# Returns to Company Training - Evidence from a New Approach Using Quasi Experimental Data*

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## Abstract

In the present paper we estimate wage returns to company training using representative individual-level cross-sectional data for the years 2000 and 2003 for Germany. We employ the approach proposed by Leuven and Oosterbeek (Journal of Applied Econometrics 2008) to identify average treatment effects on the treated. We narrow down the comparison group of non-participants first to the motivated, who wanted to participate but were not supported by their employer, and the eligible, who should have participated according to their employer but declined; and second to workers who should participate and declined due to some random event. Simple OLS estimates identify returns to company training amounting to 7.5% higher wages for participants. We do not identify any positive returns to training when we restrict the comparison group to motivated or eligible employees. Knowing that almost two thirds of training provided serves the purpose of adjustment to new job requirements we interpret our finding in a way that company training is meant to prevent productivity from falling rather than to cause a rise in productivity. It is therefore not surprising that we do not identify any wage effects of training once controlling for unobserved characteristics such as motivation or eligibility of the employees.

Keywords: Berichtssystem Weiterbildung, company training, wage returns, average treatment effect on the treated
JEL Codes: C21, J24, J31, M53

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## 1. Introduction

84% from a sample of German companies interviewed in a study of the Institut der deutschen Wirtschaft (IW) in the year 2004 fund training for their employees (Werner 2006). These training investments amount to a budget of 26.8 billion Euro for firm-sponsored training activities (Werner 2006). Given these significant expenditures it is surprising that there is still no general consensus on the returns to company training. The present paper contributes to the literature on returns to company training by using data that allow us disentangling company training from other forms of continuous training and by employing a new quasi-experimental approach to identify average treatment effects on the treated (ATT). In principle, the parameter of interest is the contribution of training to the value of the firm. However, investigations of this kind require detailed data about workers' productivity as well as worker and workplace characteristics. These data are only available on a firm level. Using firm level data restricts the generalization of the results, however.

When using representative individual level data the researcher is naturally limited to use the individual wage rate as a measure of productivity. Following the standard human capital theory (Becker 1962) wages reflect the marginal productivity of workers. This simple equation is challenged by the "New Training Literature" (Acemoglu/Pischke 1998, 1999). But, even when assuming various market imperfections like a compressed wage structure, mobility costs and asymmetric information it follows for the present study that wages of company training participants are expected to be higher than those of non-participants.

The stylized facts on the wage returns to training are characterized by a puzzling observation. Typically the wage returns to one week of training are found to be equivalent to the returns of one year of schooling. In particular the returns to training are found in a range of 7-18%. This result is found for different countries, using different econometric methods and data sets, for different definitions of training (see Bassanini et al. 2006). However, there is also evidence that the returns to training are negligible (e.g. Pischke 2001 for formal vocational training in Germany). The reasons for the presumably overestimated returns to training are due to the fundamental evaluation problem. The causal effect of training is the difference in outcomes for a worker when participating and when not participating in training. The fundamental evaluation problem denotes the fact that the outcome of a worker can be only observed in one state: either a worker participates in training or not. A selection bias is observed if the decision to participate in training systematically varies with the expected outcomes of training. Studies vary in the econometric approach to deal with the fundamental evaluation

problem. The typical parameter of interest is the causal effect of training for a participant which is called the average treatment effect on the treated (ATT).

Our empirical model follows the model in Leuven and Oosterbeek (2008), henceforth LO, who apply this model to Dutch data providing similar information as the data set we investigate in the present paper. In particular, by using answers to a question about any random event preventing already enrolled training participants from taking part in training we will be able to construct a control group which allows us under certain assumptions to estimate ATT of company training. A major difference of the present study to the study of LO is the definition of training. While LO apply their econometric approach to further continuous training in the private sector, the focus of the present paper is continuous private-sector training which is directly or indirectly financed by companies.

A further contribution of the present study it the restriction of the sample for the empirical analysis to workers with completed apprenticeship training. By this we already remove most of the heterogeneity of workers with respect to skill levels which is present in other studies.

The next section provides an overview of empirical studies which might serve as a benchmark for the present study. The empirical approach is described in section 3. Section 4 describes the data used for the empirical analysis. After presenting the results in section 5 we conclude with section 6.

## 2. Overview over empirical studies for Germany

A comparison of returns to training for different countries critically hinges on a consideration of the vocational training system in the country. Different definitions of company training and measurement problems complicate even a comparison of studies on that topic in one country. Measurement problems might arise from the comparison of a different length or a different number of training spells. The retrospective nature of self-reported training measures introduces recollection problems depending on the time elapsed between the training incidence and the time of the interview (Bassanini et al. 2006). To benchmark our results we report some details about studies on returns to continuous training in Germany in the following. For comparable overviews on this issue for other countries we refer to LO, Muehler et al. (2007), Asplund (2005) and in particular Bassanini et al. (2006). As it will turn out, however, other studies for Germany operate with a broader concept of continuous training

Using data from the German Socio Economic Panel (SOEP) Pischke (2001) analyses different aspects of incidence, financing and effects of occupational training for Western German

employees. Like for the definition of company training in the Berichtssystem Weiterbildung (BSW) continuous training in Pischke (2001) is limited to formal training in terms of courses and seminars. Following Pischke's definition, vocational training does not necessarily have to correspond with the employer nor to be company-sponsored. However the better part of vocational training takes place during work hours, at least to some extent. Therefore, it is to some extent comparable to the definition of company training in the BSW and Pischke's results serve as a reference for our results. Due to the panel structure of the data, Pischke (2001) is able to conduct fixed-effects-regressions. Without discriminating if training took place during work or leisure hours, training leads to positive but insignificant returns. Estimates for on-the-job-training (during work hours) do not result in significant effects either. To account for unobserved characteristics influencing the wage growth of participants unrelated to training participation Pischke (2001) applies a fixed-growth-regression whose coefficients are indeed higher than the ones of the previous fixed-effects-estimation but still insignificant. Altogether the findings suggest that continuous training does not results in wage returns for the employee. Instead any rents generated by productivity increases due to training are taken by the employer.

Evidence for positive effects of training on earnings is given by Kuckulenz and Zwick (2003). They use cross section data of the BiBB/IAB „Qualification and Career Survey" 1998/99 and apply two instruments to account for a selection bias. The first identifying variable is the individual perception whether further training is necessary and a second instrument is constituted by the response to a survey question about changes in the workplace environment, e.g. reorganisation. According to the instrumental variable estimation participation in training causes a 15 percent higher wage, although the effect varies by qualification and experience of the employee. In a second step Kuckulenz and Zwick (2003) discover that the effect mainly arises from external training, which also contains formal courses and seminars and is thus similar to company training in the BSW. However, in terms of our definition it is also possible that formal training is conducted internally, so that the results are not completely comparable.

In analogy to Pischke (2001), Büchel and Pannenberg (2004) also estimate the returns to training by fixed-effects-regressions using SOEP data. They report average wage returns of 4 to 7 percent for formal vocational training of employees. Apart from distinguishing different age groups they also consider regional differences between East and West Germany. Because training has to take place neither in the company nor during work hours, it is difficult to compare their results to our findings. The estimation results of the returns to training in the

study of Büchel and Pannenberg (2004) might as well originate in employees investing in other work-related training, i.e. training that is neither conducted by the employer nor during work hours. According human capital theory this should also end up in higher wages although there is no direct relationship to the employing firm.

In contrast, Kuckulenz and Zwick (2005) examine wage effects of on-the-job-training. Although this is not explicitly defined, training is obviously employer-financed. Again using in-firm reorganisation as an instrument they find weakly significant returns of 16,1 percent. Differenciating between external and internal training reveals again that the results are predominantly based on general training (e.g. formal training). This type of training rises earnings by 17.5 percent but is of only weak significance.

Jürges and Schneider (2006) estimate a fixed-growth-model with SOEP data and report similar results like Pischke (2001). Neither males nor females receive higher wages after participating in training. Again there is no complete match with the BSW definition since Jürges and Schneider (2006) do not account for short-term training spells, even if these are financed by the company.

In the most recent study Muehler et al. (2007) investigate returns to continuous training with SOEP data. Their definition of training comprises job-related courses and seminars within the 3 years preceding the interview including training which is directly or indirectly financed by the employer and other forms of training. Using information about the transferability of the acquired skills this study is able to distinguish returns to firm-specific training from returns to general training. They use a combination of a matching with a Difference-in-Difference approach. While this approach is superior to the very restrictive assumptions of the matching approach it relies on the assumption that wages of matched non-participants evolve in the same way as the wages of participants would, had they not been trained. This assumption is critical, if the enrolment in training courses is the outflow of unobserved motivation which makes a training participant more productive than the non-participants in the case of non-participation. The key finding is that there is a significant wage increase for general training while they did not find any wage effects for firm-specific training. Given the fact that the length and frequency of the training spells is not observed it is difficult to evaluate the magnitude of the effects, however.

German studies so far indicate that there are no general results for returns to training. Partly there are no significant effects at all. Even significant values for vocational training are quite heterogenous comprising a range of about 4 to 15 percent. Only one analyses explicitly deals with on-the-job-training and finds very high wage returns of 17.5 percent, even though the

Table 1: Overview of wage effects of continuous training in Germany

| Study | Data | Period | Form of training | Method | coefficient | standard error |
|---|---|---|---|---|---|---|
| Pischke (2001) | SOEP (Western Germany) | 1986-1989 | Formal continuous training (years) | FE | 0,026 | 0,019 |
| | | | | FG | 0,038 | 0,027 |
| | | | - during work hours | FE | 0,001 | 0,029 |
| | | | | FG | 0,031 | 0,029 |
| | | | - during leisure hours | FE | 0,043* | 0,024 |
| | | | | FG | 0,041 | 0,038 |
| Kuckulenz and Zwick (2003) | BiBB/IAB | 1998/1999 | Participation in continuous training | IV | 0,15*** | 0,042 |
| | | | - external (courses also) | IV | 0,13*** | 0,066 |
| | | | - internal | IV | -0,02 | 0,044 |
| Büchel and Pannenberg (2004) | SOEP | 1984-2002 | Participation in formal continuous training | FE (mean) Western Germany | 0,039*** | 1) |
| | | | | FE (mean) Eastern Germany | 0,069*** | |
| Jürges and Schneider (2006) | SOEP | 1981-2000 | (long-term) vocational training (years) | FG Male | -0,004 | 0,029 |
| | | | | Female | 0,0426 | 0,058 |
| Kuckulenz and Zwick (2005) | BiBB/IAB | 1998/1999 | Participation in firm-sponsored training | IV | 0,161* | 0,084 |
| | | | - external | IV | 0,175* | 0,095 |
| | | | - internal | IV | 0,080 | 0,139 |
| Muehler et al. (2007) | SOEP (only male respondents) | 2000 and 2004 | Continuous training (CT) | MDiD | 0.049*** | 0.015 |
| | | | Firm-specific CT | MDiD | 0.061*** | 0.017 |
| | | | general CT | MDiD | 0.018 | 0.022 |

Notes: 1) The values were determined by taking the difference between the coefficients before and after training. Büchel/Pannenberg (2004) check significance by means of a Wald-Chi$^2$-test.
Significance levels of 1% (5%, 10%) marked by *** (**,*). FE: fixed-effect-estimation; FG: fixed-growth-estimation; IV: instrumental variable estimation; MDiD: Combination of matching and difference-in-difference approach

definition is not completely comparable to our definition. It strikes that especially instrumental variable approaches lead to high results.

## 3. Empirical Strategy

Our empirical model follows the model in LO who apply this model to Dutch data which provide similar structured information than the data used for the analysis in the present paper. As we will show in the second part of this section, LO show that information about a random event preventing workers enrolled for company training to take part in that training can be used to create control groups which allow under certain assumptions to identify average treatment effects on the treated (ATT). We will first explain how we construct participant and control groups with the data used for the present study.

### *Composition of participant and comparison groups*

The BSW does not allow a straightforward identification of company training since there is no direct survey question about that. Nevertheless, it can be constructed by considering the attendance of formal vocational training in the employing company or during work hours. For participation in training programmes during the past year, i.e. 2000 or 2003, details for up to four courses were observed. Besides the purpose of the course (adjustment to a new job, other course, orientation, career development, re-training) the survey asked for duration, subject and institution. Furthermore, it was examined whether training was attended during work hours and if a certificate was delivered. As there were no detailed questions about the structure of financing, company training can only be defined by the aforementioned available information about the training participated in.

For our analysis we compose five groups that are summarized in table 2. Participant group I (PI) consists of those persons, who participated in at least one company training incidence during the past year. To avoid that acquired human capital originates from other work-related courses, employees are only included if all their courses fall in the category of company training. Participant group II (PII) consists of employees who only followed one course and is a subsample of PI. The comparison groups were also constructed in several steps. Members of comparison group I (CI) either did not participate in company training (i.e. they might have participated in other vocational training). However, in most cases the decision in favour or against training is not random. Instead it depends on the employee´s motivation on the one hand and the employer´s will to promote the employee on the other hand. Selection bias arises if those employees who are willing to participate also possess unobserved characteristics that

lead to higher training benefits for them. Just as well the company preferably chooses persons which seem more talented and therefore generate higher returns. For that reason comparison group II (CII) includes only those who wanted to follow courses but were not supported ("motivated") or who should participate but declined to do so ("eligible"). This is done on the basis of the following two survey-questions: „Did you experience in the last year an incident that you did like to participate in company training but your supervisor did not approve it?" indicates the participant´s motivation. The second question „Did you experience an incident in the last year that your supervisor did suggest you to participate in company training but you refrained from doing so?" identifies potential participants whose training participation is of value for the employer. For the latter persons there is another question that clarifies the reasons for not taking part in the training. Possible causes are (a bad) state of health, lack of time due to work load or family commitments or a refusal because participation would not have been of advantage. The last reason reflects a lack of motivation though. Merely non-participants who rejected due to a random event but would have participated otherwise are assigned to comparison group III (CIII). This is important because causal effects can only be identified if the events that led to the assignment are exogenous. Instruments have to be independent of any utility considerations, i.e. the potential outcomes. We will treat this formally in the next subsection. Note that CII is a sub-sample of CI and CIII is a sub-sample of CII and CI.

In this context we declared the following events as random: bad state of health or an illness, lack of time due to work load and family commitments. A bad state of health or an illness is considerably a random event. If the person had a chronic disease she would probably not be assigned by the company to participate in a training course because sending someone who is often ill leads to fewer returns than sending a sound person who can more frequently apply the training contents. Beneath health, also a lack of time is considered to be random. It is more likely that firms will only release people from work to attend training if the expected future returns to training are higher than the returns to the regular occupation. The line manager will only offer training if he presumes that the employee is able to redistribute the work load (in terms of time or colleagues). From the employee's point of view „lack of time due to work load" is no elusive answer of someone who is actually not interested in the training. If this is the case she could have answered that participation would not have been of advantage. If both parties expect the training to be profitable non-participation should be random, e.g. because the work load cannot be redistributed on short notice. The random character of family commitments can be supported by the fact that we restrict the sample to

full-time employees. If someone had small children there seems to be a way of handling them in the normal course of life and still following the regular occupation.

Table 2: Definition of the participant and comparison groups and average hours of training participation

| Group | Definition | Average number of training hours per participant group – short description: |
|---|---|---|
| Participant group I | Participant in at least one training | 80,4 hours "total training" |
| Participant group II | Participant in exactly one training | 69,8 hours "one training incidence" |
| Comparison group I | Persons without training | „standard" |
| Comparison group II | Persons without training who wanted to follow courses but were not supported or who should participate but declined | "motivated" |
| Comparison group III | Persons without training who should participate but declined due to a random event | "random event" |

Note: Persons who have effectively followed more than one training course (participant group I excluding participant group II), report an average duration of training participation of 105,5 hours.

Source: Own calculations with BSW 2000 and 2003.

***Identification of average treatment effects***

The strategy to identify average treatment effects follows LO. Let instrument $Z$ denote a binary random event. For a randomly chosen individual we define $Z_i = 1$ if the random event occurred and $Z_i = 0$ if it does not occur. Training participation $D_i$ depends on $Z_i$ in the following way:

$$D_i = D_i^0 + (D_i^1 - D_i^0)\, Z_i\,. \qquad (1)$$

There are two states of participation. Without an occurrence of the random event we observe $D_i^0$, while $D_i^1$ indicates participation in training when the random event does occur. The difference $(D_i^1 - D_i^0)$ constitutes the causal effect of the instrument on participation (Angrist/Imbens/Rubin 1996). As we are interested in the causal effect of training participation on the training outcome wage ($Y$) we need the additional assumption that $D$ and

$Y$ are independent. This is true if $Z$ is independent of the potential training outcome for the participant. In addition, we need to assume that the instrument does not influence what an individually normally would do. The assumptions on the existence of an instrument are summarized in condition I where we denote the wage outcome with training as $Y^1$ and the wage outcome without training with $Y^0$:

> ***Condition I: (Existence of an instrument):*** Let $Z_i$ be a binary variable such that (i) $Z_i$ is jointly independent of $\{Y_i^0, Y_i^1, D_i^0, D_i^1\}$ and ii) Prob($D_i = 1|Z_i$) is a nontrivial function of $Z_i$.

While instrumental variables are typically used to allow for an exogenous selection into participation, the random event in our case leads to non-participation. If all individuals comply in their participation decision with the state of the random event than a comparison of mean wages between participants and non-participants allows an evaluation of wage effects of company training. Because individuals are heterogeneous with regard to the benefits they expect to receive from training we might observe individuals who participate despite being ill, who never take part in training irrespective of the random event or who do the opposite than what is to be expected given the status of the random variable $Z$ (defiers). Only those who change their behavior with an exogenous variation of the instrument (compliers) are used to estimate the treatment effect (Angrist/Imbens/Rubin 1996). Following Imbens and Angrist (1994) a second non-testable but straightforward condition therefore ensures a monotone reaction:

> ***Condition II (monotonicity)***: $D_i^0 \geq D_i^1$ for all $i$.

In the context of the present paper this means that a worker who does not want to participate in company training in the state of good health, will even more not participate if he has flue. To identify our primary parameter of interest ATT, the instrument needs to prevent all workers who experience such a random event from participating in company training (Angrist and Imbens 1991, LO). This is done formally with the following condition:

> ***Condition III (homogeneity)***: Pr($D$=1|$Z$=1)=0.

When excluding the always-takers we have the ATT, defined as $\Delta^{ATT}$ = E[$Y$|$Z$ = 0] - E[$Y$|$Z$ = 1] / Pr($D$ = 1|$Z$ = 0). However, as LO we have no information about $Z_i$ for those participating

in company training. A direct identification of the term $\Delta^{ATT}$ is impossible because we cannot say whether participants experience an event which should have prevented them from taking part in company training. Only non-participants were asked why they did not participate.

LO show how we can use some algebraic transformation of the counterfactual outcome to identify wage effects of company training using an appropriate comparison group. Because our data set is in this respect comparable to that of LO we describe this approach in the following. We first decompose the counterfactual wage outcome, i.e. the wage of a participant in company training if he/she would not have participated in company training, in a part where the random event occurs and a part where it does not occur weighted with the probability that the random event happened and the probability that the random event does not take place, respectively:

$$\begin{aligned} \mathrm{E}[Y^0 | D = 1] = \mathrm{E}[Y^0 | D^0 = 1, Z = 0] \cdot \Pr(Z = 0 | D = 1) \\ + \mathrm{E}[Y^0 | D^0 = 1, Z = 1] \cdot \Pr(Z = 1 | D = 1). \end{aligned} \quad (2)$$

If a worker in the case that the random event occurs never takes part in company training (which follows from condition III), it follows vice versa that the conditional probability for the random event occurring for a participant is zero. In this case the second part of the equation drops and we can summarize the first part of the equation as:

$$\mathrm{E}[Y^0 | D = 1] = \mathrm{E}[Y^0 | D^0 = 1, D^1 = 1, Z = 0]. \quad (3)$$

Equation (3) cannot be estimated directly because we do not observe the outcomes of all workers for whom $Z$=0. Using the particular information in the BSW-data we observe the conditional expected outcome for those workers who experience an event classified as a random event when being enrolled for company training ($Z$=1). Because these workers are already enrolled and would have participated in company training in a normal course of events ($D^0 = 1$) we know that $D^1 = 0$. We observe therefore the conditional expected outcome $\mathrm{E}[Y^0 | D^0 = 1, D^1 = 0, Z = 1]$. Using statistical independence between $Y$ and $Z$ (condition I), this conditional expected outcome equals the outcome in equation (3) and we are able to identify the wage effect of company training for participants using the comparison group "random event" (CIII).

LO argue that a violation of conditions I and III leads to an overestimation of the true wage effect of training. In particular, a violation of the order condition of the instrument $Z$

(condition I (i)) will lead to an overestimation of the true effect. This is explained by the fact that any potential correlation between $Z$ and $Y_i^0$ is negative. A worker who is ill more often will have a lower productivity reflected in lower wages. A violation of condition III would also lead to an overestimation of the true wage effect of company training. Participants of company training who would have participated in any case i.e. irrespective of the occurrence of a random event (always-takers), are suspected to have higher expected returns to company training than those workers who sign off in case of a random event. Our estimates of ATT of company training will provide therefore an upper bound of the true effect.

## 4. Data

The data stem from the triennial German cross-sectional survey „Berichtssystem Weiterbildung“ (BSW) which has been accomplished since 1979. The purpose is a representative snapshot of training behaviour of 19 to 64-year old Germans. Apart from periodic questions concerning types of training, workplace characteristics and individual features, varying current topics in training are studied, e.g. attitudes towards training in East and West Germany were compared (Kuwan et al. 2006).

Our study is based on the BSW data of 2000 and 2003 (BSW VIII an IX). In each year about 7000 persons were interviewed (TNS-Infratest 2004 and Bilger 2006). In order to analyse company training we limit the sample used for the present analysis to full-time employees with completed apprenticeship training. Moreover, persons who had been unemployed during a training spell were excluded to make sure that wage effects are only based upon the training incidences. By this we ensure that our results are not biased by any preceding public sponsored training programmes. Due to these selections our sample comprises 5157 observations for both years.

As already mentioned above one of the important features of the different studies on returns to training is the definition of training. Using the in this respect detailed in formation in our data source (BSW) we define company training as a subset of formal vocational training of employees. Thereby, other important forms of firm-based training like (informal) learning on-the-job are excluded by definition. Apart from training conducted by the employer, the form of company training considered in the present analysis comprises training during work hours (Kuwan et al. 2006). This means that the employer bears direct or indirect costs. When inspecting the total sample in the years 2000 and 2003 36.9% of all workers in the sample participate in any form of continuous training (including company training) and about a fourth (26.3%) participates in company training according to the definition in the present paper.

Table 3: Features of firm-sponsored for participant group I

| | |
|---|---|
| **Purpose of training** | |
| Adjustment to a new job | 42,83 % |
| Other course | 30,06 % |
| Orientation | 17,93 % |
| Career development | 7,59 % |
| Re-training | 1,58 % |
| **Subject of training**[1)] | |
| Computer applications (commercial domain) | 10,81 % |
| Operating machinery and equipment | 9,10 % |
| Commercial training | 7,71 % |
| Computer applications (technical domain) | 7,17 % |
| Education, psychology | 6,96 % |
| Other subjects | 6,85 % |
| Leadership training, management, self-management | 6,75 % |
| Quality management | 6,10 % |
| **Certificate** | |
| Yes | 64,32 % |

Note: All calculations are based on the data excluding missing values. Thus, the number of participants may vary with the object of investigation. [1)] Only courses with more than 6 percent of all training incidences are listed.

Source: Own calculations with BSW 2000 and 2003.

Table 3 lists the purpose and the subject of the observed training courses for participants reporting one ore more training incidences in the year preceding the year of the interview. Besides a big share of training incidences serving an unspecified training purpose (30.06%) the largest share of training serves adjustment to a new job (42.83%). Taking together with training for the purpose of orientation about 60% of all company training is meant to ensure a minimum level of productivity of the employee at the workplace. Only 7.59% of all training incidences are explicitly dedicated to career development. This information is important in the light of the conjecture by Muehler et al (2007) that positive wage returns of continuous training are not to be expected when training is provided by firms to adjust to new job requirements. Regrettably, for a clean comparison between participant and comparison groups we have no information about the purpose and subject of training courses which the workers in comparison groups II and III would have followed.

Subjects of training are quite disperse and computer applications are prominent. 64% of all incidences of company training issue a formal certificate of attendance and may be thereby

documented to other employers. At least part of the company training is therefore general in the sense that it provides skills valuable to other employers.

The dependent variable is the logarithm of the net wage of the workers in the month preceding the day of the interview. Wage is reported in the survey in 9 narrow wage brackets. We assign the mid of each wage bracket as the respective wage to each worker. When taking into account that metric measures of the wage are often imprecise measured we can assume that the categories are comparable to metric measures of the wage. However, we will show the robustness of our results with estimates of ordered logit models which take the wage categories as the dependent variable.

## 5. Results

### *Descriptive Statistics*

A first thing to note is that despite the overall considerable size of our sample the number of observations in CIII is small. The frequency of the random events observed in our sample is for bad state of health or an illness: 15, for lack of time due to work load: 44, and for family commitments: 22.[1]

Sample means of the core characteristics influencing the participation in company training and wages are reported in table 4. It strikes that the characteristics of comparison groups II and III are more comparable to that of the participant groups than that of comparison group I. In particular the differences of the schooling degrees, professional degrees and firm size are noticeable. Among the workers in the simple group of non-participants are more with a low schooling degree and less workers with a high schooling degree. In this group is a lower fraction of master craftsmen and those with an academic degree than in the other groups. Moreover, the fraction of workers in smaller firms is much higher in the group of non-participants than among the PI and PII or CII and CIII. To check whether the differences in the reported means are significant we report in Table 5 p-values of t-test in the case of continuous variables and of the non-parametric Wilcoxon-Mann-Whitney rank-sum tests in the case of categorical variables. In fact the qualification variables and firm size variables differ significantly between participant groups and CI. There are no significant differences, however, in qualification levels or firm size for a comparison between participant groups and CII and CIII. The influence of qualification and firm size on training participation is in line

[1] Due to multiple answers permitted, the overall frequencies exceed the number of observations in comparison group III (76).

with studies on the determinants of participation in company training (see e.g. Asplund 2005 and Bassanini et al. 2006).

Table 4**:** Sample means of participant and comparison groups

| | Participant group | | Comparison group | | |
|---|---|---|---|---|---|
| | I | II | I | II | III |
| | (1) | (2) | (3) | (4) | (5) |
| Male | 0,63 | 0,63 | 0,62 | 0,62 | 0,61 |
| Age | 40,59 | 40,82 | 40,83 | 40,44 | 42,99 |
| Children | 0,44 | 0,42 | 0,46 | 0,52 | 0,51 |
| German | 0,98 | 0,98 | 0,94 | 0,94 | 0,95 |
| Single | 0,74 | 0,78 | 0,74 | 0,71 | 0,83 |
| **Schooling**: | | | | | |
| - low | 0,22 | 0,23 | 0,35 | 0,26 | 0,27 |
| - intermediate | 0,46 | 0,47 | 0,42 | 0,43 | 0,45 |
| - high | 0,32 | 0,30 | 0,22 | 0,31 | 0,28 |
| **Vocational training**: | | | | | |
| - None | 0,03 | 0,03 | 0,10 | 0,06 | 0,05 |
| - Apprenticeship | 0,60 | 0,63 | 0,65 | 0,55 | 0,54 |
| - Master craftsman | 0,13 | 0,12 | 0,09 | 0,14 | 0,13 |
| - University | 0,25 | 0,22 | 0,16 | 0,26 | 0,28 |
| **Firm size**: | | | | | |
| - up to 19 employees | 0,22 | 0,22 | 0,36 | 0,22 | 0,17 |
| - up to 99 employees | 0,23 | 0,24 | 0,26 | 0,21 | 0,23 |
| - up to 999 employees | 0,26 | 0,28 | 0,24 | 0,31 | 0,32 |
| - more than 999 employees | 0,28 | 0,27 | 0,13 | 0,26 | 0,28 |
| Number of observations | 1354 | 951 | 3577 | 242 | 76 |

Source: Own calculations with BSW 2000 and 2003.

Significant differences between participant groups and all comparison groups are found for German nationality, showing that the somewhat smaller percentage of workers in the comparison groups compared to the participant groups is in fact significant. Workers in the "random event"-group (CIII) are on average significant 2 years older which might be related to the fact that older workers are more inclined to unforeseen illness than their younger colleagues.

Table 5**:** Tests of equality between participant (P) and comparison (C) groups

| | PI vs. CI (1) | CII (2) | CIII (3) | PII vs. CI (4) | CII (5) | CIII (6) |
|---|---|---|---|---|---|---|
| Male | 0,5856 | 0,7045 | 0,6835 | 0,7077 | 0,7523 | 0,7103 |
| Age | 0,4839 | 0,8398 | 0,0479** | 0,9793 | 0,6208 | 0,0838* |
| Children | 0,6306 | 0,3331 | 0,2688 | 0,2378 | 0,1853 | 0,1777 |
| German | 0,0000*** | 0,0009*** | 0,0670* | 0,0000*** | 0,0033*** | 0,0965* |
| Single | 0,9893 | 0,4801 | 0,3168 | 0,1725 | 0,1510 | 0,5179 |
| Schooling | 0,0000*** | 0,3069 | 0,2940 | 0,0000*** | 0,7995 | 0,5567 |
| Vocational training | 0,0000*** | 0,9757 | 0,7425 | 0,0000*** | 0,3599 | 0,3642 |
| Firm size | 0,0000*** | 0,9656 | 0,5214 | 0,0000*** | 0,8207 | 0,4473 |

Note: The p-values are based on a t-test for the continuous variable age and on rank-sum tests for the categorical variables male, number of children, German, single, schooling, vocational trainings and firm size.
Significance levels of 1% (5%, 10%) marked by *** (**,*).

Source: Own calculations with BSW 2000 and 2003.

### *Estimation Results*

To estimate the returns to company training we investigate four specifications. In a first specification we simply test the difference in wages between the participant group and the control group; in a second specification we estimate a Mincer-type equation including indicator variables for schooling and professional education, age and the square of age. A third specification includes further control variables such as gender, nationality, living in west Germany, marital status, number of children, firm size and industry. A fourth specification in addition controls for the participation in general continuous education. The latter specification accounts for Pischke's (2005) conjecture that due to the complementarities between formal and informal types of specifications which not control for the percentage of informal education will overestimate the return to formal training.[2]

[2] The correlation between at least one incidence of company training (PI) and informal training is 0.2723 and between PI and general training 0.188. The correlation between exactly one incidence of company training (PII) and informal training is 0.1947 and between PII and general training 0.1279.

Table 6: Overview of wage effects of on-the-job training for different participant and comparison groups (OLS)

| | Dependent variable: ln (net monthly wage) | | | |
|---|---|---|---|---|
| | (1)<br>No control variables | (2)<br>Approximated Mincer-equation | (3)<br>All control variables | (4)<br>All control variables incl. general training and informal training |
| PI vs. CI | 0,1754 (0,0120)***<br>$R^2$: 0,0256; N: 4637 | 0,1143 (0,0174)***<br>$R^2$: 0,2079; N: 4536 | 0,0953 (0,0209)***<br>$R^2$: 0,2973; N: 2430 | 0,0858 (0,0220)***<br>$R^2$: 0,2982; N: 2430 |
| PI vs. CII | 0,0189 (0,0404)<br>$R^2$: 0,0002; N: 1504 | 0,0003 (0,0355)<br>$R^2$: 0,2119; N: 1485 | 0,0065 (0,0422)<br>$R^2$: 0,3199; N: 699 | 0,0079 (0,0421)<br>$R^2$: 0,3211; N: 699 |
| PI vs. CIII | -0,0147 (0,0561)<br>$R^2$: 0,0000; N: 1351 | -0,0284 (0,0420)<br>$R^2$: 0,2154; N: 1337 | -0,0173 (0,0555)<br>$R^2$: 0,3098; N: 637 | -0,0178 (0,0552)<br>$R^2$: 0,3109; N: 637 |
| PII vs. CI | 0,1476 (0,0247)***<br>$R^2$: 0,0148; N: 4257 | 0,1021 (0,0215)***<br>$R^2$: 0,1943; N: 4160 | 0,0822 (0,0232)***<br>$R^2$: 0,2883; N: 2284 | 0,0750 (0,0243)***<br>$R^2$: 0,2890; N: 2284 |
| PII vs. CII | -0,0089 (0,0429)<br>$R^2$: 0,0001; N: 1124 | -0,0131 (0,0378)<br>$R^2$: 0,1952; N: 1109 | -0,0151 (0,0434)<br>$R^2$: 0,3232; N: 553 | -0,0116 (0,0434)<br>$R^2$: 0,3264; N: 553 |
| PII vs. CIII | -0,0425 (0,0580)<br>$R^2$: 0,0005; N: 971 | -0,0438 (0,0440)<br>$R^2$: 0,1971; N: 961 | -0,0465 (0,0543)<br>$R^2$: 0,3079; N: 491 | -0,0467 (0,0536)<br>$R^2$ :0,3121; N: 491 |

Note: Control variables are gender, age, age squared, Western Germany, marital status, number of children, nationality, schooling, vocational training, firm size and industry. Estimations use sample weights.
The table displays the coefficients of the OLS-regressions. Standard errors in parentheses..
Significance levels of 1% (5%, 10%) marked by *** (**,*).

Source: Own calculations with BSW 2000 and 2003.

For reasons of brevity, we report only the coefficients for the training dummy for estimations with the different participant and comparison groups in table 6.[3] In all specifications we find significant returns to training when comparing participants with non-participants (CI). In our preferred specification with a full set of control variables we find that employees with only one training incidence (PII) earn 7.5% higher monthly wages. This magnitude is in line with the literature on returns to training (e.g. Parent 1999). When taking the observed average training length of 2 weeks in our data set and extrapolate that to 40 weeks of training as an equivalent of a one year course we estimate annual returns of 150% higher wages for participants in company training. This number contrasts to the average return to one year of

[3] Detailed results for all specifications are presented in table A1 in the appendix. The coefficients are all in line with findings in the literature on wage regressions. Somewhat weird is the significantly lower wage for those with an intermediate schooling degree compared to those with a basic schooling degree in the estimations using CI. Because we restrict the sample to workers with completed apprenticeship training the distribution of schooling degrees is not representative in our sample with an overrepresentation of those with an intermediate schooling degree. Those with a basic schooling degree are underrepresented, implying presumably a positive selection of workers with a basic schooling degree.

schooling amounting to returns between 2 to 11% (see Card 1999 for an overview). We identify no returns to training as soon as the wages of participants are compared to "motivated" or "eligible" non-participants. These results are robust to estimating the more appropriate ordered logit model.[4] The results suggest that the returns to training are returns to unobserved motivation on the side of employers or a particular suitability of the employee for the job reflected in the eligibility for training recognized by the employer rather than returns to the training per se. This is in line with findings by Pischke (2001) and LO.

***Discussion***

The main difference to the study of LO is the observation that returns to company training drop and the point estimate gets even slightly negative when restricting the comparison group to CII. When comparing this finding with that of LO for private-sector training, they report a return to training of 7.9% when comparing with their comparison group CII which is even higher than what we found for a comparison with CI but returns to training are almost nil when comparing with their CIII. A first thing to note is that our CII consists of those who want to participate but did not do so and those who should participate while the CII of LO consists only of the former. However, our results are robust when including only those who want to participate and excluding those who should.[5] Starting with the survey in 2003 there is also a question why those who want to participate were not allowed to take part in company training. Because of the small number of observations and the fact that it is not available for the 2000 cross-section we cannot systematically use this information in estimations. But an exploratory study shows that most of the reasons are due to time restrictions or reasons like overbooked course and course cancelled due to insufficient number of participants. Some mention that the participation has been denied due to the costs of the course. This could in principle reflect considerations that the perceived benefits of training are low and that the employer considers the employee in fact not eligible for training. It might, however, also reflect the simple fact that the yearly training budget of the department is exhausted. In short, there might be more members of CII who did not participate due to some random event than in fact identified in CIII. This might explain why the results for comparison group CII in our study are more comparable to the results generated with CIII in LO.

The time spell between participating in company training and the month where our wage information is taken from (month preceding the interview) is one year at maximum. This

[4] Detailed results are presented in table A2 in the appendix.
[5] Detailed results are available upon request.

entails two problems which might explain why we might not identify any returns to training even when assuming according to standard human capital theory that wages reflect productivity. Firstly, it may take some time till the training increases productivity at the workplace or the employer is able to observe the productivity increase at the workplace. Secondly, wages are not adjusted on a monthly basis. A period of less than a year might be too short to observe an adjustment of wages to a higher productivity due to training.

The observation of wage increases in the succession of training participation hinges on the assumption that the employer shares the rents of a productivity increase following from training. The amount the employer is going to share hinges on how firm-specific training is and on the sum of costs of training the employer is going to bear. While we have no information about the latter we can assume that a considerable part of the training incidences observed in our data set provide skill transferable to other employers. Otherwise a certificate documenting the training participation would be redundant.

Another aspect which might make it difficult to identify wage returns to training might be exhibited by the fact that an increasing productivity after training participation might be compensated by non-pecuniary benefits. The reward of training for the worker might be increasing job security or long-term career prospects.

We have to assume that the purpose of the training courses which the non-participants in CII and CIII would have liked to follow is similar to the courses the participants did actually follow. In contrast to the data used by LO we have no direct information on the purpose of the courses which the non-participants would have liked to follow. We know form the information provided in table 3 that most of the training courses the participants would have liked to follow are courses which should help the participants to meet the required skills at the workplace. But if workers in CII and CIII would have liked to attend rather training courses which serve their career advancement their motivation and therefore their expected wage increase in the absence of training is supposed to be lower than the motivation of the participant.

## 6. Conclusion

We employed an alternative method proposed by LO to measure the wage returns to company training. Our results suggest that what is typically measured as the returns to training are returns to some unobserved characteristics rather than to training per se. By that we are able to qualify some puzzling high returns to training found in previous studies on company training and provide confirming evidence on other studies which try to account for the

selection into training in their empirical approach like Pischke (2001),Muehler et al. (2007), and LO.

In estimates where we take workers who are motivated to take part in company training but did not get the chance to do so or who are considered as eligible for training by their employer but declined to take part in training as the comparison group (CII) the point estimate of training is even negative. In combination with the observation that a large part of the provided company training serves the purpose of adjustment to new job requirements the observed wage effects in estimates with comparison group CII and CIII provide supporting evidence for the argument by Muehler et al. (2007) that most of the observed training incidences might prevent productivity from falling rather than leading to an increasing productivity. If this explanation is valid it is therefore not surprising that we do not observe any wage effects of training once controlling for the selection of motivated and eligible employees with the prospect of increasing earnings into training.

A particular strength of the data used for the present study is the possibility to isolate participation in exactly one company training incidence. In addition, we removed most of the heterogeneity of workers with respect to skill levels which is present in other studies on returns to continuous training by restricting the sample used for the empirical analysis to workers with completed apprenticeship training.

We discussed different reasons why any productivity effects of company training might not be reflected in wages. Future research awaits the availability of data providing direct productivity measures along with information allowing to the construction of appropriate comparison groups to identify ATT.

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Table A1: Detailed list of coefficients for estimates repored in table 6

| No control variables | | | | | | |
|---|---|---|---|---|---|---|
| | **PI vs. CI** | **PI vs. CII** | **PI vs. CIII** | **PII vs. CI** | **PII vs. CII** | **PII vs. CIII** |
| Company training | 0,1754*** | 0,0189 | -0,0147 | 0,1476*** | -0,0044 | -0,0487 |
| | (0,0120) | (0,0404) | (0,0561) | (0,0247) | (0,0434) | (0,0580) |
| Constant | 7,3291*** | 7,4856*** | 7,5193*** | 7,3291*** | 7,4856*** | 7,5193*** |
| | (0,0098) | (0,0364) | (0,0534) | (0,0098) | (0,0365) | (0,0534) |
| $R^2$ | 0,0256 | 0,0002 | 0,0000 | 0,0148 | 0,0001 | 0,0005 |
| Observations | 4637 | 1504 | 1351 | 4257 | 1124 | 971 |

| Approximated Mincer-equation | | | | | | |
|---|---|---|---|---|---|---|
| | **PI vs. CI** | **PI vs. CII** | **PI vs. CIII** | **PII vs. CI** | **PII vs. CII** | **PII vs. CIII** |
| Company training | 0,1143*** | 0,0003 | -0,0284 | 0,1021*** | -0,0131 | -0,0438 |
| | (0,0174) | (0,0355) | (0,0420) | (0,0215) | (0,0378) | (0,0440) |
| Age | 0,0414*** | 0,0463*** | 0,0476*** | 0,0406*** | 0,0444*** | 0,0461*** |
| | (0,0060) | (0,0124) | (0,0133) | (0,0063) | (0,0152) | (0,0166) |
| Age squared | -0,0004*** | -0,0005*** | -0,0005*** | -0,0004*** | -0,0004** | -0,0005** |
| | (0,0001) | (0,0001) | (0,0002) | (0,0001) | (0,0002) | (0,0002) |
| Intermediate schooling level | -0,0602*** | -0,0238 | -0,0241 | -0,0689*** | -0,0472 | -0,0503 |
| | (0,0176) | (0,0313) | (0,0328) | (0,0185) | (0,0369) | (0,0396) |
| High schooling level | 0,1167*** | 0,0957** | 0,1054** | 0,1219*** | 0,0947 | 0,1117* |
| | (0,0292) | (0,0463) | (0,0501) | (0,0315) | (0,0580) | (0,0657) |
| Apprenticeship | 0,2720*** | 0,2703*** | 0,2000** | 0,2777*** | 0,3018*** | 0,2178** |
| | (0,0285) | (0,0951) | (0,0942) | (0,0288) | (0,1040) | (0,1015) |
| Master craftsman | 0,4193*** | 0,4437*** | 0,3821*** | 0,4129*** | 0,4565*** | 0,3830*** |
| | (0,0364) | (0,0992) | (0,0990) | (0,0375) | (0,1082) | (0,1066) |
| University | 0,5276*** | 0,5406*** | 0,4602*** | 0,5296*** | 0,5620*** | 0,4569*** |
| | (0,0421) | (0,1014) | (0,1006) | (0,0447) | (0,1158) | (0,1154) |
| Industry | No | No | No | No | No | No |
| Constant | 6,0887*** | 6,0760*** | 6,1357*** | 6,1071*** | 6,1038*** | 6,1704*** |
| | (0,1215) | (0,2582) | (0,2707) | (0,1283) | (0,3149) | (0,3378) |
| $R^2$ | 0,2079 | 0,2119 | 0,2154 | 0,1943 | 0,1952 | 0,1971 |
| Observations | 4536 | 1485 | 1337 | 4160 | 1109 | 961 |

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Table A1 continued

| | All control variables | | | | | |
|---|---|---|---|---|---|---|
| | **PI vs. CI** | **PI vs. CII** | **PI vs. CIII** | **PII vs. CI** | **PII vs. CII** | **PII vs. CIII** |
| Company training | 0,0953*** | 0,0065 | -0,0173 | 0,0822*** | -0,0151 | -0,0465 |
| | (0,0209) | (0,0422) | (0,0555) | (0,0232) | (0,0434) | (0,0543) |
| Male | 0,2854*** | 0,2667*** | 0,2622*** | 0,2910*** | 0,2826*** | 0,2788*** |
| | (0,0225) | (0,0400) | (0,0419) | (0,0234) | (0,0463) | (0,0493) |
| Age | 0,0192*** | -0,0090 | -0,0058 | 0,0195*** | -0,0129 | -0,0110 |
| | (0,0068) | (0,1221) | (0,0129) | (0,0070) | (0,0135) | (0,0144) |
| Age squared | -0,0002** | 0,0002 | 0,0001 | -0,0002** | 0,0002 | 0,0002 |
| | (0,0001) | (0,0001) | (0,0002) | (0,0001) | (0,0002) | (0,0002) |
| Western Germany | 0,0043 | 0,0426 | 0,0490 | -0,0084 | 0,0056 | 0,0046 |
| | (0,0188) | (0,0306) | (0,0321) | (0,0196) | (0,0358) | (0,0382) |
| German | 0,0387 | 0,0706 | 0,1098 | 0,0395 | 0,0930 | 0,1334 |
| | (0,0392) | (0,0951) | (0,1222) | (0,0396) | (0,0970) | (0,1271) |
| Married | 0,0501** | 0,1366*** | 0,1120** | 0,0483** | 0,1594*** | 0,1391** |
| | (0,0227) | (0,0485) | (0,0514) | (0,0236) | (0,0556) | (0,0607) |
| Children | 0,0298** | 0,0553** | 0,0594** | 0,0327** | 0,0716*** | 0,0806*** |
| | (0,0128) | (0,0219) | (0,0233) | (0,0134) | (0,0264) | (0,0289) |
| Intermediate schooling level | -0,0410** | -0,0327 | -0,0359 | -0,0399* | -0,0364 | -0,0437 |
| | (0,0207) | (0,0359) | (0,0375) | (0,0214) | (0,0397) | (0,0426) |
| High schooling level | 0,1509*** | 0,0603 | 0,0606 | 0,1555*** | 0,0492 | 0,0521 |
| | (0,0366) | (0,0638). | (0,0694) | (0,0370) | (0,0643) | (0,0716) |
| Apprenticeship | 0,2034*** | 0,2256** | 0,2036* | 0,2030*** | 0,2291** | 0,2036 |
| | (0,0341) | (0,0961) | (0,1192) | (0,0343) | (0,0988) | (0,1290) |
| Master craftsman | 0,3183*** | 0,3380*** | 0,3193** | 0,2997*** | 0,2912*** | 0,2593* |
| | (0,0447) | (0,1033) | (0,1262) | (0,0452) | (0,1031) | (0,1326) |
| University | 0,3977*** | 0,4927*** | 0,4541*** | 0,3983*** | 0,4952*** | 0,4386*** |
| | (0,0525) | (0,1118) | (0,1317) | (0,0539) | (0,1153) | (0,1416) |
| Firm size up to 99 employees | 0,0471* | 0,0275 | 0,0223 | 0,0535** | 0,0720 | 0,0743 |
| | (0,0243) | (0,0518) | (0,0536) | (0,0249) | (0,0569) | (0,0593) |
| Firm size up to 999 employees | 0,0854*** | 0,0605 | 0,0525 | 0,0935*** | 0,1018* | 0,1060* |
| | (0,0261) | (0,0499) | (0,0530) | (0,0267) | (0,0517) | (0,0559) |
| Firm size more than 999 employees | 0,1787*** | 0,1280** | 0,1115* | 0,1965*** | 0,1799*** | 0,1705*** |
| | (0,0281) | (0,0546) | (0,0579) | (0,0290) | (0,0595) | (0,0648) |
| Industry | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 6,1535*** | 6,5638*** | 6,5272*** | 6,1701*** | 6,6782*** | 6,6914*** |
| | (0,1449) | (0,2884) | (0,3412) | (0,1488) | (0,3153) | (0,3794) |
| $R^2$ | 0,2973 | 0,3199 | 0,3098 | 0,2883 | 0,3232 | 0,3079 |
| Observations | 2430 | 699 | 637 | 2284 | 553 | 491 |

to be continued on next page

Table A1 continued:

| All control variables incl. general training and informal trainining | | | | | | |
|---|---|---|---|---|---|---|
| | **PI vs. CI** | **PI vs. CII** | **PI vs. CIII** | **PII vs. CI** | **PII vs. CII** | **PII vs. CIII** |
| Company training | 0,0858*** | 0,0079 | -0,0178 | 0,0750*** | -0,0116 | -0,0467 |
| | (0,0220) | (0,0421) | (0,0552) | (0,0243) | (0,0434) | (0,0536) |
| Male | 0,2831*** | 0,2637*** | 0,2588*** | 0,2887*** | 0,2814*** | 0,2780*** |
| | (0,0225) | (0,0397) | (0,0413) | (0,0235) | (0,0458) | (0,0485) |
| Age | 0,0192*** | -0,0096 | -0,0060 | 0,0195*** | -0,0145 | -0,0124 |
| | (0,0068) | (0,0124) | (0,0130) | (0,0070) | (0,0137) | (0,0146) |
| Age squared | -0,0002** | 0,0002 | 0,0001 | -0,0002** | 0,0002 | -0,0002 |
| | (0,0001) | (0,0001) | (0,0002) | (0,0001) | (0,0002) | (0,0002) |
| Western Germany | 0,0043 | 0,0442 | 0,0501 | -0,0084 | 0,0100 | 0,0092 |
| | (0,0188) | (0,0308) | (0,0323) | (0,0196) | (0,0364) | (0,0387) |
| German | 0,0336 | 0,0725 | 0,1110 | 0,0351 | 0,1010 | 0,1430 |
| | (0,0392) | (0,0951) | (0,1218) | (0,0396) | (0,0981) | (0,1285) |
| Married | 0,0505** | 0,1342*** | 0,1090** | 0,0486** | 0,1580*** | 0,1382** |
| | (0,0228) | (0,0492) | (0,0524) | (0,0236) | (0,0564) | (0,0621) |
| Children | 0,0287** | 0,0552** | 0,0594** | 0,0316** | 0,0711*** | 0,0809*** |
| | (0,0128) | (0,0218) | (0,0233) | (0,0134) | (0,0263) | (0,0288) |
| Intermediate schooling level | -0,0446** | -0,0296 | -0,0332 | -0,0431** | -0,0324 | -0,0401 |
| | (0,0210) | (0,0360) | (0,0376) | (0,0218) | (0,0396) | (0,0424) |
| High schooling level | 0,1445*** | 0,0603 | 0,0600 | 0,1495*** | 0,0481 | 0,0500 |
| | (0,0370) | (0,0644) | (0,0700) | (0,0375) | (0,0644) | (0,0714) |
| Apprenticeship | 0,2005*** | 0,2264** | 0,2040* | 0,2007*** | 0,2313** | 0,2032 |
| | (0,0343) | (0,0953) | (0,1186) | (0,0345) | (0,0992) | (0,1305) |
| Master craftsman | 0,3137*** | 0,3404*** | 0,3202** | 0,2964*** | 0,2989*** | 0,2614* |
| | (0,0448) | (0,1023) | (0,1255) | (0,0454) | (0,1033) | (0,1342) |
| University | 0,3943*** | 0,4995*** | 0,4690*** | 0,3959*** | 0,5055*** | 0,4487*** |
| | (0,0525) | (0,1114) | (0,1316) | (0,0538) | (0,1151) | (0,1427) |
| Firm size up to 99 employees | 0,0483** | 0,0274 | 0,0213 | 0,0547** | 0,0700 | 0,0696 |
| | (0,0243) | (0,0517) | (0,0532) | (0,0249) | (0,0568) | (0,0591) |
| Firm size up to 999 employees | 0,0858*** | 0,0635 | 0,0563 | 0,0939*** | 0,1063** | 0,1125** |
| | (0,0262) | (0,0505) | (0,0540) | (0,0267) | (0,0517) | (0,0559) |
| Firm size more than 999 employees | 0,1789*** | 0,1285** | 0,1124* | 0,1968*** | 0,1782*** | 0,1680*** |
| | (0,0281) | (0,0543) | (0,0576) | (0,0291) | (0,0585) | (0,0636) |
| Industry | Ja | Ja | Ja | Ja | Ja | Ja |
| General training | 0,0021 | -0,0308 | -0,0298 | -0,0020 | -0,0497 | -0,0556 |
| | (0,0203) | (0,0314) | (0,0334) | (0,0211) | (0,0343) | (0,0363) |
| Informal training | 0,0301 | 0,0052 | 0,0082 | 0,0265 | -0,0146 | -0,0190 |
| | (0,0198) | (0,0419) | (0,0449) | (0,0203) | (0,0443) | (0,0481) |
| Constant | 6,1475*** | 6,5786*** | 6,5350*** | 6,1651*** | 6,7270*** | 6,7476*** |
| | (0,1446) | (0,2981) | (0,3539) | (0,1485) | (0,3262) | (0,3975) |
| $R^2$ | 0,2982 | 0,3211 | 0,3109 | 0,2890 | 0,3264 | 0,3121 |
| Observations | 2430 | 699 | 637 | 2284 | 553 | 491 |

Note: Refernce groups are low schooling level, no vocational training and firm size up to 19 employees. The following industries have been accounted for: 1) agriculture, 2) mining/energy/water, 3) chemicals/synthetics/earth/clay/stone/glas, 4) iron/steel/mechanical engineering/electrical engineering/vehicle construction, 5) wood/paper/printing, 6) leather/textiles/clothing, 7) food, 8) construction, 9) trade, 10) banks/insurances, 11) transport, 12) other services. For reasons of simplicity the coefficients of the insudtry dummies are not presented. The table displays the coefficients of the OLS-regressions. Standard errors are in parentheses. Significance levels of 1% (5%, 10%) marked by *** (**,*). Own calculations with BSW 2000 and 2003 data

Table A2: Wage effects of company training for different participant and comparison groups (Ordered-logit-estimation)

| | Dependent variable: ln (net monthly wage) | | | |
|---|---|---|---|---|
| | (1) No control variables | (2) Approximated Mincer-equation | (3) All control variables | (4) All control variables incl. general training and informal training |
| PI vs. CI | 0,6987*** | 0,5339*** | 0,4591*** | 0,4084*** |
| | (0,0686) | (0,0685) | (0,0997) | (0,1046) |
| | $R^2$: 0,0090[1)]; N: 4637 | $R^2$: 0,0792; N: 4536 | $R^2$: 0,1273; N: 2430 | $R^2$: 0,1278; N: 2430 |
| PI vs. CII | 0,1209 | 0,1047 | 0,1267 | 0,1316 |
| | (0,1606) | (0,1534) | (0,2278) | (0,2271) |
| | $R^2$: 0,0001; N: 1504 | $R^2$: 0,0782; N: 1485 | $R^2$: 0,1293; N: 699 | $R^2$: 0,1298; N: 699 |
| PI vs. CIII | 0,0075 | -0,0001 | 0,0051 | -0,0037 |
| | (0,2537) | (0,1960) | (0,3004) | (0,2981) |
| | $R^2$: 0,0000; N: 1351 | $R^2$: 0,0805; N: 1337 | $R^2$: 0,1251; N: 637 | $R^2$: 0,1256; N: 637 |
| PII vs. CI | 0,5783*** | 0,4789*** | 0,4043*** | 0,3648*** |
| | (0,0801) | (0,0813) | (0,1104) | (0,1146) |
| | $R^2$: 0,0051; N: 4257 | $R^2$: 0,0736; N: 4160 | $R^2$: 0,1240; N: 2284 | $R^2$: 0,1243; N: 2284 |
| PII vs. CII | 0,0016 | 0,0425 | 0,0068 | 0,0175 |
| | (0,1597) | (0,1531) | (0,2300) | (0,2300) |
| | $R^2$: 0,0000; N: 1124 | $R^2$: 0,0701; N: 1109 | $R^2$: 0,1317; N: 553 | $R^2$: 0,1325; N: 553 |
| PII vs. CIII | -0,1083 | -0,0657 | -0,1535 | -0,1586 |
| | (0,2449) | (0,1908) | (0,2823) | (0,2818) |
| | $R^2$: 0,0001; N: 971 | $R^2$: 0,0721; N: 961 | $R^2$: 0,1251; N: 491 | $R^2$: 0,1264; N: 491 |

Note: Control variables are gender, age, age squared, Western Germany, marital status, number of children, nationality, schooling, vocational training, firm size and industry. Estimations use sample weights.
The table displays the coefficients of the ordered-logit-estimations. Standard errors in brackets..
Significance levels of 1% (5%, 10%) marked by *** (**,*). Own calculations with BSW 2000 and 2003 data
[1)] For reasons of simplicity the $R^2$ of the respective estimation is in fact the pseudo-$R^2$.