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On-the-Job Training Differences by Sex and Firm Size*

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Investment in on-the-job training is widely considered to be a major source of income differentials among individuals. Direct evidence on the impact of training on earnings is lacking, however. Based on German microdata the acquisition of on-the-job training by men, women, and by firm size is analyzed and the issue is raised whether training differences are due to voluntary choice or institutional factors.

I. Introduction

After more than two decades of development, the human capital investment model has been firmly incorporated into the thinking of labor economists and constitutes a basis for the analysis of earnings determination. According to this theory schooling and training on-the-job constitute investments in human capital rewarded by higher labor earnings in later periods. In the case of formal schooling empirical investigations utilize observed data on the quantity of schooling. Post-school investments, however, are an unobservable investment in on-the-job training. For example, in *Mincer's* model of on-the-job training[1], the training investments are assumed to be a linear function of work experience. This hypothesis of an investment pattern implies that the logarithm of individuals earnings is a quadratic function of work experience.

This model which was first developed for men was later amended to incorporate specifities of the work experience and, by hypothesis, of the training patterns of women.[2] As women have a less regular pattern of labor force participation than men, their work horizon is shorter than the expected work experience of otherwise identical men. Thus, women have less economic incentives than men to invest in on-the-job training. Sexual differences in training acquisition are not measured directly but deduced from plausible assumptions about different sexual work experiences.

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[1] *Mincer* (1974).

[2] *Mincer/Polachek* (1974), (1978), *Polachek* (1975), *Mincer/Ofek* (1982).

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An alternative interpretation of the process of training acquisition draws on the theory of labor market segmentation. "Training on the job appears in its essential characteristics to be a process of socialization. An important part of the productivity of the worker in the work place is directly attributable to the way in which he relates to his fellow workers, and the social groups into which they form. ... The acquisition of individual job skills, i.e., skills which have an existence independent of the context in which they displayed, is dependent upon the success of this socialization process, and involves psychological mechanisms such as imitation and habit formation which are similar to, if not precisely the same as, those involved in socialization".[3] The acquisition of training within a firm relies in a fundamental way on the acceptance of the trainee by the relevant social group. I.e., an individual can only acquire training after gaining access to a job providing training. As hiring decisions are to some degree based on subjective criteria, there is usually some scope to practice discrimination. Therefore, according to segmented labor market theorists, women are frequently confined to secondary labor markets with reduced training opportunities and, when they gain access to primary labor markets, they are denied promotions to jobs with ample training.

In this paper we estimate the first model of the acquisition of training with German microdata. The investigation of the determinants of training is significant because the predominant theoretical explanations of gender wage differences presuppose the validity of the hypothesis of the training model. In the regression analysis of on-the-job training we find some evidence supporting the investment explanation of the training decision. Some evidence is found, too, to support an institutional explanation of training, i.e. an explanation of the fact that women obtain less training than men and that the training process is organized differently according to firm size.

II. An Empirical Analysis of the Acquisition of On-the-Job Training

1. Data and Variables

The data of the preliminary version of the first wave of the German Socio-Economic Panel (1984) form the basis for the empirical analysis of the determinants of training. The first wave of the Socio-Economic Panel provides representative data on income, transfer payments, labor market experience, family composition, and housing for individuals, families, and households.[4]

The data set includes a question concerning the subjective assessment of the kind of training necessary for the present job. The question is: "Which

[3] *Piore* (1973), 253 - 4.

[4] *Hanefeld* (1984).

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kind of training is in general necessary for the work you do?" The following responses were offered: "No special training necessary"; "Only a brief instruction on the job"; "A longer training in the firm"; "The participation in seminars/courses"; "Occupational training" and "University degree". Multiple responses were possible. As training within the firm is the focus of our analysis only those employees were included in our sample who answered positively with respect to one of the first four categories. The dependent variable TRAINING has been operationalized as a ordinal scaled variable with the codes - 0 -, no special training; - 1 -, brief instruction; - 2 -, longer training and - 3 - participation in seminars/-courses.

The variable constructed in this way is, of course, no precise empirical transformation of the human capital concept of investment in specific human capital which should be operationalized as the fraction of the total working time spent in on-the-job training.[5] To consider the variable TRAINING as a valid operationalization of on-the-job training four conditions must be met: Firstly, the subjective assessment of the training necessary for one's own job must be correct and the employee has actually obtained this training. Secondly, the working time used for training increases with the variable TRAINING. Thirdly, the intensity of training increases with our ordinal scale of the variable TRAINING. And fourthly, the job occupied at the time of the investigation in 1984 is the one for which training has been obtained. We have tried to satisfy the last requirement by including only those employees in our sample with tenure of less than five years. This limits the interval between the earliest possible moment of training and the time of the inquiry.

In addition to this restriction the sample has been limited to German employees less than 59 years old not participating in an apprenticeship training at the time of the inquiry. These restrictions as well as the requirement of having exogenous variables for all individuals reduces the sample of the Socio-Economic Panel used for our regressions to 440 cases (Table 1 for mean values and standard deviations of the variables).

The exogenous variables have been operationalized as follows: S - schooling in years (including university education and apprenticeship); WHOR - Work Horizon as the maximum number of years of potential employment, years between joining the last firm and retirement age; WHOR 2 - Work Horizon squared; H - Hometime, duration of the interruptions of employment since the first job not caused by unemployment, general training and continued education, or military service, measured in years; JOBS - Number of jobs since 1974, including the job held at the moment of the inquiry; UNEMP - Duration of all periods of unemployment since 1974, measured in

[5] *Becker* (1975), *Duncan/Hoffman* (1979).

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years; WTIME - Normal working time, excluding overtime, in hours per week; REX - Work experience prior to entering the current firm, measured in years; FS - Firm size (number of employees); SEX - Dummy variable (0 - male, 1 - female); COL - Dummy variable (0 - blue collar worker, 1 - white collar worker).

Table 1

Mean Values and Standard Deviations of All Variables By Subgroups

Variables	All	Firmsize < 200	Firmsize ≥ 200	Men	Women
TRAINING	1.550 (1.060)	1.423 (1.069)	1.722 (1.025)	1.812 (1.043)	1.304 (1.018)
WHOR	30.620 (10.732)	29.107 (11.060)	32.666 (9.940)	34.022 (9.732)	27.427 (10.666)
WHOR2	1052.487 (628.152)	969.086 (635.169)	1165.324 (602.018)	1251.752 (608.457)	865.512 (588.755)
H	2.710 (1.436)	3.203 (6.067)	2.043 (4.837)	0.019 (0.274)	5.235 (6.902)
JOBS	2.484 (1.436)	2.553 (1.478)	2.390 (1.377)	2.906 (1.572)	2.088 (1.168)
WTIME	34.957 (11.710)	34.336 (12.568)	35.716 (10.412)	41.117 (7.624)	29.176 (11.937)
S	11.668 (2.196)	11.439 (2.099)	11.979 (2.291)	12.122 (2.283)	11.242 (2.026)
UNEMP	0.288 (0.528)	0.328 (0.547)	0.234 (0.499)	0.348 (0.576)	0.232 (0.474)
REX	10.323 (9.609)	11.511 (10.133)	8.716 (8.620)	11.506 (10.279)	9.213 (8.814)
FS	912.114 (1163.449)	-	-	962.864 (1187.347)	864.493 (1141.140)
SEX	0.516 (0.500)	0.530 (0.500)	0.497 (0.501)	-	-
COL	0.434 (0.496)	0.391 (0.489)	0.492 (0.501)	0.333 (0.473)	0.529 (0.500)
CASES	440	253	187	213	227

Standard Deviations in Parentheses
Source: Socio-Economic Panel, First Wave (1984, Preliminary Version)

As we are unable to distinguish general from specific training it is a very difficult empirical matter to differentiate between training as an optimal investment of the individual and the behavior of employers allocating opportunities to the employees in a discriminatory manner. In the case of general training the cost of training are borne by the workers who also obtain the

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benefits of their increased productivity. Firms should not differentiate with respect to training opportunities between men and women and the training acquisition process should be similar in smaller and larger firms. If, however, training is mainly firm-specific, and firms and employees share the costs and benefits of training, firms will be interested in obtaining trained employees with minimal costs. In that case firms would, for example, prefer to train employees with lower turnover rates. The unequal treatment of identical individuals with respect to training opportunities in smaller and larger firms or the firm's differentiation of training between men and women amounts to discrimination in the case of general training and has to be interpreted as profit-maximizing behavior if specific training activities prevail.

The benefits of general training are positively related to the maximum length of the payoff period (WHOR). As our measure of the length of an individual's work horizon probably overstates the relevant payoff period we have included additional variables characterizing the probable future work commitment on the basis of the individual's work history: Years of withdrawal from the labor force since the first employment for reasons related to family responsibilities (H), the total number of firms in which the individual has worked since 1974 (JOBS), and the current working time per week (WTIME). We expect the first variables to have a negative and working time to have a positive impact on current training in the case of general training. These effects would be enhanced if training were, instead, specific. Employers might consider these variables as proxies for future work commitment and make their training decisions on that basis.

Costs of general and specific training in firms are difficult to specify. We assume that more educated individuals are able to acquire training more efficiently. Education (S) should, therefore, have a positive impact on current training. Firms might also use education as a screening device for allocating individuals to jobs providing training. In the same vein, firms might screen on the basis of an individual's duration of unemployment since 1974 (UNEMP).

Finally, we include the variables (REX) "Number of Years of Work Experience prior to the Current Job" and "Size of Firm" (FS) which capture the institutionalist perspective of the training acquisition process. Individuals disposing of a longer work experience prior to the current employer are expected to be at a disadvantage with respect to current training. Training opportunities are allocated in internal labor markets according to tenure in the current firm and individuals with longer prior work experience will probably have a shorter tenure spell and work horizon in the current firm.[6]

[6] As current tenure has been omitted from work history the correlations between the experience variable and work horizon is high but less than unity.

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The interpretation of the variable REX remains ambiguous, however. Usually, prior work experience is interpreted as accumulation of general human capital, which, consequently, could enable individuals to acquire on-the-job training more efficiently in the current firm. This interpretation of prior work experience would lead us to expect a positive effect on current training. The sign of the estimated coefficient of the variable REX, therefore, can only be interpreted as a dominant effect of two counteracting forces.

To test the relationship between internal labor markets, tenure and training opportunities in a more conclusive way it would have been desirable to include a variable like years in the present firms prior to the current job. We would expect this variable to have a positive impact on training opportunities. Unfortunately, this information is not available in our data set. The inclusion of the variable "Size of Firm" is motivated by the fact that larger firms are more frequently characterized by internal labor markets which provide a close link between tenure and training opportunities. Thus, we would expect a positive impact of firm size on training.

2. Empirical Results

Separate Ordinary-Least-Squares (OLS) regressions and polytomous probit estimates have been run using different subsamples and model specifications. We found no differences in sign between the OLS- and Probit coefficients. Likewise no significant differences in absolute t-values and in the magnitudes of the coefficients were found. Therefore, in this paper we only report the OLS results.[7]

The estimated coefficients and t-values obtained from regressing the training variable on the independent variables are presented in Tables 2 - 4. Table 2 contains five models.

[7] The polytomous probit estimates are available from the authors on request. – The assumptions of the linear regression model are of importance for our results. To ascertain whether these assumptions are fulfilled we have conducted various diagnostic tests in order to check the normality and heteroscedasticity of the errors, the adequacy of the functional form and the presence of outliers. Computations are done using the IAS-System developed at the Institute for Advanced Studies, Vienna. The following test statistics have been used: Jarque-Bera-Test for checking the normality of the errors; Breusch-Pagan-Test to check for heteroscedasticity of errors; Rainbow-Test by Utts and Regression Error Specification Test by Ramsey to test against functional misspecification; Outlier-Test by Cook and Weissberg. See *Krämer/Sonnberger* (1986) for details and the original sources. We found no rejections of the null-hypothesis of normally distributed errors and no outliers were detected in any of the estimated models. Only the WTIME variable in the models presented in Tables 2, 3 (for small firms) and 4 (for men) are systematically correlated with the error term. No clear rejection of the null-hypothesis of correct specification of the models was found. F-tests concerning the joint impact of groups of independent variables reject only a significant joint impact of the variables WTIME and H(hometime), which is consistent with the insignificance of these variables in many cases. Due to the fact that the great majority of the diagnostic tests did not reject the assumptions of the linear regression model our results can be interpreted with confidence from an econometric perspective.

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Model 1 uses as regressors the already explained independent variables excluding firm size. By adding firm size to the regressors we get model 2. Models 3 - 5 are obtained by including the variables "Sex" and "Collar" separately and jointly. The inclusion of theses variables is explained by our assumption that the process of training acquisition might differ between men and women as well as between blue and white collar workers after controlling for the independent variables. In Tables 3 and 4 the regression results, separated according to size of firm and sex, are documented.

Table 2

Regression Results for Training
(German Women and Men, Age 16 - 59)

Independent Variables	Models (1)	(2)	(3)	(4)	(5)
WHOR	0.0516 (1.58)	0.0497 (1.53)	0.0317 (0.91)	0.0527 (1.73)	0.0115 (0.36)
WHOR2	-0.0009 (2.06)	-0.0009 (2.02)	-0.0010 (2.12)	-0.0006 (1.32)	-0.0006 (1.36)
H	-0.0289 (1.48)	-0.0283 (1.45)	-0.0462 (2.07)	-0.0044 (0.24)	-0.0365 (1.77)
JOBS	-0.0719 (2.15)	-0.0669 (2.00)	-0.0773 (2.31)	-0.0403 (1.28)	-0.0443 (1.41)
WTIME	0.0206 (4.46)	0.0202 (4.37)	0.0194 (4.16)	0.0208 (4.80)	0.0181 (4.16)
S	0.1574 (6.74)	0.1566 (6.72)	0.1383 (5.28)	0.1128 (4.99)	0.0706 (2.77)
UNEMP	-0.1671 (1.92)	-0.1576 (1.81)	-0.1871 (2.14)	-0.1245 (1.53)	-0.1531 (1.88)
REX	-0.0080 (0.50)	-0.0078 (0.49)	-0.0286 (1.40)	0.0136 (0.90)	-0.0257 (1.36)
FS/1000	-	0.0611 (1.61)	-	-	0.0509 (1.45)
SEX	-	-	-0.2225 (1.61)	-	-0.4434 (3.38)
COL	-	-	-	0.7221 (7.81)	0.7787 (8.36)
CONSTANT	-1.2276 (1.36)	-1.2422 (1.38)	0.0700 (0.06)	-1.8242 (2.14)	0.7025 (0.62)
$\bar{R}^2$	0.2718	0.2745	0.2745	0.3608	0.3773
N OF CASES	440	440	440	440	440

Absolute t-Values in Parentheses
Source: Socio-Economic Panel, First Wave (1984, Preliminary Version)

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Referring to Table 2 there is some evidence that training decisions are influenced by the payoff period and work commitment (WHOR, H, JOBS). The coefficients usually show the expected sign, but are in many cases not significant at the 5% level. With respect to the costs of training or equivalently the employers' screening for training the variable "Schooling" has a strong and statistically significant impact on current training opportunities, the variable duration of unemployment (UNEMP), instead, demonstrates a noticeable negative impact on training. Of the variables (REX, FS) reflecting the institutionalist perspective on the training process, prior experience reduces and firm size enhances current training opportunities. Both variables, however, are not significant at the 5% level. Therefore, we get some statistical evidence from the data that the institutionalist interpretation of prior work experience dominates the human capital and cost reduction effect. As expected, the importance of being male and a white collar worker for training is evident in Table 2. These variables are significant at the 1% level (Model 5).

In Table 3 our sample has been split according to firm size. Basically, we find that the impact of the payoff period and of work commitment on training is more noticeable in the larger than in the smaller firms. The cost or screening variables perform in a more satisfying way in the smaller firms. The institutional variable REX produces a stronger negative effect (-0.04 versus -0.01 in model 5) in the larger firms, the coefficient, however, is not significant at the 5% level. Both sex and collar are more strongly rewarded with training opportunities in the larger than in the smaller firms (Model 5). We tend to interpret these results as being indicative of more specific human capital formation and of the more pronounced impact of the internal labor market on training in larger than in smaller firms.

Table 4 documents the regression results for men and women. The work horizon variable performs rather badly in the male and female training equations. Women, however, are more persistently penalized in terms of training opportunities than men concerning their number of jobs and obtain more benefits than men if they work longer hours, i.e. occupy full-time jobs. Interestingly, the coefficient of the labor force withdrawal variable (H) tends to be negative for women. Concerning the cost or screening variables women's education is strongly rewarded with training opportunities. Education apparently has a smaller and statistically insignificant effect (Models 4 and 5) on men's training, if they went through unemployment spells in the past. For women, however, past unemployment has no impact on training. Of the variables capturing the institutional impact on training (REX, FS), FS apparently favors men vis-a-vis women, while the reverse is true for REX. Both variables, however, are statistically not significant. Finally, female white collar workers obtain relatively greater training advantages

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than their blue collar collegues when compared with the corresponding male groups. In summary, we find some evidence for differences in the training acquisition process between men and women.

Table 3

Regression Results for Training by Firm Size
(German Women and Men, Age 16 - 59)

	Firm Size < 200				Firm Size ≥ 200			
Independent Variables	Models (1)	(3)	(4)	(5)	(1)	(3)	(4)	(5)
WHOR	0.0420 (1.06)	0.0219 (0.52)	0.0445 (1.19)	0.0154 (0.39)	0.1203 (2.01)	0.0963 (1.49)	0.1211 (2.16)	0.0574 (0.96)
WHOR2	-0.0007 (1.28)	-0.0008 (1.42)	-0.0003 (0.67)	-0.0004 (0.87)	-0.0019 (2.25)	-0.0019 (2.18)	-0.0016 (1.98)	-0.0014 (1.74)
H	-0.0362 (1.46)	-0.0552 (1.97)	-0.0122 (0.51)	-0.0386 (1.46)	0.0114 (0.36)	-0.0061 (0.16)	0.0330 (1.09)	-0.0101 (0.30)
JOBS	-0.0326 (0.75)	-0.0373 (0.85)	-0.0217 (0.53)	-0.0279 (0.68)	-0.1216 (2.36)	-0.1276 (2.46)	-0.0681 (1.38)	-0.0760 (1.56)
WTIME	0.0117 (2.03)	0.0105 (1.81)	0.0130 (2.38)	0.0113 (2.07)	0.0339 (4.43)	0.0323 (4.12)	0.0324 (4.53)	0.0280 (3.86)
S	0.2075 (6.43)	0.1879 (5.37)	0.1574 (4.95)	0.1265 (3.67)	0.0980 (2.87)	0.0788 (1.99)	0.0615 (1.87)	0.0050 (0.13)
UNEMP	-0.1953 (1.77)	-0.2219 (1.98)	-0.1247 (1.19)	-0.1601 (1.52)	-0.1247 (0.89)	-0.1398 (0.99)	-0.1277 (0.97)	-0.1684 (1.30)
REX	0.0010 (0.05)	-0.0225 (0.86)	0.0221 (1.11)	-0.0110 (0.44)	-0.0095 (0.39)	-0.0291 (0.91)	0.0100 (0.43)	-0.0392 (1.33)
SEX	-	-0.2644 (1.45)	-	-0.3837 (2.23)	-	-0.2032 (0.95)	-	-0.5404 (2.63)
COL	-	-	0.6976 (5.57)	0.7307 (5.84)	-	-	0.7013 (5.09)	0.8084 (5.72)
CONSTANT	-1.6675 (1.41)	-0.2486 (0.16)	-2.1812 (1.94)	-0.1469 (0.10)	-1.9514 (1.36)	-0.6245 (0.31)	-2.5722 (1.91)	0.8614 (0.46)
$\bar{R}^2$	0.3136	0.3167	0.3888	0.3986	0.2150	0.2146	0.3114	0.3338
N OF CASES	253	253	253	253	187	187	187	187

Absolute t-Values in Parentheses
Source: Socio-Economic Panel, First Wave (1984, Preliminary Version)

III. Conclusions

In this paper we found evidence that on-the-job training follows a pattern which can best be described as a mixture of investment and institutional

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arguments. The consequences of this finding for the relationship between training and earnings have still to be explored. In this context one hopefully fruitful research approach might be to utilize the probabilities of belonging to the four training categories obtained from the polytomous probit-regressions as training variables in an earnings regressions. These results could then be compared with a traditional specification of an earnings function, i.e. including work experience.

Table 4

Regression Results for Training by Sex
(German Women and Men, Age 16 - 59)

	Men				Woman			
Independent Variables	Models (1)	(2)	(4)	(5)	Models (1)	(2)	(4)	(5)
WHOR	0.0158 (0.30)	0.0077 (0.14)	0.0108 (0.21)	0.0019 (0.04)	0.0368 (0.70)	0.0380 (0.72)	0.0017 (0.04)	0.0021 (0.05)
WHOR2	-0.0010 (1.50)	-0.0009 (1.33)	-0.0009 (1.28)	-0.0008 (1.10)	-0.0007 (1.07)	-0.0008 (1.12)	-0.0002 (0.29)	-0.0002 (0.31)
H	0.2438 (1.03)	0.2152 (0.90)	0.2895 (1.25)	0.2589 (1.11)	-0.0282 (0.93)	-0.0275 (0.91)	0.0221 (0.85)	-0.0220 (0.85)
JOBS	-0.0472 (1.06)	-0.0410 (0.91)	-0.0354 (0.81)	-0.0285 (0.65)	-0.1123 (2.10)	-0.1087 (2.02)	-0.0575 (1.25)	-0.0567 (1.22)
WTIME	0.0118 (1.36)	0.0118 (1.36)	0.0116 (1.37)	0.0117 (1.38)	0.0213 (3.75)	0.0208 (3.65)	0.0197 (4.04)	0.0195 (3.99)
S	0.1165 (3.07)	0.1133 (2.98)	0.0693 (1.74)	0.0653 (1.63)	0.1501 (4.05)	0.15177 (4.09)	0.0758 (2.32)	0.0765 (2.33)
UNEMP	-0.3227 (2.66)	-0.3131 (2.57)	-0.2901 (2.43)	-0.2792 (2.34)	-0.0042 (0.03)	-0.0020 (0.02)	-0.0163 (0.15)	-0.0156 (0.14)
REX	-0.0449 (1.56)	-0.0452 (1.57)	-0.0406 (1.44)	-0.0408 (1.46)	-0.0145 (0.39)	-0.0146 (0.91)	-0.0163 (0.43)	-0.0163 (1.33)
FS/1000	-	0.0609 (1.06)	-	0.0622 (1.18)	-	-0.0531 (1.02)	-	-0.0148 (0.33)
COL	-	-	0.5087 (3.19)	0.5142 (3.23)	-	-	0.9762 (9.03)	0.9762 (8.93)
CONSTANT	1.4416 (0.82)	0.5464 (0.87)	1.7152 (0.99)	1.8320 (1.06)	-0.8682 (0.52)	-0.9302 (0.56)	-0.1489 (0.11)	-0.1688 (0.12)
$\bar{R}^2$	0.1882	0.1887	0.2232	0.2247	0.2721	0.2722	0.4683	0.4661
N OF CASES	213	213	213	213	227	227	227	227

Absolute t-Values in Parentheses
Source: Socio-Economic Panel, First Wave (1984, Preliminary Version)

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Summary

Based on the microdata of the first wave of the Socio-Economic Panel (1984) we analyze (a) the determinants of on-the-job training, (b) differences in the acquisition of training between men and women, and (c) the impact of firm size on training. OLS regression and polytomous probit estimates with training as dependent variable are estimated. On the one hand evidence is found that the acquisition of training can be interpreted as an investment decision. On the other hand institutional forces have an impact on the allocation of training and training differences between men and women.

Zusammenfassung

Anhand der Mikrodaten der ersten Welle des Sozio-ökonomischen Panels aus dem Jahr 1984 werden (a) die Determinanten der innerbetrieblichen Ausbildungsentscheidung, (b) Unterschiede der Ausbildungsbeteiligung von Männern und Frauen sowie (c) der Einfluß der Betriebsgröße auf das On-the-Job Training untersucht. Geschätzt werden KQ-Regressionen und polytome Probitschätzungen mit der innerbetrieblichen Ausbildung als abhängiger Variable. Es zeigt sich, daß die Ausbildungsbeteiligung als Investitionsentscheidung aufgefaßt werden kann. Deutlich wird aber auch, daß institutionelle Kräfte die Ausbildungsbeteiligung und Ausbildungsdifferenz zwischen Männern und Frauen beeinflussen.

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