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# Continuous training in Germany

**Jörn-Steffen Pischke**

Centre for Economic Performance, London School of Economics, Houghton Street, London WC2A 2AE, England (Fax: +44-207-955-7595; e-mail: s.pischke@lse.ac.uk)

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**Abstract.** Using data from the German Socio Economic Panel, I analyze the incidence, financing, and returns to workplace training in Germany for the years 1986 to 1989. Much of this training seems general, and is provided to workers by their employer at no direct cost. While workers typically report larger productivty gains from the training during work hours, such training has lower returns than training undertaken during leisure time. Workers with higher earnings growth seem more likely to participate in training. I deal with this selection problem by estimating models that allow for inidividual level heterogeneity in earnings growth rates.

**JEL classification:** J24, J31

**Key words:** On-the-job training, human capital model, returns to training

## 1. Introduction

The German apprenticeship system has become the focus of much recent literature studying the financing of such training (Soskice 1994; Oulton and Steedman 1994; Harhoff and Kane 1997; Acemoglu and Pischke 1998). This literature concludes, contrary to the predictions of Becker (1964), that firms

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pay a share of the training costs of apprentices, even though the qualifications of apprentices are largely general skills. But initial vocational qualifications are not enough for workers to remain productive, and on-the-job training received after completion of the apprenticeship plays a large role in the skill development of workers. In fact, in a 1979 survey, when German labor force participants were asked where they acquired the skill used most on their job, the two most important avenues of acquiring job skills were formal firm-based continuous training and informal training on-the-job by colleagues or by learning-by-doing. Among workers who completed an apprenticeship, for example, when asked for the single most important place for acquiring job skills only 32 percent of respondents named the apprenticeship or vocational school while 58 percent point to some form of continuous training or on-the-job learning.[1]

This paper analyzes data from the German Socioeconomic Panel (GSOEP) on work-related training received by workers after they have entered the labor market. The dataset is unique in that it asks a lot of direct questions about the financing and payoffs to this type of training. This provides some suggestive evidence that firms participate in the financing of continuous training in Germany, especially training during work hours. In addition, the panel nature of the data also allows me to analyze the returns to training in terms of wages in the traditional way. I estimate separate returns to training during work hours and to training during leisure time. If all training is general, the two types of training should have the same returns under the standard human capital model. I also employ more direct evidence in the data on the portability of the skills received across employers.

Despite its potential importance, continuous training in Germany has received comparatively less attention than the apprenticeship system. Notable exceptions are a concurrent paper by Pannenberg (1997), as well as recent work by Schömann and Becker (1998), and by Pfeiffer and Reize (2000). Pannenberg also looks at the GSOEP data and tries to assess how firm financing of training is related to returns to training and promotions. Schömann and Becker use the German Life History Survey and focus on the differences of returns to training for job changers and stayers. Pfeiffer and Reize use the cross-sectional Qualification and Career Survey and focus on the returns to formal and informal training among those working for others versus the self-employed.

The rest of this paper is organized as follows. The next section describes the data set and discusses a few methodological issues. Section 3 gives basic descriptive facts about the receipt of continuous training, like the incidence and duration among various groups of workers. This section also describes worker responses about the nature, financing, and self-assessed benefits of the training. Section 4 analyzes the link between training and subsequent wage growth while Sect. 5 draws some conclusions about the implications for the operation of the training market in Germany.

## 2. The data

The data used in this paper come from the first six waves of the (West) German Socioeconomic Panel (GSOEP) which has been conducted annually since 1984. It consists of a representative sample of about 4,500 household and

includes an oversample of 1,500 foreign household from the five major guest-worker nations (Turkey, Italy, Spain, Greece, and the former Yugoslavia). The GSOEP is largely patterned after the US Panel Study of Income Dynamics and includes information on demographics and household composition, living quarters, labor market information, income and recipiency of government transfers, time use, and a variety of attitudinal questions. In addition to the core questionnaire, modules of questions on particular topics are conducted each year. In this paper, I use the extensive set of questions on continuous training asked in the 1989 interview wave.

The training questions were posed to all respondents age 16–64, irrespective of employment status. The interview sequence, after two questions on attitudes towards continuous training, starts with the following question: "There are various possibilities for work-related training. Thinking about the past three years, for your own job related education, have you read books and journals, participated in conferences and congresses, or participated in work-related courses?" Respondents who answered that they have taken any courses were asked specific questions about the duration, goals, content, costs, and benefits of the training. The lead-in question demonstrates that the survey is only concerned with relatively formal courses or seminars, thus presumably missing many more informal avenues of skill development.[2] While the training questions are asked of all respondents, I only consider employed workers in this paper, since my main interest is in the degree of employer involvement and financing of training. It is necessary to point out, however, that the training analyzed need not be directly related to the employer. For example, a respondent could obtain work-related training at a private or public training center outside of work without any employer involvement. In addition, some of the training may be sponsored by the unemployment insurance system.

Another important feature of the questionnaire has to be noted. After the initial question, details like the start date, duration, goals, and whether the training took place during work hours or leisure time, are asked for up to three courses. After these questions, additional questions are asked about the most important course in the judgement of the respondent. This segment includes questions about the content and organizer of the course, on the financing, and on the perceived benefits from the training. Since the responses to these questions are central to my analysis, and in order to present the evidence in a simple fashion for participants of multiple courses, I will focus on this self-designated most important course when analyzing the financing and benefits from training.

Interviews for the GSOEP are conducted mostly in early spring, about 80 percent take place in March and April. When asked about training, respondents seem to have interpreted the three year reference period as the period immediately prior to the interview, since many respondents reported courses which started in the first few months of 1989. In reporting statistics about the incidence of training below, I will use all the courses reported for the three year period. Unfortunately, the reference period differs from those used in other surveys on training, and this should be kept in mind when comparing results. For example, the German Qualification and Career Survey ("Qualifikation und Berufsverlauf") asks about training during the past five years. The British Social Attitudes Survey, analyzed by Booth (1991) reports training during the past two years, while the 1991 wave of the National Child Development Survey inquires about work-related training during a ten year period.

The US Current Population Survey supplements on training in 1983 and 1991 ask about training received in the current job, while the National Longitudinal Survey of Youth (NLSY) asks about training since the last interview in each wave. It is likely that respondents will have forgotten some training episodes if the recall period is too long. For example, many more respondents in the sample report courses starting in 1988 than in the prior years, even among those respondents only reporting one course. This seems to matter mostly for measuring training incidence. I repeated much of the analysis in the paper for training spells in progress during 1988 only, and I find very similar results to those reported below for the three year window.

There are 1,418 respondents in the survey, who reported participation in one or more courses. I focus on employed respondents and I limit the samples analyzed to those respondents without missing values of the relevant variables. My samples will therefore include substantially fewer trainees. I basically utilize three different samples below. The particular questions asked determine which sample I look at. In order to describe the incidence of training, I focus on those individuals who are employed in 1986 (i.e. prior to the training for the vast majority of all training spells reported). In analyzing the information about the most important course, I match that course to the job held when the course started. Finally, in order to analyze the wage effects of training, I match all three courses for each respondent to the wage information from 1986 to 1989. This final sample includes everyone employed in at least three waves during this period. Details on the construction of the variables are given in Appendix 1.

The GSOEP is a non-representative sample due to oversamples of the foreign population. All results reported here use the cross sectional person weights calculated by the DIW for the 1989 wave (where the training information comes from). Many of my analyses use variables from various waves so that this is not strictly correct. However, I often combine 1989 training information with job information at the start of the training so that the wave used is individual specific. Since there are no directly appropriate weights available for this type of longitudinal analysis, I use the cross sectional weights as an approximation. Alternative weights yielded very similar results.

## 3. Incidence, financing, and benefits of training

Table 1 reports some basic statistics about the incidence and intensity of the training received. 28% of those employed in 1986 report that they participated in at least one course or seminar during the 1986 to 1989 period. Incidence is lower for women, foreigners, and those with less schooling. Maybe surprisingly, training incidence remains high for workers into their forties, but drops substantially for workers older than that. Blue collar workers receive substantially less training than white collar workers, while civil servants (a diverse group including mail-carriers, railway workers, teachers, etc.) receive the most training.

These findings are roughly in line with those from other surveys and other countries. 35% of Germans in the 1991–1992 Qualification and Career Survey indicate that they have received work-related training during the past five years, up from 27% in the 1985–1986 survey. This straddles the 28% found in the GSOEP data, despite the different reference period. Booth (1991) reports a

**Table 1.** Descriptive statistics about training receipt (in %)

| Group | | Participated in any training | Among those participating | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 Course | 2 Courses | 3 or More courses | Duration 1 day | Duration 2 days to 1 week | Duration 1 week to 3 months | Duration > 3 months | Training employer sponsored | Uncond. duration (weeks) | Number of obs. |
| All Workers | | 28 | 29 | 21 | 50 | 14 | 52 | 19 | 15 | 83 | 3.9 | 3413 |
| Gender | Men | 31 | 28 | 20 | 51 | 11 | 55 | 19 | 15 | 85 | 4.5 | 2216 |
| | Women | 22 | 30 | 22 | 47 | 22 | 43 | 21 | 14 | 79 | 2.7 | 1197 |
| Nationality | Germans | 29 | 29 | 21 | 50 | 14 | 52 | 19 | 15 | 84 | 4.1 | 2548 |
| | Foreigners | 5 | 38 | 27 | 35 | 16 | 50 | 22 | 12 | 92 | 0.5 | 865 |
| Education | No degree | 7 | 36 | 38 | 27 | 21 | 37 | 19 | 23 | 81 | 1.7 | 1119 |
| | Apprenticeship | 27 | 30 | 22 | 47 | 13 | 50 | 22 | 15 | 82 | 3.8 | 1947 |
| | University | 60 | 26 | 15 | 59 | 15 | 59 | 14 | 13 | 87 | 7.1 | 347 |
| Age | Less than 35 | 36 | 32 | 24 | 44 | 13 | 43 | 22 | 22 | 80 | 7.1 | 1155 |
| | 35–44 | 33 | 24 | 19 | 57 | 12 | 54 | 19 | 14 | 82 | 4.6 | 938 |
| | 45 and older | 18 | 30 | 18 | 52 | 18 | 64 | 15 | 3 | 90 | 0.8 | 1320 |
| Occupation | Blue collar | 10 | 41 | 31 | 28 | 11 | 36 | 25 | 29 | 74 | 2.5 | 1600 |
| | White collar | 36 | 29 | 18 | 53 | 14 | 55 | 17 | 14 | 81 | 4.7 | 1238 |
| | Self-employed | 19 | 22 | 22 | 56 | 21 | 53 | 14 | 11 | 63 | 1.1 | 248 |
| | Civil servants | 57 | 25 | 22 | 54 | 13 | 53 | 23 | 11 | 98 | 7.2 | 327 |

*Note*: Sample includes respondents employed in 1986, occupation refers to 1986. Duration among those participating refers to the most important course. Unconditional duration adds durations for all courses attended.

somewhat higher participation rate of 44% among men in Britain. This number refers to formal job related training within the last two years from the British Social Attitudes Survey conducted in 1987. Among women the rate is 34%. My own estimates from the 1991 Current Population Survey (CPS) for the US indicate that 17% of workers received formal company training and training in school, the concept most closely resembling the GSOEP question. The US incidence is lower despite the fact that the CPS question refers to all training received in the current job, and average tenure in the sample is 8.4 years. In other US surveys the training incidence is higher. Veum (1993) reports 38% of those less than 35 reporting training during a six year window in the NLSY. While this number is obtained from combining the answers to annual questions with a much shorter recall period, it matches almost exactly the incidence of 36% among young workers in Germany.

Table 1 also reports a variety of measures of the intensity of training. The majority of respondents who participated in any training report 3 or more courses. Duration of the courses is coded in seven brackets,[3] and this duration measure for the most important course is summarized into four categories in the table. The median duration is less than one week. Women and older workers, who receive less training also have shorter training spells. The same is not true for other groups with less training, in particular foreigners, those with less education, and blue collar workers. The incidence of very long training spells is higher among the less educated and blue collar workers. This is mostly due to the fact that retraining sponsored by the unemployment insurance system, which lasts longer than the average training spell, is geared more towards less educated and blue collar workers.

Another measure reported in Table 1 is whether the training can be linked to the employer. This variable is again created for the most important course. I assume such a link if the training either took place during work hours or the employer is named as the organizer of the training or the employer bore at least some of the monetary cost of the training. More than 80% of all training of those employed is employer sponsored according to this definition. This indicates substantial employer involvement in continuous training.[4]

To assess the overall distribution of training intensity, the last column combines the incidence and duration of training into one single measure. In order to create this variable, I assigned the midpoints to the brackets of the weekly duration variable. Effectively, the mean of the unconditional training measure is the product of incidence, the mean number of courses taken (up to a maximum of three), and the average duration per course. This calculation will slightly underestimate the total length of training for those with more courses. It should also be noted that very long courses will influence this measure a lot. The results imply slightly less than four weeks of training per worker but there is still substantial variation left. University graduates, the young, and civil servants are the groups receiving the most training. Blue collar workers and the less educated are less far behind in terms of total time spent training than on incidence because of their higher participation in longer courses.

Since there is a good deal of correlation among the various demographic breakdowns in Table 1, it is useful to learn which of these are driving the results. As it turns out, all the partial correlations hold up even when controlling for other factors. The first four columns in Table 2 present linear probability models of the total incidence of training and of employer sponsored training

**Table 2.** Training incidence and duration

| Independent variable | Linear probability model | | | | Censored LAD |
|---|---|---|---|---|---|
| | Participated in any training | | Training employer sponsored | | Number of weeks |
| | (1) | (2) | (3) | (4) | (5) |
| Mean of the dep. var. | 0.28 | 0.28 | 0.23 | 0.23 | 3.87 |
| Years of schooling in Germany | 0.040* | 0.015* | 0.036* | 0.012* | 0.14* |
| | (0.005) | (0.006) | (0.005) | (0.005) | (0.02) |
| Years of schooling outside Germany | 0.017* | 0.004 | 0.016* | 0.006 | −0.10 |
| | (0.006) | (0.006) | (0.006) | (0.005) | (0.09) |
| Potential experience | −0.007* | −0.008* | −0.005* | −0.006* | −0.04* |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.01) |
| Female | −0.073* | −0.067* | −0.069* | −0.061* | −0.31* |
| | (0.024) | (0.025) | (0.023) | (0.023) | (0.13) |
| Part-time | −0.053 | −0.027 | −0.046 | −0.025 | −0.27 |
| | (0.027) | (0.027) | (0.025) | (0.024) | (0.21) |
| Foreigner | 0.110* | 0.054 | 0.110* | 0.045 | −0.36 |
| | (0.053) | (0.050) | (0.051) | (0.048) | (0.33) |
| Semi-skilled | – | −0.013 | – | −0.015 | – |
| | | (0.022) | | (0.021) | |
| Skilled | – | 0.024 | – | 0.005 | – |
| | | (0.030) | | (0.028) | |
| Foreman | – | 0.043 | – | 0.039 | – |
| | | (0.041) | | (0.038) | |
| Self-employed | – | 0.137* | – | 0.089* | – |
| | | (0.042) | | (0.035) | |
| Simple white collar | – | 0.044 | – | 0.036 | – |
| | | (0.034) | | (0.032) | |
| Skilled white collar | – | 0.218* | – | 0.183* | – |
| | | (0.031) | | (0.029) | |
| Managers/Prof. | – | 0.338* | – | 0.291* | – |
| | | (0.048) | | (0.047) | |
| Public/low rank | – | 0.238* | – | 0.248* | – |
| | | (0.058) | | (0.059) | |
| Public/higher rank | – | 0.368* | – | 0.385* | – |
| | | (0.062) | | (0.061) | |
| Public/upper rank | – | 0.337* | – | 0.349* | – |
| | | (0.077) | | (0.076) | |
| Firm size 20–200 | 0.062* | 0.048 | 0.073* | 0.051* | 0.47* |
| | (0.026) | (0.027) | (0.023) | (0.023) | (0.20) |
| Firm size 200–2000 | 0.071* | 0.053 | 0.101* | 0.076* | 0.14 |
| | (0.028) | (0.028) | (0.025) | (0.025) | (0.23) |
| Firm size > 2000 | 0.146* | 0.119* | 0.179* | 0.141* | 0.82* |
| | (0.028) | (0.029) | (0.026) | (0.026) | (0.21) |
| Firm size missing | 0.177 | 0.145 | 0.096 | 0.074 | 1.39* |
| | (0.129) | (0.140) | (0.126) | (0.130) | (0.38) |
| $R^2$ or pseudo $R^2$ | 0.203 | 0.247 | 0.199 | 0.243 | 0.011 |

*Note*: Sample size is 3413. Sample includes those employed in 1986. Employment related regressors refer to 1986. The regressions also include a constant and 19 industry dummies.

on a variety of demographics and firm characteristics. The independent variables chosen are those typically found in cross-sectional earnings regressions.[5] Women tend to receive less training, even after controlling for education, occupation, industry and part-time status. Training is strongly related to both schooling and occupational position. In order to gauge the effect of schooling, I present regressions including and excluding occupation dummies. The effect of education is smaller for foreigners. This means that foreigners receive less training than Germans, even though the intercept term is positive. On average, foreigners have slightly less than 7 years of foreign schooling and 1.5 years of German schooling. This means that the average foreigner obtains about 5 percentage points less training than a similar German with an equal number of years of schooling, all of which were obtained in Germany. Results are very similar for employer sponsored training, as shown in columns 3 and 4.

The last column looks at the total number of weeks of training. The dependent variable is the unconditional duration measure used in Table 1. Since those individuals not reporting training have zero weeks of participation, this censored regression equation is estimated using Powell's (1984) least absolute deviations estimator. Because the distribution of the duration variable is extremely skewed, this estimator will reflect the central tendency of the data better than, say, a Tobit model.[6] The results are to be interpreted as the partial effects on duration conditional on participating in training. The coefficients are qualitatively very similar to the incidence equations. The point estimates imply that women and foreigners take shorter courses than German men, but the results for foreigners are not significant.

These results indicate that training is highly concentrated by observable previous skills. This raises the question whether there is also important selection into training on the basis of unobservables, even within observably similar groups. In order to asses this possibility, I ran standard wage regressions for those employed in 1986 (i.e. before most of the training reported took place).[7] Those who receive training in the future have earnings that are *lower* by about 1 percentage point than the earnings of non-trainees. Results are similar for those with any future training and for employer sponsored training. In either case, the results are not statistically significant with t-statistics of about 0.5. These results do not point to important selection on the basis of unobservables, which are related to the level of wages.

Information on the financing of the training is contained in Table 3, which refers only to participants of training who were employed when the training started. All information in this table refers only to the most important course designated by the respondent. About two thirds of trainees received some type of monetary assistance or had their wages paid during training, mostly by the employer. Financial assistance by the unemployment insurance system is relatively rare in this sample, which conditions on employment. Most participants also report that they had no explicit monetary costs. Women report that slightly less of their training was employer financed. The responses to the financing questions, of course, do not mean that workers did not implicitly pay for the training expenses through lower wages, as envisioned by Becker. Because wage observations are only available at annual intervals and most training spells are very short, it is not possible to test directly whether wages have been reduced for workers receiving training.

However, a further question, only asked of those respondents who report explicit financial assistance, indicates that there is some reluctance of training

**Table 3.** Financing of training (in %)

| | | Source of financial assistance | | | Own costs zero? | Participate without assistance? | | | Received certificate? | Number of obs. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | None | Employer | UI office and other | | Yes | Maybe | No | | |
| All courses | All workers | 33 | 62 | 4 | 71 | 37 | 34 | 28 | 61 | 832 |
| | Men | 31 | 65 | 4 | 71 | 36 | 32 | 32 | 62 | 583 |
| | Women | 37 | 57 | 6 | 71 | 41 | 39 | 19 | 60 | 249 |
| During work hours | All workers | 25 | 75 | 0 | 80 | 33 | 35 | 32 | 58 | 616 |
| | Men | 23 | 76 | 0 | 80 | 32 | 32 | 36 | 58 | 456 |
| | Women | 28 | 71 | 1 | 81 | 37 | 42 | 21 | 58 | 127 |
| During leisure hours | All workers | 57 | 27 | 16 | 42 | 58 | 31 | 10 | 70 | 216 |
| | Men | 57 | 27 | 16 | 38 | 58 | 33 | 9 | 75 | 160 |
| | Women | 56 | 28 | 15 | 49 | 58 | 29 | 13 | 65 | 89 |
| Received certificate | All workers | 31 | 63 | 6 | 65 | 38 | 38 | 25 | 100 | 520 |
| | Men | 30 | 65 | 5 | 65 | 38 | 36 | 27 | 100 | 367 |
| | Women | 34 | 57 | 9 | 62 | 37 | 43 | 20 | 100 | 153 |
| No certificate | All workers | 36 | 63 | 1 | 80 | 38 | 28 | 34 | 0 | 312 |
| | Men | 33 | 66 | 1 | 80 | 33 | 26 | 41 | 0 | 216 |
| | Women | 42 | 56 | 1 | 84 | 50 | 33 | 17 | 0 | 96 |

*Note*: Sample includes respondents employed at the start of training. All responses refer to the most important course. Number of observations for question whether participate without assistance is 566 for all workers.

participants to spend their own money knowingly. The question asked whether the respondent would have participated in the training without the financial assistance received from the employer, UI office, or other source. The answers are relatively evenly split between yes, no and maybe. Women, who participate in less training, show slightly more willingness to finance their own training. If the explicit financing of training did not matter, because workers take wage cuts to reimburse firms for the costs they incur, all workers should answer that they are willing to participate without assistance. Either workers do not recognize that there is a trade-off between the explicit financing of training and wages, or firms pay some of the training expenses.

In order to get a more detailed picture of the financing of training, it is useful to look at whether the course took place during work hours or during the respondents' leisure time. 65% of courses take place during work hours, 10% partly during work and partly during leisure time, and the remaining 25% during leisure time. Women are more likely to undertake training during leisure time than men. 33% of their courses are after work, while only 22% of the courses attended by men are during leisure time. When looking at the financing of courses conditional on whether they were during work or leisure time, fewer differences emerge across men and women with respect to courses undertaken during leisure time. More importantly, employers are much less involved in the financing of courses during leisure time. Both direct financial assistance is low compared to courses during work hours, workers frequently pay some direct monetary costs, and workers are more willing to participate in costly courses. This indicates that the distinction between courses during work hours and leisure time is a useful indicator for the degree of employer financing.

An important issue in judging the financing of the training is whether the training is general or firm-specific. In fact, the differences in the willingness to pay for training across demographic groups may be due to differences in the nature of the training. The only measure in the data set speaking to this issue is a question on whether respondents received a written certificate for the participation in the course, which they would show to a future employer if they applied for a new job. Such certificates may attest to particular qualifications received by the trainee, but frequently they are simply given to any employee actually showing up at the training course. Pfeiffer and Reize (2000) report that about three quarters of all certificates received by training participants are simply certifying participation.[8] Answers to this question are useful to assess whether the skills learned are easily portable to a new job, since the answers will depend both on whether respondents view the course as sufficiently important, in addition to whether the nature of the skills is general. 61% of respondents received such a certificate. Even among participants in courses as short as one day this fraction is still 38%. This indicates that employees view participation as quite relevant for their career, and that skills might be highly portable. Of course, other courses might provide general skills without certification, so that the fraction of general skills received in training is likely to be even higher.[9] Workers, who trained during work hours received certificates less often than those training during leisure time, but the difference, 58 versus 70%, is smaller than I would expect if most of the training during work hours were firm-specific. The incidence of certificates is high even for training at work. There are also hardly any differences between men and women, especially for training during work hours. Hence, the specificity of the

training is also unlikely to explain the financing differences between men and women. Of course, an alternative interpretation of these certificates would be that future employers simply view them as a signal of employee motivation and willingness to learn, while they are actually not very informative about the portability of the skills.

The bottom part of the table displays results on the financing according to whether participants received a certificate. Direct employer assistance is equally likely irrespective of whether the course was certified or not, but workers indicate that their own costs were higher if they received a certificate. This is certainly consistent with the notion that courses with certificates contain more general skills, and therefore employee finance should be more likely. But in 65% of the cases, workers do not report any costs for courses for which they received a certificate. They are also only slightly more willing to participate in these courses without assistance.[10] Hence, this evidence, while somewhat indirect, certainly suggests that employers finance a lot of training, even when the content is highly general.

Respondents were also asked whether they felt that the training helped them in their careers. Trainees generally felt positive about their participation. 80% responded that the courses helped them a lot or somewhat. Training primarily helped respondents to do their current job better: 70% of respondents (including those not perceiving any benefits) felt that to be true. I interpret this as primarily a benefit for the firm: the productivity of the worker has increased, and if the worker can still be employed at the old wage, this benefits the employer. But workers may also feel happier if they are able to do their job better. Respondents were also asked about benefits that are more clearly private benefits to them: whether training helped them get a higher wage or a promotion, whether it made their job more secure or helped them to move to a more interesting job, or whether it made it possible to find a new job more easily. Only 10% of participants felt that higher wages were a benefit of the training. 37% of participants named one of the private benefits from training, substantially less than those who felt that their productivity had been improved.

In Table 4, I analyze whether there are systematic differences in the responses to these benefit questions by demographics and characteristics of the training. Because the benefit responses are in three ordered categories, I estimate ordered logit models for the benefit equations. I also analyze the benefits for the firm (better skills for the current job) and for the worker (all remaining benefits) separately.[11] There is surprisingly little evidence that demographics matter for the workers' feelings about the success of the course. More educated workers claim that training lets them do their job better, but are less likely to feel that they receive personal benefits than less educated workers. A similar pattern arises for older workers. This may indicate that workers with more previous skills are more easily trainable, or that their training is productive more quickly on the job. In no case do women and foreigners, the groups with less training, report significantly different perceptions about the course than men and Germans.

I also display models that control for some course characteristics. These controls have little effect on the coefficients on the demographics but the course characteristics matter quite a bit themselves. Some interesting patterns emerge. Workers who received a written certificate feel more positive about the course. In fact, both benefits for the firm and for the worker are affected.

**Table 4.** Ordered logits for training benefits

| Independent variable | Any benefit | | Benefit for the firm | | Benefit for the worker | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Years of schooling in Germany | 0.04 | 0.03 | 0.07* | 0.06* | −0.08* | −0.10* |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.03) |
| Years of schooling outside Germany | 0.08 | 0.06 | 0.13* | 0.13* | −0.01 | −0.04 |
| | (0.05) | (0.06) | (0.05) | (0.06) | (0.05) | (0.05) |
| Potential experience | 0.005 | 0.001 | 0.010 | 0.005 | −0.046* | −0.045* |
| | (0.007) | (0.007) | (0.007) | (0.007) | (0.008) | (0.008) |
| Female | −0.18 | −0.18 | −0.04 | −0.05 | −0.33 | −0.25 |
| | (0.16) | (0.16) | (0.16) | (0.16) | (0.18) | (0.18) |
| Part-time | −0.33 | −0.28 | −0.40 | −0.30 | −0.11 | −0.20 |
| | (0.27) | (0.28) | (0.27) | (0.27) | (0.33) | (0.36) |
| Foreigner | −0.10 | 0.01 | 0.12 | −0.06 | 0.03 | 0.17 |
| | (0.41) | (0.42) | (0.40) | (0.40) | (0.40) | (0.42) |
| Duration 1 day to 1 week | – | −0.03 | – | −0.18 | – | 0.84* |
| | | (0.20) | | (0.20) | | (0.27) |
| Duration > 1 week | – | −0.07 | – | −0.35 | – | 1.09* |
| | | (0.23) | | (0.23) | | (0.30) |
| Training during work hours | – | 0.54* | – | 0.56* | – | 0.48* |
| | | (0.19) | | (0.19) | | (0.22) |
| Training partly during work hours | – | 0.15 | – | −0.02 | – | 0.55 |
| | | (0.25) | | (0.25) | | (0.28) |
| Received certificate | – | 0.41* | – | 0.39* | – | 0.65* |
| | | (0.13) | | (0.14) | | (0.16) |
| Organizer: employer | – | 0.03 | – | 0.08 | – | 0.15 |
| | | (0.22) | | (0.21) | | (0.25) |
| Organizer: business association | – | −0.11 | – | −0.15 | – | −0.28 |
| | | (0.24) | | (0.24) | | (0.28) |
| Organizer: private firm | – | 0.16 | – | 0.26 | – | 0.28 |
| | | (0.26) | | (0.25) | | (0.29) |
| Initiative: worker | – | 0.40* | – | 0.34* | – | 0.30 |
| | | (0.17) | | (0.17) | | (0.20) |
| Initiative: worker and employer | – | 0.31 | – | 0.42* | – | 0.13 |
| | | (0.19) | | (0.19) | | (0.21) |
| No costs to worker | – | 0.63* | – | 0.63* | – | 0.08 |
| | | (0.17) | | (0.17) | | (0.19) |

*Note*: Sample includes respondents employed at the start of the training. Responses refer to the most important course. All regressions also include four firm-size dummies and a constant. Number of observations is 832.

This may mean that one aspect these certificates capture is the importance of the training rather than just its transportability. But the strong effects on the workers' benefits is also consistent with the view that certified training is more general since the worker will benefit typically through a change in their outside options. Courses where the worker did not pay any monetary expenses lead to higher benefits, particularly for the firm. If these costs were not shifted to wages then this implies that firms seem to benefit more from the courses they finance.

There are also a number of puzzling findings, however. Training during work hours benefits both the firm and the worker more than training during the worker's leisure time. So why are workers participating in courses on their

own time if they do not feel any benefits from those courses? One answer may be that such courses are more likely to be effective further in the future. Alternatively, workers may also participate in courses during leisure time at their own initiative that have some consumption value, and are less directly related to work. If the initiative for the training came from the worker rather than from the employer, the firm seems to benefit more but the results are less pronounced for the worker's own benefits. This is again curious, but the largest benefits for the firm are due to a joint initiative. The firm and the worker seem to be able to agree beforehand on the value of the training that is immediately productive. Nevertheless, it is curious that workers do not take the initiative for courses which benefit them. Longer duration courses benefit the worker but not the firm. This is likely due to the fact that these courses may pay off only in the longer run, so that the skills are not immediately being used on the job.

This section has revealed some interesting differences in the receipt and attitudes of workers to their training. Not surprisingly, the more educated and younger workers receive more training. Women, who attend fewer courses, are somewhat more willing to finance their own training. Firms are involved in the financing of much of the training which takes place during work hours, even though much of this training is likely to be rather general. On the other hand, men and women do not seem to differ much in terms of their assessment of the success of training. A dichotomy of the types of courses seems to emerge from the results. Less educated workers participate in longer duration courses, many directed towards learning new skills for a better job or a new occupation. The payoffs from these courses are often not very immediate, in terms of higher productivity on the current job, but rather long run, in terms of new job prospects. More educated workers, on the other hand, participate in many more but generally shorter courses, which yield immediate benefits on the current job in terms of higher productivity. There seem to be fewer benefits from these courses for the worker directly. This will be an important interpretation to keep in mind in examining earnings growth.

## 4. Training and earnings growth

The potential importance of on-the-job training for earnings growth over the life-cycle has long been emphasized by economists (Becker 1964; Mincer 1974). There has been much debate since as to whether wage growth related to general experience and to tenure with a particular employer is linked directly to human capital accumulation or can be explained by alternative theories like matching (Jovanovic 1979), back-loading of wages due to the agency problem (Lazear 1979), or learning and insurance (Harris and Holmström 1982). Furthermore, alternative theories of training imply lower returns to training than the Becker-Mincer model (Acemoglu and Pischke 1999). The GSOEP data offer a good opportunity to measure the returns to training, and therefore to shed some light on these competing hypotheses.

Similar studies, linking direct information on training to earnings growth have been undertaken, among others, by Brown (1989), Lynch (1992), Lillard and Tan (1992), Barron et al. (1997), and Loewenstein and Spletzer (1998) for the US and by Booth (1991), Blanchflower and Lynch (1994), Blundell et al. (1996) and Arulampalam et al. (1997) for the U.K. These studies have had

varied results but typically found significant returns to at least some types of training. Other studies of this type for Germany are Pannenberg (1997), who also uses the GSOEP data, and Schömann and Becker (1998) and Pfeiffer and Reize (2000).

My approach to the issue is fairly standard. If training enhances wage growth then training variables should have a significant effect in a standard wage equation over and above the wage growth due to general experience and tenure effects. In fact, including training variables in the regression should dampen wage growth related to experience and tenure if it is true that much of the life-cycle earnings growth is related to human capital accumulation. Unfortunately, much human capital accumulation is likely to be rather informal so that it might not be picked up by the GSOEP questions on continuous education courses. (See Pfeiffer and Reize 2000 for an analysis of returns to informal training in Germany.) Nevertheless, if anything, these variables are likely to be positively correlated with other means of skill improvement so that we would expect to find a bigger effect than is attributable to formal training alone.

There are a number of complications to this exercise. First, there is the selection issue alluded to in the previous section. If workers with unobserved abilities get more training, then we would see higher wages for workers who report more training. Standard fixed effects regressions will eliminate any effects correlated with the level of wages. I therefore start by estimating models of the form

$$\ln w_{it} = X_{it}\beta + \gamma T_{it} + \alpha_i + \varepsilon_{it}, \tag{1}$$

where $X_{it}$ is a set of regressors like labor market experience and tenure with the current employer, $T_{it}$ denotes that the worker has received training at some time *before* period $t$ (since training should enhance earnings permanently), and $\alpha_i$ is a fixed person specific constant affecting all time invariant determinants of the level of earnings.

There are good reasons why even this model may be problematic. For example, high ability workers may receive more training and have higher wage growth from other sources as well. This would be the case in a model with learning about worker abilities (as in Jovanovic 1979) and specific training. In this case, $\gamma$ would be overestimated because the training variable picks up some of the omitted wage growth of the high ability workers. This makes clear that it is important to control accurately for other potential sources of wage growth unrelated to training. In the regressions reported below, I use a quartic in potential experience and a quartic in tenure to make sure that the training measure does not pick up omitted nonlinearities in wage growth (see Murphy and Welch 1990).

Nevertheless, it is possible that a correlation between training and the growth rates of wages remains, so that the results may still be biased. In order to address this problem, I also estimate the alternative model

$$\ln w_{it} = X_{it}\beta + \gamma T_{it} + \alpha_i + \delta_i t + \varepsilon_{it}, \tag{2}$$

where $\delta_i$ is an individual specific growth rate of earnings. This model is identified, as long as there are at least three periods available on each individual and there is enough variability in training receipt within individuals. The fixed

**Table 5.** Patterns of training spells

| 1986–1987 | 1987–1988 | 1988–1989 | Number of observations |
|---|---|---|---|
| 0 | 0 | 0 | 2627 |
| 0 | 0 | 1 | 219 |
| 0 | 1 | 0 | 118 |
| 0 | 1 | 1 | 180 |
| 1 | 0 | 0 | 60 |
| 1 | 0 | 1 | 41 |
| 1 | 1 | 0 | 65 |
| 1 | 1 | 1 | 53 |

*Note*: Entries denote at least one training spell in the given year. Sample of individuals used for estimation of earnings regressions.

effects model in Eq. (1) implies that individuals without training spells do not contribute anything to the estimation of $\gamma$. Similarly, Eq. (2) implies that individuals who receive the same amount of training each year do not contribute anything to the estimation of $\gamma$. Table 5 displays the pattern of training spells in the estimation sample used below. While many workers have three or more spells, there are relatively few cases where these spells are distributed evenly between the four waves from 1986 to 1989. 93% of the workers with training spells have received training in some years but no training in other years, and will therefore allow the estimation of the return to training in the model with heterogeneous growth rates. In addition, variation in the length of training courses between different years will also contribute to the identifying variation in the data.[12]

The sample covers the four years from 1986 to 1989, the year of the survey with the training questions. I focus on this time period because this is the time frame the training questions refer to, so my constructed training measures should be most accurate. The training variable I use is years of training received since the 1986 survey. Recall that individuals could report details on up to three courses. I constructed total training by converting the bracketed duration measure to a continuous variable and adding up the resulting weeks for all of the reported courses. For any wave, the training refers to the cumulative amount since the 1986 survey.

There are some training spells which I observe starting before 1986 and ending after 1989. Omitting these will not bias my results. Any wage effects of training received before 1986 will be captured by the fixed effect $\alpha_i$. Training after 1989 should not affect wages any earlier. Including the available training information or wages before 1986 or after 1989, on the other hand, would lead to estimates that are biased downward since the information on training is certainly incomplete.

I distinguish between training obtained at the workplace and other training. I classify a training spell as the former if the individual reports that the training took place at least partly during work hours. The information on whether the employer was the organizer of the training and on the worker's costs is only available for one of the three courses reported in the survey. This information is therefore not used here. Pannenberg (1997) exploits this information more fully, at the cost of looking only at one training spell per worker. I find this procedure somewhat problematic, because it will also lead

to a downward bias on the training effects. Nevertheless, our results are very similar.

I also create a count variable, which captures whether the worker has received any new training during the year, but multiple spells are counted as a single occurrence. This variable is zero in 1986. It increments by one whenever the worker participated in any training since the last wave, and can therefore reach a maximum value of three by 1989. In changes, this corresponds to a dummy for any training receipt since the last interview. When using this variable in the fixed effects specification, it will capture whether an individual participated in any training between interviews, regardless of the number and duration of spells.

According to standard human capital theory, training during work hours that ultimately benefits the worker should be paid for by the worker by accepting a lower current wage. I experimented with a variable capturing the number of hours of training during the month before the survey but coefficients on this variable always turned out to be very close to zero and completely insignificant. These results are not reported below.

A final data issue refers to the earnings variable. Monthly earnings are reported as of the month prior to the interview. However, not all individuals work the same number of hours and training tends to be more prevalent among full-time workers. I include a dummy for full-time workers in the regressions. Including an hours variable is admittedly problematic since hours are endogenous if individuals choose hours according to labor supply theory. Results using a constructed hourly wage as the dependent variable were similar but the monthly earnings measure actually fits the data much better (in the sense of lower standard errors on almost all the regressors). My interpretation of this is that the weekly hours reports are likely to be very noisy, for example, because unusually long or short hours are mostly a transitory phenomenon and therefore not necessarily reflected in monthly salaries.

The regressions use the 1989 cross-section weights and results are presented in Tables 6 and 7. Table 6 shows results from the standard fixed effects specification. The baseline specification in column (1) includes formal schooling, the quartics in experience and tenure, a dummy for full-time workers, and a dummy for years in which the worker switched jobs. The next column adds total training as an additional regressor. The variable is specified in years so that the coefficient directly yields the annual return, which is less than 3% but not significant. The (cross-sectional) return to a year of full time schooling in these data is close to 8% (Krueger and Pischke 1995). A lower return on continuous training would not be surprising since on average, workers only spend 20 hours a week in training. Thus, if the training coefficient indeed reflected the true return, these results would imply that the returns to continuous training might be in the order of two thirds of the returns to schooling, apprenticeships, or similarly formal education. Also note that the experience and tenure profiles do not move at all compared to the specification without the continuous training variable. This variable clearly does not do a good job in explaining wage growth over the life-cycle.

Of course, this is not the whole story. Column (3) distinguishes training during work hours and during leisure time. Only training during leisure time has a positive return of an economically sensible magnitude. The return to training during work hours is zero. A puzzling result emerges in column (4) when I add a variable capturing whether the individual participated in any

**Table 6.** Fixed effects log earnings regressions: 1986–1989 (Standard errors in parentheses)

| Independent variable | Mean | (1) | (2) | (3) | (4) |
|---|---|---|---|---|---|
| Years of schooling | 11.2 | −0.021 | −0.024 | −0.023 | −0.026 |
| | | (0.056) | (0.057) | (0.057) | (0.057) |
| Potential experience | 23.3 | 0.039* | 0.039* | 0.039* | 0.039* |
| | | (0.016) | (0.016) | (0.016) | (0.016) |
| Pot. exp.$^2 \times 10^{-2}$ | – | −0.182 | −0.181 | −0.184 | −0.188 |
| | | (0.112) | (0.112) | (0.112) | (0.112) |
| Pot. exp.$^3 \times 10^{-4}$ | – | 0.353 | 0.356 | 0.363 | 0.380 |
| | | (0.315) | (0.315) | (0.315) | (0.314) |
| Pot. exp.$^4 \times 10^{-6}$ | – | −0.268 | −0.272 | −0.279 | −0.294 |
| | | (0.300) | (0.300) | (0.300) | (0.300) |
| Tenure | 11.2 | 0.008 | 0.008 | 0.008 | 0.008 |
| | | (0.007) | (0.007) | (0.007) | (0.007) |
| Tenure$^2 \times 10^{-2}$ | – | −0.127 | −0.127 | −0.126 | −0.120 |
| | | (0.083) | (0.083) | (0.083) | (0.083) |
| Tenure$^3 \times 10^{-4}$ | – | 0.513 | 0.513 | 0.511 | 0.486 |
| | | (0.348) | (0.348) | (0.348) | (0.348) |
| Tenure$^4 \times 10^{-6}$ | – | −0.661 | −0.659 | −0.657 | −0.628 |
| | | (0.452) | (0.451) | (0.451) | (0.451) |
| Job change | 0.07 | 0.058* | 0.058* | 0.057* | 0.058* |
| | | (0.022) | (0.022) | (0.022) | (0.022) |
| Full time | 0.87 | 0.263* | 0.262* | 0.262* | 0.261* |
| | | (0.053) | (0.053) | (0.053) | (0.052) |
| Any training spell | 0.19 | – | – | – | 0.012 |
| | | | | | (0.006) |
| Training duration (in Years) | 0.023 | – | 0.026 | – | 0.016 |
| | | | (0.019) | | (0.019) |
| Training duration during Work hours | 0.011 | – | – | 0.001 | – |
| | | | | (0.029) | |
| Training duration during Leisure hours | 0.012 | – | – | 0.043 | – |
| | | | | (0.024) | |

*Note*: Unbalanced sample including employed respondents. The number of observations is 12946; number of individuals is 3363. All regressions include a full set of year dummies.

training, in addition to the duration variable. Participation in any course yields a return of slightly more than one percent, which is marginally insignificant, but longer courses hardly yield any higher returns. A similar pattern has also been found by Pannenberg (1997) in this dataset and by Schömann and Becker (1998) in the German Life History Study, and for other countries (see for example Booth 1991 for the UK and Frazis and Loewenstein 1999 for the US). A 1% return would be quite remarkable given that the median course duration is less than a week.

These results are very hard to reconcile with any type of human capital model. Payoffs should depend on the length of the training investment, not the incidence per se. In fact, the result in column (4) suggests strongly that individuals who have higher wage growth are more likely to receive training of short durations, so that heterogeneity drives the results. The analysis in the previous section indicated a pattern where short duration training only seemed to affect productivity but not worker benefits. In addition, observable characteristics like education which are associated with steeper earnings profiles are correlated with more training but courses of shorter duration (see

**Table 7.** Fixed growth rates log earnings regressions: 1986–1989 (Standard errors in parentheses)

| | All workers | | | | German men | | German women | |
|---|---|---|---|---|---|---|---|---|
| Independent variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Years of schooling | −0.080 | −0.080 | −0.080 | −0.080 | −0.025 | −0.025 | −0.168 | −0.169 |
| | (0.085) | (0.085) | (0.085) | (0.085) | (0.052) | (0.052) | (0.161) | (0.162) |
| Job change | 0.112* | 0.112* | 0.112* | 0.112* | 0.080 | 0.080 | 0.171* | 0.171* |
| | (0.041) | (0.041) | (0.041) | (0.041) | (0.046) | (0.046) | (0.082) | (0.082) |
| Full time | 0.164* | 0.164* | 0.164* | 0.164* | 0.344 | 0.344 | 0.108 | 0.107 |
| | (0.083) | (0.083) | (0.083) | (0.083) | (0.242) | (0.242) | (0.076) | (0.076) |
| Any training spell | −0.003 | −0.003 | – | – | – | – | – | – |
| | (0.014) | (0.014) | | | | | | |
| Training duration | 0.038 | – | – | – | 0.030 | – | 0.060 | – |
| (in years) | (0.027) | | | | (0.034) | | (0.045) | |
| Training duration during | – | 0.033 | 0.031 | – | – | 0.039 | – | 0.018 |
| work hours | | (0.030) | (0.029) | | | (0.042) | | (0.019) |
| Training duration during | – | – | – | 0.030 | – | – | – | – |
| work hours, certificate | | | | (0.033) | | | | |
| Training duration during | – | – | – | 0.034 | – | – | – | – |
| work hours, no certificate | | | | (0.038) | | | | |
| Training duration during | – | 0.043 | 0.041 | 0.041 | – | 0.024 | – | 0.093 |
| leisure hours | | (0.040) | (0.038) | (0.038) | | (0.050) | – | (0.071) |

*Note*: Unbalanced sample including employed respondents. The models are estimated by applying fixed effects to the differenced equation. All regressions also include a full set of year dummies. Number of observations for all workers is 9583 (3363 individuals), for German men it is 4557 (1584 individuals), and for German women it is 2464 (878 individuals)

Table 1). The heterogeneous growth model in eq. (2) allows for such correlations between unobserved determinants of earnings growth and training. Results are displayed in Table 7.[13] Because the individual specific slopes allow for different earnings growth of individuals at different stages in the life-cycle, and the curvature of the age-earnings profile is not very important over a short time span like three years, I omit the non-linear experience and tenure terms from this specification. These terms turned out to be completely insignificant when included.

The heterogeneous growth model indeed suggests that the positive effect for participation in training was due to selection into training by high earnings growth individuals. The intercept effect goes to zero in these specifications while the effect of training duration more than doubles. This implies that it is relatively low earnings growth individuals who participate in the longer duration courses, so that the regressions allowing only for heterogeneity in the level of wages underestimate the effect of training on earnings. The return to training at work is now also positive and about 3% while the return to training during leisure time is slightly higher. Unfortunately, these coefficients are still imprecisely determined, which makes it difficult to draw any strong conclusions.

The lower return to training during work hours, if it is indeed real, may indicate that some workplace training is being financed by employers, and employers reap some benefits from this training later. The returns to training financed primarily by the workers themselves are larger, on the other hand. We found in Table 3 above, that employers are more likely to finance training during work hours, while employees finance much of the training during leisure time. This could either mean that training during work hours is more likely to be firm-specific, or firms are willing to invest even in the general skills of their employees, because the wage returns to such training are relatively low. In order to probe whether firm-specific skills explain these results, I interact the variable for training during work hours with whether the worker has received a certificate for the training or not. The results in column (4) show no evidence that returns for training spells for which workers received certificates have higher returns than those for which they did not. To the degree that these certificates proxy for general skills, the returns to general training are not higher than the returns to firm-specific training.

The final four columns in the table presents separate results for German men and women. Returns for women are higher than for men. The low returns for men are entirely due to their lower returns for training taken during leisure time, while returns to training at work are more similar for men and women. This is curious because women report a somewhat greater willingness to contribute to the financing of training during work hours. Similar results are found by Blundell et al. (1996) for Britain.

In order to interpret these results, it is important to keep in mind that training receipt, its timing and duration may be measured rather poorly, especially when the data are collected by retrospective surveys. Frazis and Loewenstein (1999) point out that measurement error in training can potentially explain the high returns to short training spells. The question therefore arises, whether measurement error, rather than heterogeneous growth rates in wages may account for both the results of the fixed effects and the fixed growth rates estimation. One type of measurement error is mismeasurement of the duration of training among those who received training. Frazis and

**Table 8.** The impact of measurement error on estimated returns to training, means of 5000 Monte Carlo replications

| Parameters | | Fixed effects estimates | | | Fixed growth rates estimates | | |
|---|---|---|---|---|---|---|---|
| Fract. of duration var. error, $m$ | Var. of indiv. wage growth, $\sigma^2_{\Delta w}$ | (1) | (2) | | (3) | (4) | |
| | | Training duration | Any training | Training duration | Training duration | Any training | Training duration |
| 0.0 | 0.0 | 0.100 | 0.000 | 0.100 | 0.100 | 0.000 | 0.100 |
| 0.333 | 0.0 | 0.068 | 0.049 | 0.062 | 0.068 | 0.049 | 0.062 |
| 0.0 | 0.150 | 0.089 | 0.069 | 0.083 | 0.100 | 0.001 | 0.100 |
| 0.133 | 0.060 | 0.077 | 0.045 | 0.072 | 0.080 | 0.031 | 0.076 |

*Note*: Monte Carlo results using estimates from samples with three periods and 3,000 individual observations. Return to training duration is set to 0.100 in all models. See Appendix 2 for details on the design.

Loewenstein (1999) demonstrate that this will lead to the usual attenuation of the returns to training *duration* while raising the returns to participating in any training spell. This type of measurement error can therefore potentially explain the results in Tables 6.

In order to investigate whether measurement error might be responsible for the results, I performed a small Monte Carlo experiment. I generated wage observations for three periods and 3000 individuals. The models incorporate heterogeneous wage growth, which is positively correlated with the receipt of training and negatively with training duration as well as measurement error in training duration. I then estimated both fixed effects regressions (corresponding to the results in Table 6) and fixed growth rates regressions (corresponding to the results in Table 7). The return to training in all models was set to 10%, and the other parameters were chosen so that the fixed effects results would tend to mimic the patterns of results in Table 6: the effect on training duration is attenuated when a dummy for any training is introduced and the dummy coefficient is positive and slightly smaller than the return to training. Details on the design are given in Appendix 2.

Table 8 displays the results of 5000 replications of these estimates. The first row demonstrates the obvious result that both fixed effects and fixed growth rates estimators correctly identify the returns to training in the absence of heterogeneous wage growth and measurement error. The next two rows show that either model is able to generate the pattern of results in Table 6. Measurement error or heterogeneous growth rates lead to attenuation of the estimated returns to training, as well as to the finding that the returns to short spells are higher. However, measurement error leads to the same results with the fixed growth rates estimator (row 2), while this estimator identifies the true return in the heterogeneous growth rates model (row 3). The pattern of coefficients in Tables 6 and 7 together is quite consistent with the heterogeneous growth rates model, but not with the measurement error model. The last row in the table combines measurement error and heterogeneous growth rates. It demonstrates that even a moderate amount of measurement error should still lead to a positive effect on the dummy for any training with the fixed growth rates estimator. Measurement error in the duration of training therefore does not seem to be an important ingredient in explaining the patterns of returns to

training in the German data. Of course, it is possible that other forms of measurement error are present in the data, like misreporting of the incidence or the timing of training receipt. These would lead to a pure attenuation of the training effects with either estimator, and can therefore not be ruled out based on the empirical results.

## 5. Conclusion

Using the training reported in the GSOEP, about 200 million man-hours were spent in continuous training in the German economy during 1988. That amounts to about 0.5% of the total man-hours worked. Presumably, this estimate even understates the true scope of continuous training since information is not available on all training spells. Employer involvement in training is extremely prevalent: Much of the continuous training in Germany is provided by employers and takes place during work hours. The evidence on the financing of such training suggests that employers pay for a large part of the monetary costs of such training. Workers may be contributing to the training costs indirectly through lower wages, an assertion that is hard to test directly with in the GSOEP data. However, workers report some reluctance to explicitly pay for more of their own training. This makes me skeptical that workers, at least knowingly, accept lower wages in return for receiving employer provided continuous training. The high prevalence of written certificates, which workers would use at the time of applying for a new job, seems to indicate that much of the workplace training is general in nature.

There is little evidence in the German data that selection into training programs is important in terms of wage levels. While training is strongly correlated with previous schooling, trainees do not receive higher earnings prior to participating in training, conditional on observables. Nevertheless, there is important selection into training on the basis of earnings growth. In particular, workers with high earnings growth seem more likely to participate in shorter training spells. I deal with this problem by estimating models which allow for heterogenous growth rates across workers. Selection on the basis of earnings growth may be an important issue in the estimation of returns to training for other countries too. Annual returns, especially to short training spells, in the US are often estimated to be above 100% (see Frazis and Loewenstein 1999).

These estimates allowing for heterogeneous growth rates show smaller returns to training during work hours than to training during leisure time, particularly for women. These results, although not statistically significant, together with the financing of training, suggest that employers may reap some rewards from training investments in their employees. This is also born out by the answers to direct questions about the benefits of training. Pannenberg (1997) draws the same conclusion and interprets this finding as implying that much of the workplace training is actually firm specific. However, there is no evidence for this in the data, to the degree that the variable on certificates provides reliable information on this question. In addition, findings for the US (Loewenstein and Spletzer 1997) shows that as much as 80 percent of workplace training is rather general.

It may seem curious that employers in Germany would finance some general training and reap returns to this training later, since this is not consistent

with the standard model of training by Becker (1964) and Mincer (1974). Recent research by Acemoglu and myself (1999) on training in imperfect labor markets tries to provide a systematic explanation for these phenomena. The basic story we are telling is based on two ingredients: First, workers do not receive their marginal product. This means that firms will obtain some rents from the employment relationship which lets them recoup any up-front investment costs. Second, labor market imperfections lead to a compression of the returns to training. This implies that workers do not have the right incentives to invest. On the other hand, since the rents which firms can collect are tied to the skill levels of workers, firms have an incentive to undertake investments even in general skills. These conditions for firm sponsored general training are likely to prevail in Germany, due to a compressed wage structure and labor market institutions which limit flexibility.

Of course, the results in this paper are only suggestive that this is the correct explanation for workplace training in Germany. A more direct distinction between specific and general training will be necessary in order to rule out explanations of low returns based on standard human capital models. Furthermore, more comparative work ought to assess the relative size of the returns to training in different countries. Given the potential importance of selection into training based on earnings growth uncovered here, controlling for selection is only possible with long panel surveys with repeated measures on training, like the US NLSY.

## Appendix 1
## Data and sample selection

The samples in Tables 1 and 2 are conditional on whether an individual works in the 1986 wave of the data and has non-missing information on the demographics, job attributes, and training variables used in these tables. Individuals were asked whether they participated in work related courses and how many, this information is displayed in Table 1. The duration of training and whether the course was employer sponsored refer to the most important course. Training is designated as employer sponsored if respondents answered either that the employer is the organizer of the course (variable FP5701), that the employer provided financial assistance for the course (variable FP5901), or that the course took place during work hours (variables FP5411, FP5423, or FP5435 = 1). The unconditional duration of training is derived by assigning midpoints to the bracketed duration variable as follows:

| Bracket | Midpoint (days) |
|---|---|
| 1 day | 1 |
| up to 1 week | 3.5 |
| up to 1 month | 18.5 |
| up to 3 months | 49 |
| up to 1 year | 228 |
| more than 1 year | 546 |
| more than 2 years | 770 |

The total duration in weeks is obtained by dividing these values by 7 and adding them across the three courses reported. The education categories in Table 1 refer to degrees obtained in Germany.

Years of schooling are constructed as described in Pischke (1993). Potential experience is max(age – years of schooling – 6, 0). The occupational categories used are derived from the variables CP38xx ("berufliche Stellung"). The following categories are combined: CP3801 = 4 and 5 and CP3804 = 1, all categories for CP3802, CP3804 = 4 and 5, and CP3805 = 1 and 2.

The samples used in Tables 3 and 4 condition on employment at the beginning of the most important training spell and use all non-missing observations for the variables used in these two tables. Training is designated as during work hours when the respondent replied that it took place either during work hours or partly during work and partly during leisure hours (variables FP5411, FP5423, or FP5435 = 1 or 2). The information on financing is taken directly from questions about sources of financial assistance or wage subsidies for the training (FP59xx) and whether the respondent would have participated in the course without receiving this financial assistance (FP60). The own monetary costs were coded as zero if the respondent answered that these costs were zero (FP6102) or reported actual costs less than 1% of their wave 6 gross monthly earnings (DM 30 on average). The variable about certificates is directly taken from the variables FP5412, FP5424, or FP5436 and the variable about the initiative for the training from FP58.

For the analysis in Tables 6 and 7, all observations on employed respondents in each of the waves 1986 to 1989 are stacked. The sample includes all respondents with non-missing values on the variables used in these two tables. Training variables are constructed to reflect the cumulative training received since 1986. These variables are zero in 1986. For each year after that, for training duration the number of weeks of training in all courses since the last interview is added to the value of the previous year. Weeks of training between interviews is constructed from the start date of the course and duration (constructed in the same way as the duration variable used in Tables 1 and 2). The variable for any training spell is constructed analogously, except that a value of one is added for every year in which the individual participated in any course. Training duration during work hours, during leisure hours, training for which certificates were received, etc. is constructed by adding up only weeks in courses satisfying the respective criterion.

## Appendix 2
## Design of the Monte Carlo experiment

The goal of the Monte Carlo experiment is to estimate fixed effects and fixed growth rates regressions for individual earnings. Since fixed effects regressions can be estimated consistently by applying OLS to the growth rates of earnings, I specified the underlying model for earnings directly in terms of growth rates:

$$\Delta \ln w_{it} = \gamma \Delta T_{it} + \delta_i + \varepsilon_{it}.$$

Data were generated for two periods (corresponding to three periods in levels of earnings). $\gamma$ is set to 0.1 throughout, $\varepsilon_{it} \sim N(0,1)$, and $\delta_i \sim N(1, \sigma^2_{\Delta w})$. Since

$T_{it}$ is the stock of human capital, $\Delta T_{it}$ corresponds to training receipt between two periods. I assume that $\Delta T_{it}$ is log-normally distributed. Define $u_{it} = \mu_{it} - 5\delta_i$, where $\mu_{it} \sim N(0,1)$. Then

$$\Delta T_{it} = \begin{cases} \exp(u_{it}) & \text{if } p_{it} = 1 \\ 0 & \text{if } p_{it} = 0. \end{cases}$$

The specification of $u_{it}$ implies that individual earnings growth and the duration of training are negatively correlated. The indicator for training participation, $p_{it}$, was generated in the following way. Let $z_{it} \sim N(0,1)$. Then

$$p_{it} = \begin{cases} 1 & \text{if } \frac{1}{\sqrt{1+\sigma^2_{\Delta w}}}\Phi(z_{it} - \delta_i) < q \\ 0 & \text{otherwise} \end{cases}$$

where $\Phi(\cdot)$ is the normal cumulative density function and $q$, the probability of participation in training, is set to 0.3. Notice that this specification implies a positive correlation between individual earnings growth and the probability of participating in training. Finally, observed training duration, $\Delta\tilde{T}_{it} = \exp(u_{it} + v_{it})$, if $\Delta T_{it} > 0$, where $v_{it} \sim N(0, \sigma^2_v)$. $\Delta\tilde{T}_{it}$ is the variable used in the regressions. The variance of measurement error is parameterized by the fraction of the variance of log duration that is due to error, $m = \sigma^2_v / (\sigma^2_v + 25\sigma^2_{\Delta w} + 1)$.

## Endnotes

[1] The numbers are my own calculations based on the 1979 Qualification and Career Survey conducted by the IAB and BIBB, as made available by the German Zentralarchiv für empirische Sozialforschung. None of thse institutions bears any responsibility for my analysis or interpretation of these data.

[2] See Pfeiffer and Reize (2000) for evidence on this for Germany and Loewenstein and Spletzer (1999a) for the US.

[3] The brackets are 1 day or less, up to 1 week, up to 1 month, up to 3 months, up to 1 year, up to 2 years, and more than 2 years.

[4] The unconditional incidence of employer sponsored training is 23%. This is somewhat below the 28% reported by Olson (1996) for a similar measure from the National Household Education Survey for the US.

[5] I do not control for union membership, although unions may play an important role in determining training. However, union coverage, the economically relevant concept, is almost universal in Germany, while membership is much lower.

[6] Rather than constructing a continuous variable from the underlying grouped indicator it might seem more sensible to estimate an ordered probit on the bracketed variable. However, the number of groups is rather large owing to the fact that respondents report up to three courses and the aggregation across courses is not really possible without auxiliary assumptions anyway.

[7] The regression includes all the regressors in Table 2, including the occupation dummies, and in addition a quartic in potential experience, dummies for marital status, marital status interacted with gender, and a dummy for whether the person participated in training in the following three years. The sample size is 2917 for these regressions because of missing wage observations for many respondents.

[8] This variable therefore differs substantially from the measure of accredited courses used by Arulampalam et al. (1997), where the certificate is given by an organization different from the sponsor of the training course.

[9] Loewenstein and Spletzer (1999b) find that as much 80–85% of the training reported in US surveys is very general, based on the assessment of workers or employers.

[10] The difference between courses with and without certificates is not significant, using a test for first order stochastic dominance based on the Smirnov statistic (McFadden 1989).

[11] Specification tests reveal few problems with these models. LM-tests against a Burr-II distributions never rejected the logit specification. Tests for heteroskedasticity revealed that the variable duration is a potential source of heteroskedasticity in the regression for any benefits; years of schooling and duration in the regressions for benefits for the firm; and female, part-time, and the employer as organizer in the regressions for benefits for the worker.

[12] Another way to assess whether there is sufficient variation in training to identify the heterogeneous growth rate model is to look at the autocorrelation matrix of the difference of weeks of training between adjacent waves. If these autocorrelations are positive, there will be little identifying variation in the data. In the sample, these autocorrelations are all virtually zero.

[13] Technically, I estimate this model by first differencing Eq. (2), sweeping out $\alpha_i$, then applying deviations from means to the resulting equation, and adjusting the standard errors for the serial correlation of the residuals within individual. Number of observations refers to the number of first differences.

## References


Acemoglu D, Pischke J-S (1998) Why Do Firms Train? Theory and Evidence. *Quarterly Journal of Economics* 113:70–119

Acemoglu D, Pischke J-S (1999) The Structure of Wages and Investment in General Training. *Journal of Political Economy* 107:539–572

Arulampalam W, Booth A, Elias P (1997) Work-related Training, and Earnings Growth for Young Men in Britain. *Research in Labor Economics* 16:119–147

Barron J, Berger M, Black D (1997) *On-the-job Training*. W.E. Upjohn Institute for Employment Research, Kalamazoo

Becker, Gary (1964) *Human Capital*. The University of Chicago Press, Chicago

Blanchflower D, Lynch L (1994) Training at Work: A Comparison of US and British Youth. In: Lynch L (ed.) *Training and the Private Sector. International Comparisons*. NBER Series in Comparative Labor Markets. University of Chicago Press, Chicago, 233–260

Brown J (1989) Why do Wages Increase with Tenure? On-the-job-Training and Life-cycle Wage Growth Observed Within Firms. *American Economic Review* 79:971–991

Blundell R, Dearden L, Meghir C (1996) *The Determinants and Effects of Work Related Training in Britain*. IFS, London

Booth A (1991) Job-related Formal Training: Who Receives It and What is it Worth? *Oxford Bulletin of Economics and Statistics* 53:281–294

Frazis H, Loewenstein M (1999) Reexamining the Returns to Training: Functional Form, Magnitude, and Interpretation. mimeographed, Bureau of Labor Statistics

Harhoff D, Kane T (1997) Is the German Apprenticeship System a Panacea for the US Labor Market? *Journal of Population Economics* 10:171–196

Harris M, Holmström B (1982) A Theory of Wage Dynamics. *Review of Economic Studies* 49:315–333

Jovanovic B (1979) Job Matching and the Theory of Turnover. *Journal of Political Economy* 87:972–990

Krueger A, Pischke J-S (1995) A Comparative Analysis of East and West German Labor Markets: Before and After Unification. In: Freeman R, Katz L (eds.) *Differences and Changes in Wage Structures*. NBER Series in Comparative Labor Markets. University of Chicago Press, Chicago, 405–445

Lazear E (1979) Why is There Mandatory Retirement? *Journal of Political Economy* 87:1261–1284

Lillard L, Tan H (1992) Private Sector Training: Who Get's it and What Are Its Effects? *Research in Labor Economics* 13:1–62

Loewenstein M, Spletzer J (1998) Dividing the Costs and Returns to General Training. *Journal of Labor Economics* 16:142–171

Loewenstein M, Spletzer J (1999a) Formal and Informal Training: Evidence from the NLSY. *Research in Labor Economics* 20

Loewenstein M, Spletzer J (1999b) General and Specific Training: Evidence and Implications. *Journal of Human Resources* 34:710–733

Lynch L (1992) Private Sector Training and the Earnings of Young Workers. *American Economic Review* 82:299–312

McFadden D (1989) Testing for Stochastic Dominance. In: Fomby T, Seo TK (eds.) *Studies in the Economics of Uncertainty*. Springer, Berlin Heidelberg New York

Mincer J (1974) *Schooling, Experience, and Earnings*. Columbia University Press, New York

Murphy K, Welch F (1990) Empirical Age-earnings Profiles. *Journal of Labor Economics* 8:202–229

Oulton N, Steedman H (1994) The British System of Youth Training: A Comparison with Germany. In: Lynch L (ed.) *Training and the Private Sector. International Comparisons*. NBER Series in Comparative Labor Markets. University of Chicago Press, Chicago, 61–76

Olson C (1996) Who Receives Formal Firm Sponsored Training in the U.S.? mimeographed, University of Wisconsin

Pannenberg M (1997) Financing On-the-job Training: Shared Investment or Promotion Based System? Evidence from Germany. *Zeitschrift für Wirtschafts- und Sozialwissenschaften* 117:525–543

Pischke J-S (1993) Assimilation and the Earnings of Guest-Workers in Germany. mimeographed, MIT

Pfeiffer F, Reize F (2000) Formelle und informelle berufliche Weiterbildung und Verdienst bei Arbeitnehmern und Selbständigen. ZEW Discussion Paper No. 00-01, Mannheim, Germany

Powell J (1984) Least Absolute Deviations Estimation of the Censored Regression Model. *Journal of Econometrics* 25:303–325

Schömann K, Becker R (1998) Selektivität in der beruflichen Weiterbildung und Einkommensverläufe. In: Pfeiffer F, Pohlmeier W (Hrsg.) *Qualifikation, Weiterbildung und Arbeitsmarkterfolg*. ZEW Wirtschaftsanalysen, vol. 31. Nomos Verlagsgesellschaft, Baden-Baden, Germany, 279–309

Soskice D (1994) Reconciling Markets and Institutions: the German Apprenticeship System. In: Lynch L (ed.) *Training and the Private sector. International Comparisons*. NBER Series in Comparative Labor Markets. University of Chicago Press, Chicago, 25–60

Veum J (1993) Training Among Young Adults: Who, What Kind, and for How Long? *Monthly Labor Review* (August): 27–32