Wage Returns of Company Training – Evidence from a Comparison Group Approach*

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Abstract

We empirically evaluate wage returns to company training using representative individual-level cross-sectional data for the years 2000, 2003, and 2007. A comparison group approach allows comparing wages of participants with non-participants, who were willing to participate in training, yet were restrained out of random reasons. For training participants, we identify a 7.5% wage premium compared to non-participants, which vanishes once the comparison group is restricted to employees enrolled for training who finally declined participation. The results indicate that typically measured returns to training programs may in fact be returns to unobserved characteristics such as innate ability, personality or cognitive and non-cognitive skills.

Keywords: Company Training, Wage Returns, Evaluation, Berichtssystem Weiterbildung

JEL Codes: C21, J24, J31, M53

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Introduction

Given the significant expenditures of firms on company training, the interest in the financial returns has increased and led to a growing amount of literature during the last decade. The returns to training on earnings are measured in a range of 7-18%. This result is found for different countries, using different econometric methods and data sets and different definitions of training (see Bassanini et al., 2007). Typically, the wage returns to one week of training are found to be almost equivalent to the returns to one year of schooling, despite of substantially shorter training spells (Acemoglu and Pischke, 1999a; Acemoglu and Pischke, 1999b). If one year of education with 1,600 hours of schooling leads to a wage return of 8.1%, then on-the-job training, with 137 hours of learning per year, should lead to a relative wage effect of 0.7% (Haelermans and Borghans, 2012). While this implies that job-related training is more effective in increasing individual productivity than educational schooling, there is also evidence that the returns to training are negligible (e.g. Pischke, 2001; Hinerasky and Fahr, 2014, both for formal job-related training in Germany). One might therefore suspect that the estimated returns to company training are likely to be overestimated.

However, the argument for comparing the returns to education with the returns to training is equally fragile, as everyone undergoes formal education, but not every person participates in further education and training. The literature has extracted a number of factors which influence whether training is being offered to an employee and whether an employee decides to participate or not. Participants in training are therefore likely to differ systematically from non-participants, which in turn should lead to heterogeneous training effects.

Since every study on the returns to training has been facing this selection problem, sophisticated econometric models have been used to tackle the inequalities between the treatment and comparison groups. These empirical methods (panel estimations, instrumental variables, matching etc.) have indeed led to substantially lower training estimates, however a consensus on the size of returns has not been found yet (Haelermans and Borghans, 2012). Reasons for varying results have been found to lie firstly in the empirical method used, as the results often decline with the strength of the used econometric model. Secondly, the type of training measure, i.e. a missing distinction between the form of training (general vs. firm-specific, formal off-the-job vs. informal on-the-job) and its associated funding (employer-funded (fully/partly) vs. self-paid (monetarily or spare time)), could explain the differing outcomes. Thirdly, the duration and amount of training and the available length of the observational period after training participation is not homogeneous among studies and may

impede a valid comparison. Fourthly, unobservable heterogeneity (motivation, ability, or education level) and fifthly, the employer's reasons for investment in human capital have both a bearing on outcomes. There is, to our knowledge, no study that contains all relevant information and tackles the selection problem as well.

The present study adds to the existing literature by taking into account all relevant information and furthermore contributes to a classification and generalization of our and previous findings. Our econometric approach tries to fully eliminate the selection effect by building on a model by Leuven and Oosterbeek (2008) which comes as close to random selection as possible in a firm environment. Using information on already-enrolled training participants, who eventually were prevented from taking part because of a random event, we will be able to construct a control group which allows us to estimate a clean treatment effect. Under specific homogeneity assumptions it may even be interpreted as the average treatment effect of company training. Even if one does not accept these specific assumptions, we will at least obtain a valid point estimate for training participation which, however, cannot be generalized to the overall population (Angrist, 2004). Due to the strong requirements on the information needed, the approach by Leuven and Oosterbeek has only been applied by themselves to Dutch data (Leuven and Oosterbeek, 2008) and by Görlitz (2011) to German data.

As low-educated workers seem to be significantly less willing to participate in company training, we restrict the sample to full-time 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.[4] Further, the present paper accounts for the influence of the type of training for the observed wage returns. In addition, when analyzing the impact of training on wages, it is fundamental to control for financial involvement of the employer. Measuring no returns to training might reflect the fact that the employer first wants to settle the cost incurred through the training investments.[5] True returns to company training are higher than those observed in the data, once a company partly or fully pays for training, e.g. in the set up of courses. We therefore add information on whether the employer bears direct or indirect costs.

[4] So far, there are mixed results on whether economic results to training differ by education level. Fouarge et al. (2013) find that the economic returns to company training do not differ between low- and higher-educated workers. However, it is clear that there is a significantly lower participation rate among lower-educated workers, which was also studied by Görlitz and Tamm (2012). Whether this gap can be explained by non-cognitive skills, such as economic preferences and personality traits, is still under research but again strengthens the fact that individual characteristics lead to heterogeneous training effects.

[5] Passing on only parts of the generated productivity effects to wages could also ground on the rather compressed wage structure in Germany (Acemoglu and Pischke, 1999a and Acemoglu and Pischke, 1999b).

Lastly, we analyze the short-/mid-term impact of training, as the current net wage was retrieved no more than 15 months after the event of training. A broader horizon would impede a causal interpretation, as informal learning (on-the-job or at home) could impact wage as well. The extensive information provided by our data enables us to tackle sources of inconsistency across other studies by using a distinct training measure in a clear framework to draw an overall picture of different training forms and their respective effects.
The next section provides an overview of empirical studies which might serve as a benchmark for the present study. Section 3 describes the data and section 4 the empirical approach used for the analysis. After presenting the results in section 5, we conclude with section 6.

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 a single country. These 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., 2007). In the following, to benchmark our results, we report some details about studies on returns to continuous training in Germany. As it will turn out, however, other studies for Germany operate with a broader concept of continuous training. For comparable overviews on this issue in other countries, we refer to Leuven and Oosterbeek (2008), Muehler et al. (2007), Asplund (2005) and in particular Bassanini et al. (2007). Our study investigates company training which is defined as the attendance of a formal vocational training program executed in the employing company or during working hours. There is no study with an identical definition and identical observational period. This may not enable to benchmark our results, yet may help to draw an overall picture of different training forms and their respective effects.

Using data from the German Socio Economic Panel (SOEP), Pischke (2001) analyses different aspects of incidence, financing and effects of occupational training for West German employees. The definition of continuous training in Pischke (2001) is limited to formal training in terms of courses and seminars and is comparable to the definition of company training in our dataset (Berichtssystem Weiterbildung (BSW)). While in Pischke's definition vocational

training not explicitly has to correspond with the employer nor does it have to be company-sponsored, the majority of vocational training usually takes place, at least in parts, during work hours. It is therefore to some extent comparable to the definition of company training in the BSW and Pischke's results may 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 differentiating whether training took place during working hours or leisure time, training leads to positive but insignificant returns. Estimates for on-the-job training (during work hours) do not result in significant effects either. In a fixed-growth regression that accounts for unobserved characteristics influencing the wage growth of participants unrelated to training participation, coefficients are larger, but still insignificant. Altogether the findings suggest that continuous training does not result in wage returns for the employee. Instead, productivity increases due to training at most accrue to the employer.

Evidence for positive effects of training on earnings is given by Kuckulenz and Zwick (2003). They use cross-sectional data from the BiBB/IAB „Qualification and Career Survey" 1998/99 and apply two instruments to account for selection bias. The first identifying variable is the individual perception on whether further training is necessary and the second instrument is constituted by the response to a survey question on changes in the workplace environment, e.g. reorganisation. According to the instrumental variable estimation, participation in training causes a 15 percent higher wage, but varies by qualification and experience of the employee. Kuckulenz and Zwick (2003) discover that the effect is mainly driven by external training, which also contains formal courses and seminars and is thus similar to the definition of company training in the BSW.

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% for formal vocational training of employees. Apart from distinguishing between different age groups, they also consider regional differences between East and West Germany. Because training neither takes place in the company nor during work hours, their results cannot be used as reference to our findings.

In contrast, Kuckulenz and Zwick (2005) examine wage effects of training that is executed on-the-job. While not explicitly defined, training is obviously employer-financed. Again using in-firm reorganisation as an instrument they find weakly significant returns of 16.1%. Differentiating between external and internal training again reveals that the results are predominantly based on general training (i.e. training which increases the productivity of the

trained worker in more than one firm). This type of training increases earnings by 17.5 %, yet is only of weak significance.

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

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 as well as other forms of training. By using information about the transferability of the acquired skills, they are able to distinguish between returns to firm-specific training and returns to general training. They choose a combination of a matching and a Difference-in-Difference approach. While this approach is superior to the very restrictive assumptions of the sheer 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 even in the case of non-participation. The key finding is a significant wage increase for general training and no 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.

Görlitz (2011) uses the comparison-group approach by Leuven and Oosterbeek (2008) with German linked employer-employee data (WeLL) and focuses on on-the-job training such as courses, seminars or lectures. In addition, she is able to apply firm-fixed effects and finds insignificant effects of training on gross monthly wage, but a statistically significant selection effect ranging from 4.3 % to 4.8 %.

To provide a well-defined framework, we only take studies with German data as a comparison and provide an overview of their estimated wage effects in Table 1. Despite the equal institutions encompassing continuous training, the overview of studies for Germany in Table 1 indicates that there is no global coefficient for the returns to training in Germany. In fact, the coefficients listed in the papers range from a nil result, to significant returns to training in the range of 4 to 15%.

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

Study	Data	Period	Form of training	Method	Estimate
Pischke (2001)	SOEP (West GER)	1986-1989	Formal continuous training (years)	FE	0.026
				FG	0.038
			- during work hours	FE	0.001
				FG	0.031
			- during leisure time	FE	0.043*
				FG	0.041
Kuckulenz/Zwick (2003)	BiBB/ IAB	1998/1999	Continuous Training	IV	0.15***
			- external	IV	0.13***
			- internal	IV	-0.02
Büchel/Pannenberg (2004)	SOEP	1984-2002	Formal continuous training	FE West GER	0.039*** 1)
				FE East GER	0.069***
Jürges/Schneider (2006)	SOEP	1981-2000	(Long-term) vocational training (years)	FG Male	-0.004
				FG Female	0.0426
Kuckulenz/Zwick (2005)	BiBB/ IAB	1998/1999	Firm-sponsored training	IV	0.161*
			- external	IV	0.175*
			- internal	IV	0.080
Muehler et al. (2007)	SOEP (only males)	2000,2004	Continuous training	MDiD	0.049***
			- firm-specific	MDiD	0.061***
			- general	MDiD	0.018
Görlitz (2011)	WeLL	2006	Formal continuous training	OLS	0.05
				Tobit	0.05

Notes: 1) The values were determined by taking the difference between the coefficients before and after training. Büchel and 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.

Data

We use data 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 the training field are implemented (Kuwan et al., 2006). Our study is based on the BSW data of 2000, 2003 and 2007 (BSW VIII, IX and X) and includes about 7,000 persons in each wave (TNS, 2004, Bilger, 2006, and Rosenbladt, 2008). The BSW allows a straightforward identify-cation of company training by considering the attendance of formal vocational training in the employing company or during working hours. For participation in training programmes during the past year, i.e. 2000, 2003 or 2006, 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 working hours and whether a certificate was issued.

For the sake of comparison, we limit the sample to full-time employees with completed apprenticeship training who, in addition, had been employed in the full course of 3 years prior the interview date. By this, we make sure that wage effects are only based upon the company training incidences and are not blurred by preceding publically-sponsored training programmes. Due to these selections, our sample comprises 6,538 observations. As already mentioned above, one important feature of studies on training returns is the definition of training. The BSW data provides detailed information on the training incidences and allows us to disentangle formal off-the-job training from informal on-the-job training and informal self-learning. To avoid acquired human capital originating from other work-related courses, employees are only included if all their courses belong to the category of company training. Given that, we define company training as a subset of formal employee vocational training which is either provided by the employer himself, or conducted fully or partly during working hours. This way, the employer bears direct or indirect costs of training.[6]

36.8% of all workers in the samples of 2000, 2003 and 2007 participated in some form of continuous formal and informal training and about a quarter (26.8%) participated in company training according to the definition stated in the present paper. The average employee per year spends 62 hours in her first, 42 hours in her second, 28 hours in her third and 15 hours in her fourth training incidence. In the year 2000, almost half of the courses (45 %) charge fees, for which 12 % of the participants themselves had to pay for in parts and even 77 % in total. On average, a participant spends 158.00 EUR[7] on the first, 80.00 EUR on the second and 89.00 EUR on the third course. The number of participants who have to bear any form of the costs declined to 18 % in 2003 and 21 % in 2007. However, the average costs for these courses mounted to 507.50 EUR in 2003 and 609.00 EUR in 2007.

Table 2 lists the purpose and topic of the observed training courses for participants reporting one or more training incidences in the year preceding the year of the interview. Besides a big share of training incidences serving an unspecified training purpose (30.20%), the largest share of training serves adjustment to a new job (40.19%). Putting that together with

[6] An analysis among those participants whose employer does not directly or indirectly share costs would intensify the selection problem, as low-educated workers show a significant smaller willingness to participate in training despite identical economic returns (Fouarge et al., 2013). Besides, the number of observations would be too small.
[7] The data, originally, was gathered in German Mark (DM), whereby 1 Euro relates to 1,95583 DM.

Table 2: Features of firm-sponsored training for participants with at least one training incidence

Purpose of training	**%**
Adjustment to a new job	40.19
Other course	30.20
Orientation	18.81
Career development	9.33
Re-training	1.47
Training topics [1)]	
Computer applications (commercial domain)	10.11
Commercial training	8.52
Leadership training, management, self-management	8.11
Education, psychology	7.61
Operating machinery and equipment	6.92
Other subjects	6.92
Quality management	6.51
Medicine and physical health	6.42
Certificate	
Yes	65.56

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 % of all training incidences are listed.
Source: Own calculations with BSW 2000, 2003 and 2007.

Training for orientation, about 60% of all company training is meant to secure a minimum level of productivity or to compensate for productivity declines at the workplace. Only 9.33% of all training incidences are explicitly dedicated to career development. While we cannot explicitly distinguish between general and firm-specific training, Muehler et al. (2007) hypothesize that firms may use specific training to adjust to new job requirements, whereas career development may be accomplished by general training. As standard human capital theory attributes larger wage returns to general training, we expect a resulting wage growth to be smaller in our data. Unfortunately, we have no information on the purpose and topic of courses among the group of employees who were willing to follow training yet were not able to, because of lack of support or a random event. Training topics are widespread but computer applications, commercial training and leadership training are quite prominent. In 66%, a formal certificate is issued which may be used to document attendance 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 in the month preceding the day of the interview. In the survey of 2000 and 2003, wage is reported in 9 narrow wage brackets. We assign the mid of each wage bracket as the respective wage to each worker. As metric measures of the wage are often given imprecisely, we can assume that the wage categories are comparable

to metric wage measures. However, we will show the robustness of our results with estimates of ordered logit models, which take the wage categories as the dependent variable. Due to the migration of the BSW into the Adult Education Survey (AES) in 2007, the last BSW wave in 2007 comprised of a reduced survey which no longer retrieved the wage variable. As our empirical strategy defines the comparison group as persons who wanted to participate but could not due to a random event, we are already dealing with rather small sample sizes. In avoidance of losing the 2007 wave, we impute monthly net wage from the representative German Socio Economic Panel (GSOEP) (for information see Wagner et al. 2007), following the strategy for out-of-sample predictions with GSOEP data by Fahr (2005). Using the 2007 GSOEP wave, we estimate a wage regression among German full-time employed males by controlling for living in West Germany, marital status, age, educational degree, job status and industry. The predicted monthly net wage is then imputed to the BSW 2007 dataset based on an identification of the explanatory variables.

Empirical strategy

Composition of participant and comparison groups

For our analysis we build two participant and three comparison groups that are summarized in Table 3. Participant group I (PI) consists of employees who participated in at least one company training incidence during the past year. To avoid acquired human capital originating from other work-related courses, employees are only included, if all their courses belong to the category of company training. Participants of general or informal training are explicitly excluded. Participant group II (PII) is a subsample of PI and consists of employees who followed exactly one training course. Employees in comparison group I (CI) did not participate in any form of company training. However, they might have participated in other vocational training forms.

Table 3: Definition of the participant and comparison groups and number of observations

Group	Definition	Obs.
Participation I	at least 1 training course	1,752
Participation II	exactly 1 training course	1,122
Comparison I	no training	4,495
Comparison II	no training but	316 *)
	- wanted to follow courses but were not supported “motivated”	179
	- should have participate but declined “eligible”	149
Comparison III	-“eligible” but declined due to a random event	98

Note:*) 12 participants fall into both categories “eligible” and “motivated”. Source: Own calculations with BSW 2000, 2003 and 2007.

A training effect estimation based on the comparison of participant groups PI and PII with the comparison group CI would most likely render biased results. In most cases, the decision in favour or against training participation is not random, but depends on the employee´s motivation on the one hand and the employer´s will to provide support on the other hand. When employees who are willing to participate in training, however, possess unobserved characteristics that lead to higher training outcomes, or, if the company preferably chooses (seemingly) more talented employees to participate in training, and who subsequently generate higher returns, selection bias would arise. For that reason, we build a comparison group II (CII) which only includes employees who wanted to follow courses but were not supported ("motivated"), or, who should have participated 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?" This question indicates the participant´s motivation. And the 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 would have been valuable to the employer. The latter group of "eligible" persons was then asked to clarify reasons for not taking part. Possible causes are (a bad) state of health, lack of time due to high work load or family commitments, or because participation has not been considered beneficial. "Eligible" non-participants who were 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 lead to non-participation are exogenous. These instruments have to be independent of any utility considerations, i.e. the potential outcomes. We declare the following events as random: bad state of health or illness, lack of time due to high work load and family commitments.

Whether bad state of health can be considered as exogenous is controversial. Jäckle and Himmler (2010) find a positive relation between good health and wages for men. We argue, however, that a person with chronic disease would not have been chosen by the company to participate in training in the first place. From a cost-benefit point of view, investments in human capital of unhealthy employees lead to fewer returns than investments in healthy employees, who can more frequently make productive use of the training contents. Excluding the health-status as random event, however, leaves our results unchanged.

Results

Descriptive statistics

Remarkably, 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: 18, for lack of time due to work load: 56, and for family commitments: 28.[8] For comparison reasons between the different participation and comparison groups, we report sample means of the core characteristics influencing participation in company training and wages in Table 4. With respect to schooling, training participants most frequently own an intermediate degree whereas there is a much higher fraction of low schooling and lower fraction of high schooling in comparison groups II and III. Regarding vocational training, the participant and comparison groups seem to differ the most. The fraction of employees without vocational training is highest among comparison groups II and III, whereas the fraction of employees with a university degree is even the lowest in these groups. It is surprising that comparison group I seems to differ from the participant groups the least.

We test for significant differences in the reported means with t-tests in the case of continuous variables and with the non-parametric Wilcoxon-Mann-Whitney rank-sum tests in the case of categorical variables. Results are shown in Table 5. In fact, the qualification and firm size variables significantly differ between both participant groups PI and PII and comparison group 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 with studies on the determinants of participation in company training (see e.g. Asplund, 2005 and Bassanini et al., 2007). However, Table 5 clearly shows that the average treatment effect of trained participants compared to non-participants (PI or PII vs. CI) would be biased by observable characteristics, such as nationality, schooling, vocational training and firm size, as well as number of children and marital status (PII vs CI).

Restricting the comparison group to those who were asked to or wanted to participate significantly reduces the selection bias. Non-participants in CII only significantly differ from PI in their nationality and from PII in a larger fraction of those having children (57 % vs. 52 %) and their marital status (57 % vs. 63 % singles). Reducing the comparison sample to those who did not participate due to a random event renders a comparison group that is astonishingly

[8] Due to multiple answers permitted, the overall frequencies exceed the number of observations in comparison group III (98).

similar to the participant groups based on observable characteristics and should lead to least biased results in our estimated training effects.

Table 4: Sample means of participant (P) and comparison (C) groups

	Participant group		**Comparison group**		
	I at least 1 course	**II** exactly 1 course	**I** no training	**II** no training but „eligible“ or „motivated“	**III** “random”
Male	0.62	0.63	0.62	0.62	0.62
Age	40.77	40.97	40.64	41.02	41.00
Children	0.58	0.52	0.58	0.57	0.57
German	0.97	0.98	0.98	0.95	0.95
Single	0.55	0.63	0.54	0.57	0.56
Schooling:					
- Low	0.20	0.23	0.20	0.31	0.31
- Intermediate	0.46	0.47	0.45	0.42	0.42
- High	0.33	0.30	0.35	0.26	0.27
Vocational training:					
- None	0.03	0.03	0.02	0.07	0.07
- Apprenticeship	0.59	0.63	0.57	0.63	0.63
- Master craftsman	0.12	0.11	0.13	0.10	0.10
- University	0.22	0.21	0.24	0.17	0.17
Firm size:					
- up to 19 employees	0.22	0.21	0.21	0.32	0.32
- up to 99 employees	0.23	0.25	0.23	0.25	0.25
- up to 999 employees	0.27	0.29	0.27	0.25	0.25
- more than 999 employees	0.28	0.26	0.29	0.17	0.18
Observations	**1,752**	**1,122**	**4,495**	**316**	**98**

Source: Own calculations with BSW 2000, 2003 and 2007.

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

	PI at least 1 course vs.			**PII** exactly 1 course vs.		
	CI no training	**CII** “eligible” or “motivated”	**CIII** “random”	**CI** no training	**CII** “eligible” or “motivated”	**CIII** “random”
Male	0.9332	0.5900	0.5706	0.7582	0.4738	0.4964
Age	0.1882	0.8947	0.4115	0.5500	0.8806	0.5268
Children	0.2981	0.2143	0.3699	0.0067***	0.0023***	0.0449**
German	0.0000***	0.0051***	0.2556	0.0000***	0.0105**	0.2797
Single	0.3077	0.2399	0.6980	0.0171**	0.0036***	0.1602
Schooling	0.0000***	0.5355	0.1979	0.0000***	0.5720	0.5738
Vocational training	0.0000***	0.8394	0.9178	0.0000***	0.1341	0.3762
Firm size	0.0000***	0.8700	0.6748	0.0000***	0.9774	0.7297

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, 2003 and 2007.

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, children, firm size and industry. And in a fourth specification, an indicator for the participation in general and informal continuous education is added. This is in line with Pischke (2005) who assumes that due to the complementarities between formal and informal types of training, not controlling for the percentage of informal education will overestimate the return to formal training.[9] For reasons of brevity, we only report the estimation of the training dummy in Table 6. Detailed results for all specifications are presented in Table A1 in the appendix.[10] We only estimate and report specifications (i) and (ii) to compare these with similar specifications in the literature. Note that sample sizes of these specifications are much larger than of specifications (iii) and (iv) and that coefficients are biased due to omitted variables.

In line with the company training literature, we find significant positive returns to training by simply comparing participants with non-participants (PI and PII vs. CI). Controlling for a numerous list of variables (row iii), significant returns range from 5.0 % of one training course to 6.7 % of multiple training courses. This magnitude is in line with the literature on returns to training (e.g. Parent, 1999) and corresponds to an annual return of 102 % higher net wages for participants in company training. In contrast, the average returns to one year of schooling lie between 2 to 11 % (see Card, 1999 for an overview). Once we restrict the comparison group to "motivated" and "eligible" non-participants (PI and PII vs. CII), returns to training fall to zero. These results are robust to an estimation of the more appropriate ordered logit model (Table A2 in the appendix). The results suggest, that the measured positive returns to training rather reflect returns to unobserved motivation on the side of the employee, or a particular suitability of the employee for the job reflected in the eligibility for training recognized by the employer. This is in line with findings by Pischke (2001) and Leuven and Oosterbeek (2008). Yet, an analysis shows no difference in comparing participation groups with

[9] We have information on the amount of further general and further informal training. The correlation between participation in informal training and least one incidence of company training (PI) is 0.2511 and between PI and general training 0.1754. The correlation between exactly one incidence of company training (PII) and informal training is 0.1703 and of 0.1075 between PII and general training.

[10] The coefficients are all in line with findings in the literature on wage returns to training.

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

		Dependent variable: ln (net monthly wage)			
		(i) No control variables	(ii) Approximated Mincer-equation	(iii) All control variables	(iv) All control variables incl. general training and informal training
1)	PI vs. CI	0.1476*** (0.0167) Adj.-R^2: 0.02 N: 5932	0.1057*** (0.0145) Adj.-R^2: 0.21 N: 5817	0.0673*** (0.0169) Adj.-R^2: 0.36 N: 4428	0.0574*** (0.0177) Adj.-R^2: 0.36 N:4428
2)	PI vs. CII	-0.0074 (0.0336) Adj.-R^2: 0.00 N: 1966	0.0011 (0.0293) Adj.-R^2: 0.24 N: 1946	-0.0172 (0.0285) Adj.-R^2: 0.37 N: 1319	-0.0178 (0.0285) Adj.-R^2: 0.37 N: 1319
3)	PI vs. CIII	-0.0244 (0.0493) Adj.-R^2: 0.00 N: 1762	-0.0286 (0.0341) Adj.-R^2: 0.25 N: 1748	-0.0699* (0.0385) Adj.-R^2: 0.37 N: 1183	-0.0714* (0.0384) Adj.-R^2: 0.37 N: 1183
4)	PII vs. CI	0.1210*** (0.0217) Adj.-R^2: 0.01 N: 5331	0.0912*** (0.0188) Adj.-R^2: 0.19 N 5220:	0.0501** (0.0220) Adj.-R^2: 0.34 N: 4052	0.0414* (0.0229) Adj.-R^2: 0.34 N: 4052
5)	PII vs. CII	-0.0340 (0.0364) Adj.-R^2: 0.00 N: 1365	-0.0150 (0.0315) Adj.-R^2: 0.20 N: 1349	-0.0374 (0.0316) Adj.-R^2: 0.34 N: 943	-0.0370 (0.0316) Adj.-R^2: 0.34 N: 943
6)	PII vs. CIII	-0.0510 (0.0512) Adj.-R^2: 0.00 N: 1161	-0.0440 (0.0370) Adj.-R^2: 0.21 N: 1151	-0.0902** (0.0419) Adj.-R^2: 0.33 N: 807	-0.0923** (0.0415) Adj.-R^2: 0.33 N: 807

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, 2003 and 2007.

"eligible" or "motivated" non-participants separately. According to our findings it is therefore irrelevant whether the employee or the employer initiates the training. When restricting the comparison group further to "random" non-participants, the estimates show even weakly significant negative training effects. We can only speculate when interpreting this robust but not representative observation. It is possible that training would have been necessary to maintain a constant or required level of productivity, as the principal purpose of training was stated to be adjustment to new job requirements. From the overview of wage effects with no control variables (Table 6 row (i)), one can see that training participants, both PI and PII, have on average slightly and insignificantly lower wages than CII and CIII employees. Even though the fraction of low educated and low-skilled workers in CIII is largest, it is highly possible that participants (PI and PII) are in urgent need for training to close up to and compete with other employees, as their given skill level has already resulted in a wage penalty. The results therefore offer valuable insight in the mechanism behind training selection. If one follows this argument, then the random event reveals higher (unobserved) skills of CII and CIII employees compared

to PI and PII participants, which allow CIII employees to cancel training participation on short notice due to their established higher productivity reflected by higher wages. However, as these estimation results are based on a small sample size of only 98 observations, they have to be considered carefully and should not be over-interpreted.

Why returns to training are nil

The time spell between participation in training and the wage retrieval is 15 months at the maximum. Such a short time frame helps to ensure that no further training incidences blur the influence of the training under observation, but entails two further problems. First, it may take some time until training increases productivity at the workplace or until increased productivity can be observed by the employer. Second, as wages are not adjusted on a monthly basis, a period of about a year could be too short to observe a wage increase.

Based on the assumption that the employer shares the rent of productivity increases, the shared amount hinges on the generalizability of the training content and the costs the employer has to bear for training in the first place. While two thirds of the employees were issued a training certificate, we can assume that a considerable part of the training incidences provide skills transferable to other employers, which enhance employability both inside and outside the firm. Dearden et al. (2006) find that the effects of training on the workers' wages are half the size of the initial training effect on firm productivity and Konings and Vanormelingen (2010) find the same result for Belgium, where the effects of training on firm productivity are twice the size of the effects of training on workers' wages. As in two thirds of the training incidences in our data, initial costs were already shared between the employer and the employee, so the employers might reckon up their share of the costs of training with the wage increase.

If training was simply carried out to maintain productivity on a steady level, wage returns will also not be observable in the short term. Even though Borghans et al. (2009) could identify an increased investment in informal learning complementing formal training in the cases where training is done to compensate skill gaps or to adjust to new tasks in the current job, we assume that an effect from these activities should only be experienced with a considerable delay. A further explanation can lie in the compensation of increased productivity by non-pecuniary benefits such as increased job security or long-term career prospects.

Conclusion

We employed a comparison group approach proposed by Leuven and Oosterbeek (2008) to measure the wage returns to company training. A particular strength of the data used for the present study lies in the possibility to clearly measure the returns to 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. Comparing wages of non-participants, who were willing to participate in training but were held back from participating out of random reasons with wages of training participants, we find no effects for training whatsoever. Our results suggest that typically measured returns to training are indeed returns to unobserved characteristics such as innate ability, personality or cognitive and non-cognitive skills, 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 add supporting evidence to other studies which try to account for the selection into training in their empirical approach, such as Pischke (2001), Muehler et al. (2007), Leuven and Oosterbeek (2008) and Görlitz (2011).

The point estimate even turns negative in estimations which use a comparison group of workers who either were willing to participate but were not permitted by their employer or were offered participation but had to cancel due to random reasons. In combination with the observation that a large part of the provided company training serves the purpose of adjustment to new job requirements, we offer consent to Muehler et al.'s (2007) assumption that most of the observed training incidences rather occur to prevent productivity from falling.

We can conclude that the true returns to company training are lower or even zero once an appropriate control for selection into training is implemented. Estimated treatment effects and the timing of those also depend on the purpose of initial training and will therefore vary between e.g. training that is preparing for new job requirements and job promotions as well as training that ensures productivity on the current job. Information on the purpose of training is therefore necessary to classify measured returns.

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Appendix A

Table A1: Detailed List of Coefficient Estimates Reported 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	0.1476***	-0.0074	-0.0244	0.1210***	-0.0340	-0.0510
	(0.0167)	(0.0336)	(0.0493)	(0.0217)	(0.0364)	(0.0512)
Constant	7.3679***	7.5229***	7.5399***	7.3679***	7.5229***	7.5399***
	(0.0084)	(0.0304)	(0.0472)	(0.0084)	(0.0304)	(0.0472)
Observations	5932	1966	1762	5331	1365	1161
Adj. R-squared	0.02	0.00	0.00	0.01	0.00	0.00

Approximated Mincer-equation						
	PI vs. CI	**PI vs. CII**	**PI vs. CIII**	**PII vs. CI**	**PII vs. CII**	**PII vs. CIII**
Company training	0.1057***	0.0011	-0.0286	0.0912***	-0.0150	-0.0440
	(0.0145)	(0.0293)	(0.0341)	(0.0188)	(0.0315)	(0.0370)
Age	0.0470***	0.0512***	0.0517***	0.0456***	0.0483***	0.0490***
	(0.0050)	(0.0098)	(0.0104)	(0.0054)	(0.0129)	(0.0141)
Age squared	-0.0005***	-0.0005***	-0.0005***	-0.0004***	-0.0005***	-0.0005***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Intermediate schooling level	-0.0576***	-0.0332	-0.0422	-0.0649***	-0.0456	-0.0586
	(0.0151)	(0.0273)	(0.0284)	(0.0160)	(0.0337)	(0.0360)
High schooling level	0.1578***	0.1199***	0.1083***	0.1588***	0.1252**	0.1172**
	(0.0224)	(0.0386)	(0.0410)	(0.0251)	(0.0499)	(0.0568)
Apprenticeship	0.0556**	-0.0824	-0.1292**	0.0782***	-0.0123	-0.0745
	(0.0253)	(0.0577)	(0.0558)	(0.0269)	(0.0781)	(0.0783)
Master craftsmen	0.1881***	0.0763	0.0406	0.2039***	0.1355*	0.0879
	(0.0314)	(0.0607)	(0.0602)	(0.0338)	(0.0813)	(0.0836)
University	0.2866***	0.1832***	0.1403***	0.3070***	0.2382***	0.1716**
	(0.0324)	(0.0520)	(0.0507)	(0.0370)	(0.0794)	(0.0836)
Industry	No	No	No	No	No	No
Constant	6.1695***	6.3036***	6.3667***	6.1862***	6.3186***	6.3947***
	(0.1033)	(0.2091)	(0.2143)	(0.1107)	(0.2742)	(0.2905)
Observations	5817	1946	1748	5220	1349	1151
Adj. R-squared	0.21	0.24	0.25	0.19	0.20	0.21

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	0.0673***	-0.0172	-0.0699*	0.0501**	-0.0374	-0.0902**
	(0.0169)	(0.0285)	(0.0385)	(0.0220)	(0.0316)	(0.0419)
Male	0.2590***	0.2476***	0.2511***	0.2612***	0.2544***	0.2617***
	(0.0180)	(0.0370)	(0.0394)	(0.0191)	(0.0476)	(0.0529)
Age	0.0295***	0.0356**	0.0402**	0.0287***	0.0328*	0.0391*
	(0.0060)	(0.0151)	(0.0160)	(0.0063)	(0.0193)	(0.0208)
Age squared	-0.0003***	-0.0003**	-0.0004**	-0.0003***	-0.0003	-0.0004
	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0002)
West	0.3058***	0.2216***	0.2283***	0.3136***	0.2186***	0.2271***
	(0.0184)	(0.0319)	(0.0341)	(0.0196)	(0.0410)	(0.0455)
German	0.0795***	0.0752	0.0654	0.0792***	0.0733	0.0605
	(0.0277)	(0.0553)	(0.0664)	(0.0292)	(0.0713)	(0.0937)
Married	0.0849***	0.1195***	0.1052***	0.0852***	0.1412***	0.1228***
	(0.0148)	(0.0298)	(0.0314)	(0.0158)	(0.0395)	(0.0434)
Children	0.0790***	0.0246	0.0208	0.0859***	0.0327	0.0306
	(0.0140)	(0.0282)	(0.0301)	(0.0151)	(0.0358)	(0.0394)
Intermediate schooling level	0.0566***	0.0548*	0.0567	0.0549***	0.0460	0.0492
	(0.0167)	(0.0325)	(0.0345)	(0.0177)	(0.0413)	(0.0453)
High schooling level	0.2107***	0.1389***	0.1424***	0.2170***	0.1438***	0.1551**
	(0.0235)	(0.0462)	(0.0521)	(0.0246)	(0.0554)	(0.0664)
Apprenticeship	0.0340	-0.1148**	-0.1336**	0.0484**	-0.0739	-0.0942
	(0.0230)	(0.0561)	(0.0632)	(0.0238)	(0.0684)	(0.0815)
Master craftsmen	0.1501***	0.0305	0.0197	0.1520***	0.0437	0.0271
	(0.0307)	(0.0634)	(0.0702)	(0.0318)	(0.0761)	(0.0883)
University	0.2404***	0.1565***	0.1276**	0.2513***	0.1951***	0.1544*
	(0.0327)	(0.0529)	(0.0590)	(0.0358)	(0.0722)	(0.0857)
Firm size up to 99 employees	0.0516***	0.0549	0.0491	0.0531***	0.0715	0.0640
	(0.0174)	(0.0360)	(0.0372)	(0.0182)	(0.0457)	(0.0484)
Firm size 99 to 999 employees	0.0547**	0.0620	0.0624	0.0520**	0.0561	0.0556
	(0.0235)	(0.0532)	(0.0574)	(0.0251)	(0.0722)	(0.0810)
Firm size more than 999 employees	0.1464***	0.1306***	0.1291***	0.1546***	0.1501***	0.1532***
	(0.0202)	(0.0401)	(0.0429)	(0.0216)	(0.0532)	(0.0593)
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Constant	5.6848***	5.7928***	5.7952***	5.6809***	5.7808***	5.7508***
	(0.1217)	(0.2846)	(0.3033)	(0.1281)	(0.3600)	(0.3966)
Observations	4428	1319	1183	4052	943	807
Adj. R-squared	0.36	0.37	0.37	0.34	0.34	0.33

Table A1: continued

All control variables incl. general and informal training						
	PI vs. CI	**PI vs. CII**	**PI vs. CIII**	**PII vs. CI**	**PII vs. CII**	**PII vs. CIII**
Company training	0.0574***	-0.0178	-0.0714*	0.0414*	-0.0370	-0.0923**
	(0.0177)	(0.0285)	(0.0384)	(0.0229)	(0.0316)	(0.0415)
General training	-0.0027	-0.0142	-0.0194	-0.0044	-0.0209	-0.0297
	(0.0157)	(0.0282)	(0.0298)	(0.0170)	(0.0361)	(0.0396)
Informal training	0.0378***	0.0112	0.0145	0.0353**	-0.0074	-0.0059
	(0.0140)	(0.0321)	(0.0350)	(0.0145)	(0.0386)	(0.0436)
Male	0.2562***	0.2462***	0.2492***	0.2583***	0.2534***	0.2604***
	(0.0178)	(0.0360)	(0.0384)	(0.0189)	(0.0466)	(0.0519)
Age	0.0298***	0.0355**	0.0402**	0.0290***	0.0323	0.0388*
	(0.0060)	(0.0154)	(0.0162)	(0.0063)	(0.0197)	(0.0210)
Age squared	-0.0003***	-0.0003*	-0.0004**	-0.0003***	-0.0003	-0.0004
	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0002)
West	0.3089***	0.2233***	0.2302***	0.3168***	0.2205***	0.2299***
	(0.0185)	(0.0327)	(0.0350)	(0.0197)	(0.0423)	(0.0470)
German	0.0775***	0.0757	0.0669	0.0775***	0.0763	0.0682
	(0.0273)	(0.0553)	(0.0663)	(0.0289)	(0.0721)	(0.0949)
Married	0.0851***	0.1189***	0.1042***	0.0856***	0.1413***	0.1223***
	(0.0148)	(0.0300)	(0.0317)	(0.0158)	(0.0400)	(0.0442)
Children	0.0775***	0.0245	0.0207	0.0842***	0.0333	0.0314
	(0.0140)	(0.0282)	(0.0301)	(0.0151)	(0.0359)	(0.0396)
Intermediate schooling level	0.0528***	0.0556*	0.0578	0.0513***	0.0483	0.0529
	(0.0170)	(0.0333)	(0.0354)	(0.0179)	(0.0424)	(0.0467)
High schooling level	0.2035***	0.1391***	0.1427***	0.2099***	0.1451***	0.1576**
	(0.0238)	(0.0464)	(0.0525)	(0.0249)	(0.0557)	(0.0671)
Apprenticeship	0.0308	-0.1145**	-0.1333**	0.0453*	-0.0723	-0.0934
	(0.0231)	(0.0562)	(0.0632)	(0.0239)	(0.0685)	(0.0815)
Master craftsmen	0.1439***	0.0308	0.0200	0.1466***	0.0474	0.0298
	(0.0309)	(0.0634)	(0.0704)	(0.0319)	(0.0758)	(0.0884)
University	0.2368***	0.1587***	0.1305**	0.2476***	0.1987***	0.1580*
	(0.0327)	(0.0533)	(0.0595)	(0.0359)	(0.0725)	(0.0862)
Firm size up to 99 employees	0.0519***	0.0544	0.0480	0.0535***	0.0702	0.0619
	(0.0173)	(0.0358)	(0.0369)	(0.0181)	(0.0455)	(0.0480)
Firm size 99 to 999 employees	0.0539**	0.0620	0.0624	0.0511**	0.0554	0.0546
	(0.0235)	(0.0534)	(0.0576)	(0.0251)	(0.0720)	(0.0808)
Firm size more than 999 employees	0.1452***	0.1299***	0.1282***	0.1538***	0.1482***	0.1506**
	(0.0202)	(0.0398)	(0.0425)	(0.0215)	(0.0528)	(0.0589)
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Constant	5.6666***	5.7900***	5.7897***	5.6640***	5.7994***	5.7647***
	(0.1218)	(0.2900)	(0.3077)	(0.1281)	(0.3685)	(0.4027)
Observations	4428	1319	1183	4052	943	807
Adj. R-squared	0.36	0.37	0.37	0.34	0.34	0.33

Note: Reference groups are low schooling level, no vocational training and firm size up to 19 employees. The following industries have been accounted for: agriculture, industry, craft, trade, services and public service. For reasons of simplicity the coefficients of the industry 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, 2003 and 2007.

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

	Dependent variable: ln (net monthly wage)			
	(1)	**(2)**	**(3)**	**(4)**
	No control variables	**Approximated Mincer-equation**	**All control variables**	**All control variables incl. general training and informal training**
PI vs. CI	0.5888*** (0.0599)	0.4877*** (0.0599)	0.3887*** (0.0767)	0.3347*** (0.0794)
	Ps-R^2: 0.0064; N: 5932	Ps-R^2: 0.0772; N: 5817	Ps-R^2: 0.1564; N: 4428	Ps-R^2: 0.1571; N: 4428
PI vs. CII	-0.0164 (0.1397)	0.0686 (0.1307)	0.0102 (0.1494)	0.0099 (0.1490)
	Ps-R^2: 0.0000; N: 1966	Ps-R^2: 0.0911; N: 1946	Ps-R^2: 0.1573; N: 1319	Ps-R^2: 0.1574; N: 1319
PI vs. CIII	-0.0524 (0.2294)	-0.0463 (0.1706)	-0.2343 (0.1969)	-0.2421 (0.1987)
	Ps-R^2: 0.0000; N: 1762	Ps-R^2: 0.0952; N: 1748	Ps-R^2: 0.1582; N: 1183	Ps-R^2: 0.1585; N: 1183
PII vs. CI	0.4710*** (0.0730)	0.4190*** (0.0745)	0.3069*** (0.0950)	0.2584*** (0.0985)
	Ps-R^2: 0.0032; N: 5331	Ps-R^2: 0.0699; N: 5220	Ps-R^2: 0.1515; N: 4052	Ps-R^2: 0.1521; N: 4052
PII vs. CII	-0.1241 (0.1394)	-0.0031 (0.1315)	-0.0869 (0.1552)	-0.0846 (0.1547)
	Ps-R^2: 0.0002; N: 1365	Ps-R^2: 0.0754; N: 1349	Ps-R^2: 0.1417; N: 943	Ps-R^2: 0.1421; N: 943
PII vs. CIII	-0.1592 (0.2199)	-0.1051 (0.1656)	-0.3254* (0.1965)	-0.3388* (0.1985)
	Ps-R^2: 0.0002; N: 1161	Ps-R^2: 0.0777; N: 1151	Ps-R^2: 0.1396; N: 807	Ps-R^2: 0.1402; N: 807

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, 2003 and 2007.