only 2.6 percent of the male employees work less than 30 hours. We also use a dummy for working overtime in order to take hours worked into account. The results do not change qualitatively, however, if we use log hourly wages instead of log earnings as the dependent variable.

[11]In order to include women, we would need to correct for sample selection in the earnings equation. This is impossible since only those women who participate in the labour market are included in the data.

[12]On the other hand, Blundell, Dearden and Meghir (1999) find for Great Britain the highest returns to training for employees with no qualifications.

[13]The test statistic is: $F(1, 8215) = 15.25$, $Prob > F = 0.00$.

[14]Note that training incidence is captured for a period of 2 years and may entail multiple training spells that have a cumulative earnings effect (Gerfin, 2004).

[15]An exception is the paper by Goux and Maurin (2000) who simultaneously take into account post-training employee mobility besides training selectivity.

[16]We assign all training forms either to internal or to external training, following the results of the factor analysis. It detects two independent factors with eigenvalues above 1. Both factors

explain about 52% of the total variance and clearly attribute every training form to one of both factors.

[17]Again, a Durbin-Wu-Hausman test confirms that internal and external training are endogenous in the wage equation (the F-statistic for internal training is: $F(1, 8000) = 2.85$, $Prob > F = 0.09$, while the F-statistic for external training is: $F(1, 8000) = 23.29$, $Prob > F = 0.00$).