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Employer Provided Further Training: Evidence from German Establishment Data

By Knut Gerlach and Uwe Jirjahn*

Abstract

Using Panel data from a representative sample of manufacturing firms this paper investigates the determinants of employer provided further training. The composition of the workforce, characteristics of the firm, technology and the organization of work, industrial relations and incentive systems are important determinants of the training decision: (i) It is shown that training correlates positively with the employees' level of qualification. (ii) An advanced technology and participative forms of work organization have a positive impact on training. (iii) Although in general there is negative correlation between the proportion of blue-collar workers and employer provided training blue-collar workers are more likely to receive training in establishments characterized by innovative activities and a participative work organization. (iv) Since the existence of a works council increases training expenditures it is argued that works councils alleviate some of the problems related to training such as poaching, holdups and inefficient separations. (v) Further training is more likely in larger firms and it is less likely in establishments which are not part of a multi-establishment firm.

Zusammenfassung

Mit Daten des Hannoveraner Firmenpanels wird untersucht, welche Faktoren die Entscheidung von Betrieben beeinflussen, Weiterbildungsmaßnahmen für die Arbeitnehmer zu finanzieren. Die Zusammensetzung der Belegschaft, die Firmenstruktur sowie industrielle Beziehungen und innerbetriebliche Anreize stellen sich als zentrale Bestimmungsgründe dieser Entscheidung heraus: (i) Betriebe mit einer qualifizierten Belegschaft weisen eine höhere Wahrscheinlichkeit auf, daß Weiterbildung für die Arbeitnehmer finanziert wird. (ii) Eine moderne Produktionstechnologie und eine partizipative Form der Arbeitsorganisation wirken sich positiv auf die Finanzierung von Weiterbildungsmaßnahmen aus. (iii) Während ein hoher Anteil gewerblicher Arbeitnehmer im allgemeinen einen negativen Einfluß auf die Finanzierung von Weiterbildung ausübt, nehmen gewerbliche Arbeitnehmer in innovativen Betrieben mit einer partizipativen Arbeitsorganisation mit einer größeren Wahrscheinlichkeit an Weiterbildungsmaßnahmen teil. (iv) Betriebe, in denen ein Betriebsrat vorhanden ist, haben eine höhere Wahrscheinlichkeit, daß Weiterbildung finanziert wird. (v) Die

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Betriebsgröße übt einen positiven Einfluß auf die Weiterbildungsentscheidung aus, während Einzelbetriebe Weiterbildung für Arbeitnehmer weniger wahrscheinlich finanzieren.

JEL-Classification: J 24, D 21

1. Introduction

There are important differences between the developed countries in providing workers with skills. Firms in the U.S. seem to invest less in human capital than their European counterparts (Acemoglu and Pischke 1999). Especially there is some interest in the German apprenticeship system which provides workers with high initial skills. But vocational training is not the only training ensuring a high qualified labour force in Germany. Further training taking place after a worker has acquired an initial occupational qualification is another important contributor to the skills of the German work force.

There are several reasons why further training plays a crucial economic role and why it deserves a detailed economic analysis. First, a growing number of empirical studies suggests that skill-biased technological progress has induced a decreased demand for less skilled workers in developed countries over the last two decades. This gives rise to the question whether further training can alleviate the qualification deficits of unskilled and semiskilled workers to enhance their employment opportunities. Moreover, also qualified workers can be negatively affected by technological progress which causes an obsolescence of skills. The second reason which is closely related to technological progress concerns the emergence of new human resource management practices. The diffusion of microelectronics is only one aspect of innovation occurring in the last two decades. Changes in the organization of work towards team work, quality circles and job rotation can also be seen as innovations to enhance the flexibility of production and the quality of products. More complex tasks require multiple skills of workers. There are several possibilities to cope with the increased demand for multi-skilling. Firms can rely more strongly on workers with vocational training. Or they can invest in further training to provide employees with these multiple skills. Third, incentives to finance further training matter. The differences in human capital investment between countries suggest that institutions can play also an important role for employer provided training. In this context the dual system of industrial relations in Germany characterized by collective bargaining at the industry level and codetermination at the establishment level is of special interest. On the one hand, centralized bargaining can contribute to an inflexibility of the wage structure hindering adjust-

ment processes at the firm level. On the other hand, the industrial relations in Germany can create favourable conditions for human capital investment by reducing bargaining conflicts at the establishment level and by promoting trust and loyalty between management and the work force.

Most empirical studies examining further training use cross-section or panel data of persons and emphasize the supply side of training (Pannenberg 1995, Pischke 1996 among others). However, a substantial amount of further training in Germany is financed by employers. According to an estimate of the 'Institut der deutschen Wirtschaft' manufacturing firms have spent about DM 34.3 Bill. in 1998 for employer provided training (Weiß 2000). Pfeiffer and Brade (1995) emphasize that the importance of further training has increased in the period 1982 to 1992, i.e. the number of participants and the expenditures for training have grown. Evidently, the number of participants in further training and the expenses of the private sector of the economy continued to rise (Weiß 2000). Hence, detailed establishment data focusing on the demand side of the labor market are required to examine the determinants of further training.

Using data from manufacturing firms with at least five employees in the federal state Lower Saxony, we investigate the establishment characteristics exerting an impact on the probability of employer provided training. The basic questions addressed in this paper are: How do innovation and modern human resource management systems influence the decision to finance further training? Is there an impact of profit sharing, collective bargaining agreements and works councils on employer provided training? Which role do the structure of the work force, firm size and multi-establishment firms play for the training decision? Additionally, this paper examines the establishment characteristics influencing the probability that blue-collar workers receive further training. Although, in general there is a negative link between blue-collar workers and employer provided training it is shown that team work and innovative activities of firms promote further training for blue-collar workers.

This paper continues our earlier study about employer financed training (Gerlach and Jirjahn 1998). We extend the analysis by using all four waves of the Hannover Panel. Additionally, we do not only investigate the decision to finance training. We also examine the determinants having an impact on the amount of training expenditures.

The plan of the paper is as follows. Section 2 presents the basic hypotheses. In Section 3 the data set employed is reviewed and the results are presented. Section 4 concludes.

2. Determinants of Training Activities – Basic Hypotheses

We use two dependent variables, a dummy variable for employer financed training and the amount of training expenditures. Additionally, we investigate the determinants of employer provided training for blue-collar workers. The hypotheses we test are organized around four large themes: structure of the work force, production technology and the organization of work, incentives and industrial relations, and the firm structure.

2.1 Structure of the Work Force

A firm will more likely offer training if the employees are willing and capable to accumulate additional human capital. Therefore, a better educated workforce enhances the probability of employer provided training. Various variables controlling for the qualification of the employees are included in the regressions. It is expected that the proportion of university and college graduates and – to a lesser degree – the proportion of skilled blue-collar workers will augment the probability of financing further training by employers. Conversely, a negative correlation between the proportion of all blue-collar workers (unskilled, semiskilled and skilled) and employer provided training is expected. Additionally, we control for the proportion of part-time workers.

In general, employer provided training will enlarge the skill gap between qualified and less qualified workers. However, Bartel and Sicherman (1998) find that in U.S. manufacturing industries with higher technological progress young production workers and employees without prior training are more likely to receive company training. Hence, there might exist particular circumstances narrowing the gap between qualified and less qualified workers. Using additional information from the third wave of the panel data, we investigate the impact of technological change and additionally of a participative work organization on further training for blue-collar workers.

Further training is not the only possibility to invest in the employees' human capital. Firms can also invest in vocational training. Therefore, we incorporate the proportion of apprentices in the analysis. The proportion of apprentices might influence training in two distinct ways. On the one hand, sizeable investments in apprenticeship training substitute for training activities. On the other hand, further training and apprenticeship training can be complements.

2.2 Production Technology and the Organization of Work

Production technology and the organization of work reflect the skill requirements of an establishment and therefore the demand side of training. Recent studies have focused on the impact of skill-biased technological change on the relative demand for less educated workers (Berman, Bound and Machin 1997). One way to cope with the increased demand for skills is to hire qualified workers from the external labour market. Another possibility is to train the less skilled workers. Moreover, technological change contributes to the obsolescence of initial vocational training (Blechinger and Pfeiffer 1999). Therefore, technological change may also induce more activities in further training for qualified workers. Additionally, multiskilled workers will be willing to cooperate with the introduction of labour-saving technological progress (Carmichael and MacLeod 1993). Workers trained in more than one job are less likely to be dismissed when technological change is introduced. This hypothesis is supported by Gerlach and Jirjahn (1999) who find that further training as an element of a cluster of modern human resource management practices reduces the downsizing of firms. In this paper the production technology is captured by a variety of variables. We include a dummy variable equal to one if the technology is of the most recent vintage. Additionally, dummy variables for product and process innovation and for establishing or extending research and development are included. Further, since the production process varies across industries industry dummies are included.

Conventionally, the introduction of computer-based equipment is viewed as the main force of technological change. However, an innovative organization of work is also a form of technological progress. Of course, the organization of work is related to a computer-based production technology (Aoki 1990; Brynjolfsson and Hitt 1998). The use of computers improves the availability of information. This enables the decentralization of decision rights causing increased skill requirements. Studies by MacDuffie and Kochan (1995) and by Black and Lynch (1998) show that firms with a flexible and participative organization of work are more likely to train workers. These findings are in accordance with theoretical considerations: Learning is important for workers to cope with production uncertainties (Aoki 1990a). Moreover, with a participative work organization workers have to perform a broader set of tasks. Delegating some decision rights to the shop floor presupposes that workers comprehend important elements of the production process and of the organization of the firm. Since the significance of social interaction increases with participation (Aoki 1995) workers also have to be trained in social competences.

Participation enhances the skill requirements for workers who are directly involved in participation. Additionally, a participative organization

of work may also increase the skill requirements of employees who are indirectly affected by this form of work organization. A professional human resource management is necessary to implement and coach new forms of work organization. It can be expected that e.g. the skill requirements of employees in the personnel department are increased.

The organization of work is captured by two variables. The first variable is a dummy variable equal to one if workers are organized in production teams with increased responsibility and with expanded involvement in decision-making. The second variable is a dummy variable equal to one if employees participate in investment decisions affecting their job. Only the third wave of our panel data contains more detailed information about the organization of work: Suggestions for product innovation from quality circles, responsibility for quality control and percentage of sales attributed to the main product group. These variables are included in the investigation of employer provided training for blue-collar workers. The first two variables measure the complexity of tasks. They can be assumed to exert a positive impact on training for blue-collar workers. The third variable is a proxy for a standardized production which may have a negative impact.

2.3 Incentives and Industrial Relations

Investigating training in the world auto industry, MacDuffie and Kochan (1995) find that, even controlling for production technology and human resource management practices, differences in training activities between firms of different countries persist. Obviously, country-specific institutions matter. Institutions are related to the incentives to invest in human capital. In this paper we address the issue which determinants cause differences in training activities between firms within a country.

Which kind of incentives for investing in human capital matters? A general agency problem might exist. The installation and implementation of training requires special efforts of managers. In these cases profit sharing for managers can contribute to the efficient planning and implementation of training activities. Apart from the general agency-problem there are three specific issues related to investment in human capital, i.e. inefficient separations, holdup and poaching. Investment in training will be fostered when the contracting parties install rules which alleviate these problems.

Inefficient separations might occur in the case of training, if information is distributed asymmetrically. In a model formulated by Hashimoto (1995) the worker can assess his external productivity in other firms while the firm is at an advantage in predicting his / her internal efficiency. Both productivities are subject to random shocks after training has been acquired. The

worker will quit if his external productivity is higher than a previously specified fixed wage. The firm will dismiss the worker if the worker's internal productivity does not attain this wage. These criteria can result in inefficient separations characterized by the worker's internal productivity exceeding his external productivity. This reduces the incentives to invest in human capital. One possibility to make inefficient separations less likely is to introduce a flexible payment scheme based on proxies for the worker's productivity. Hence a positive impact of profit sharing for employees on further training can be predicted.

A holdup problem arises when one contract party can ex post expropriate part of the surplus of a specific investment undertaken by the other party (McCain 1989), thus causing disincentives for investing in specific human capital. A worker who has benefitted from employer financed training might renegotiate higher wages by threatening to quit or to reduce effort. Conversely, if the investment in specific human capital is shared the employer can also behave opportunistically by withholding a promised wage increase or promotion.

In case of general human capital a poaching problem exists. According to Becker (1964) firms don't finance investment in general human capital of their workers because other firms will poach the workers. Apart from theoretical issues concerning the role of perfect and imperfect markets in the derivation of Becker's result (Stevens 1996), empirical evidence shows that many firms finance general training. A prominent example is the German apprenticeship training (Harhoff and Kane 1997) and also part of the human capital acquired by further training in Germany is general (Pischke 1996).

It is of specific interest if industrial relations can support employer provided training by alleviating inefficient separations, holdups and poaching. Works councils provide a highly developed mechanism for codetermination at the establishment level (Heywood, Hübler and Jirjahn 1998). The councils are expressly provided for by the Works Constitution Act but their creation depends on the initiative of the establishment's employees. Therefore, works councils are not universal in all eligible establishments. The existence of a works council in the voice-theoretic sense (Freeman and Medoff 1979) contributes to a reduction of inefficient separations because the information flow between management and employees is improved. A council will request that management takes into consideration the preferences of the workforce concerning the implementation of training. Moreover, a council is an institution to weaken holdups and ex-post opportunism. The works council and management can negotiate a collective contract (Williamson, Wachter and Harris 1975) designed to limit ex-post contracting of indivi-

dual workers. If workers and firms share the costs of training, the works council will monitor management's potentially opportunistic behavior (Smith 1991). Finally, the poaching problem can be mitigated (Soskice 1994). Works councils promote internal labour markets. The promotion opportunities related to internal labour markets reduce the mobility of workers between firms. A works council representing the interests of workers employed in the establishment will foster training for insiders instead of hiring workers from the external labour market. Specifically, this should occur if further training contributes to the reduction of employment risks caused by strategies which tend to increase the capital-labour ratio and to modernize the production process (Sadowski, Backes-Gellner and Frick 1995). Additionally the wage structure of internal labour markets constrains management's possibilities to use wage strategies to poach workers from other firms. In sum, it can be expected that the existence of a works council enhances the probability of employer provided training.

Collective bargaining of unions and employers usually occurs at the sectoral level. Usually only those firms which are members of an employers' association are covered by a collective bargaining agreement. Recently, centralized bargaining has been characterized as being not sufficiently responsive to local conditions at the firm level. However, there are several arguments suggesting a positive impact of collective bargaining agreements. The wage structure imposed by a collective agreement might also restrict strategies to poach qualified workers from other firms (Soskice 1994). Moreover, the holdup problem can be mitigated if distributional conflicts are transferred to collective negotiations at the sectoral level. In that case the bargaining partners at the firm level will have an incentive to concentrate on the introduction of efficiency-enhancing measures (Freeman and Lazear 1995). Additionally, unions are interested in including further education in the bargaining agenda in order to improve workers' employment opportunities (Hardes 1991).

2.4 Structure of the Firm

Firm size and training activities can be correlated positively for several reasons. The potential number of employees who can participate in training increases with the size of the firm. Economics of scale lower the unit costs of training. Further, larger firms are more likely to establish internal labour markets. With improved opportunities of promotion in larger firms tenure might increase and a better quality of matches will be attained. The resulting reduced turnover raises the probability that larger firms benefit from training activities. Presumably, even smaller establishments which are part

of a multi-establishment firm might benefit from the size dependence of training activities. The fixed costs of training can be spread over a number of establishments (Black and Lynch 1998). Thus single establishments which are not part of a multi-establishment firm will be less involved in training.

3. Empirical Analysis

3.1 The Survey

The empirical analysis is based on four waves (1994–1997) of a panel study (Hannover Firm Panel) of manufacturing establishments in the federal state of Lower Saxony. The population consists of all manufacturing establishments with at least 5 employees. The sample is stratified according to firm size and industry. Interviews were conducted by Infratest Sozialforschung, a German survey and opinion research institute. The data were collected on the basis of a questionnaire in personal interviews with the owner, top manager or head of the personnel department. In the first wave (1994) 51 percent of the establishments in the sample agreed to participate. In spite of this non-response rate the difference between the planned and realized stratification is so small that the data are representative of the manufacturing establishments in Lower Saxony in 1994 and the subsequent years. The number of firms taking part in the panel study declined from 1025 (1994) to 849 (1995), 721 (1996) and 709 (1997).

Information on employer provided internal or external further training (Weiterbildung) is available in each wave, these data, however, refer to the years 1993 to 1996. In addition, information has been collected on annual expenditures for training, and exclusively in the third wave on the frequency of training for blue collar workers.

Apart from general information on the firm a nucleus of themes is addressed annually. Different additional topics are sampled in consecutive waves. This implies that some variables which conceivably are determinants of training are available in only one wave. If the assumption is plausible that the realizations of those variables have not changed during the relatively short period of investigation, they are incorporated as time-constant variables in the panel data analysis.

3.2 Basic Facts Describing Employer Provided Training

Table 1 contains average values of employer provided training in the period 1993 to 1996. The proportion of manufacturing establishments financing

training decreased from 0.608 (1993) to 0.569 (1995) and roughly stabilized in 1996. Likewise, the average expenditures per employee of all firms declined substantially between 1993 and 1995 and increased strongly in the subsequent year. Taking into consideration only those firms with training expenditures in the respective years an identical time pattern prevails for the higher costs incurred by the training firms. Since only a proportion of the workforce participates in training, the expenditure per participant exceeds the financial amounts documented in Table 1. However, information about the rates of participation in specific firms is not available.

For firms which have been interviewed in three biannual periods (1993/94, 1994/95, 1995/96) Table 2 compares their involvement in training activities. The basic message is that a fairly large proportion of firms exhibits a constant involvement in training activities, although about 20 percent of the manufacturing establishments change their training decisions in each biannual period. This finding is confirmed by Tables 3 and 4. Table 3 documents the firms providing information on training in each year. Approximately 59 percent of the firms were never or permanently involved in training while the rest exhibited an intermittent pattern. The correlation coefficients of training expenses per employee (Table 4) are positive and at a 1 percent significance level different from zero. Their magnitude shows, however, that the correlations across the various years are not perfect.

Summarizing, the descriptive findings demonstrate that in each year more than 50 percent of the interviewed manufacturing firms with at least five employees were involved in training activities. On the one hand, for a large proportion of firms participation in training tends to be a long-run decision in the sense of permanent involvement or abstention. This could imply that long-term factors like technology or structure of the workforce determine the training activities. In the same vein, sunk costs could play a role, since training requires frequently specific investments, for example a professional personnel management. Once these investments have been incurred, it is advantageous to fund training on a regular basis. Potential sunk costs, however, could deter firms permanently from any involvement in training activities. On the other hand, the firms with intermittent training activities should not be neglected. Evidently, funding of training might be induced by cyclical factors like product market variations. In addition, changes of long-term characteristics of firms could lead to an adoption or suspension of training.

3.3 Determinants of Employer Provided Training

A first impression of the determinants of training is obtained from Table 5.a and Table 5.b. They contain simple comparisons of the means of variables describing various characteristics of manufacturing firms with and without training in each year of the panel study. The variables capture aspects of the work force and the firm, production technology, work organization and incentives, and of the state of industrial relations. The amazing result is that firms with and without training differ in these dimensions in the four years of investigation. Specifically, firms with training are characterized by a higher percentage of academically educated employees, a lower percentage of blue-collar and part-time workers, they employ proportionally more apprentices, are larger, use a more modern technology, are more involved in R&D, product and process innovation, have a work organization which is based more frequently on teams and worker participation, tend to install modern payment systems like profit and gain sharing, are more frequently subject to a collective bargaining contract. Works councils are much more common in firms with involvement in training. Employer provided training, evidently, is a variable which helps to differentiate neatly between firms.

In a multivariate analysis the data of all four waves are used as an unbalanced panel. The dependent variable is employer provided training, which has the value 1 (0, otherwise) if an establishment financed training in the respective year. The independent variables capture characteristics of the workforce and the firm, technology, work organization, incentives and industrial relations. In addition, time variables (for 1994, 1995, 1996) are included. A pooled probit model and additionally a random-effects-probit model (Butler/Moffit 1982), controlling for an establishment-specific and time-invariant error component, are estimated.¹ Alternatively, a pooled Tobit model with training expenditures divided by firm size (number of employees) as the dependent variable is estimated.²

Table 6 presents the results of the probit models. The estimates show that firm size, a modern technology, a participative work organization, a strategy emphasizing R&D and product innovations exert a positive impact on training.

Likewise, with respect to the structure of the work force the empirical results are in accordance with the theoretical conjectures. Larger proportions of academically trained employees, skilled blue-collar workers and appren-

¹ All estimations were performed with LIMDEP 7.0.

² We also tried to estimate a random-effects-tobit model. Unfortunately, this model failed to converge.

tices in the workforce increase the probability that a firm finances training. A negative impact stems from a larger proportion of blue-collar workers.

Interestingly, the existence of a works council has a positive impact on training, while the presence of a collective bargaining agreement does not produce a significant effect. These results suggest that the industrial relations at the establishment level are crucial for the incentives to invest in human capital. The existence of a works council can create cooperative and trustful industrial relations alleviating the problems related to inefficient separations, holdups and poaching.

Concerning the flexible payment schemes the findings are mixed. Because profit sharing for managers and profit sharing for employees are highly correlated, variables are created representing various combinations of these forms of financial participation. Profit sharing for managers has a positive impact on training, while this form of compensation for employees tends to influence training negatively. However, profit sharing for employees combined with a flexible remuneration for managers exerts a strong impact on further training. Obviously, agency problems play an important role. It is not sufficient to reduce inefficient separations by installing profit sharing for employees. A financial participation of managers in the results of efficiency enhancing measures appears to be a condition that must be met so that managers are willing to support training for employees.

In addition, the estimates show that training activities have been reduced with respect to the base year 1993. This might be due to the severe recession after 1993. Finally, the random-effects-probit estimates demonstrate that firm specific factors, which are not captured in the model, have an impact on training.

In a similar study Bellmann and Düll (1998) use a probit model to explain establishment financed training on the basis of the IAB-Firm Panel data for 1997. They do not take into account the organization of work and incentives. There are, however, common determinants of establishment financed training in both investigations, namely the structure of the work force, firm structure, production technology and industrial relations. Interestingly, with the exception of the variables depicting industrial relations Bellmann and Düll obtain results for employer provided training in manufacturing firms which are very similar to the results presented here. Concerning the impact of works councils on further training the authors compute a positive, but insignificant coefficient. In sum, the impact of the common variables used in both studies is amazingly symmetrical and the divergence of the variables capturing industrial relations is not too great.

Table 7 presents the results of the Tobit regression. These results are largely in accordance with the results of the probit regressions. However, par-

participation in investment decisions and profit sharing only for employees are no longer significant while the coverage by a collective bargaining agreement exerts a significant impact on the amount of training expenditures. The latter result shows that sectoral bargaining may play an important role for the industrial relations at the establishment level. The reduction of distributional conflicts might foster the creation of cooperative industrial relations at the establishment level and/or unions might try to improve the workers' employment opportunities by supporting further training.

3.4 Determinants of Employer Provided Training for Blue-Collar Workers

A negative relationship between the proportion of blue-collar workers and training activities has been found in the above estimates. Taking into consideration the additional information of the third wave (1996) of the Hannover Firm Panel, it is feasible to investigate the conditions that must prevail for a firm to finance training for blue-collar workers: Does the core workforce of blue-collar workers participate normally in training activities? This information is used for the following variable:

$$\text{TRAINBLUE} = \begin{cases} 0, & \text{if no training for blue-collar workers} \\ 0, & \text{if intermittent training for blue-collar workers} \\ 0, & \text{if regular training for blue-collar workers} \end{cases}$$

This variable is used in an ordered-probit estimation. Table 8 presents the results. The complexity of work tasks has a positive impact on further training for blue-collar workers. This can be gleaned from the variables describing a participative work organization, noticeably team work, quality circles and the responsibility for quality control. A modern technology, process and product innovations are also significantly positive determinants. The proportion of the firm's revenue which is earned with the most important product group has a negative influence. A low proportion of revenue of the main product group tends to imply a larger variety of products and less standardization in production. These results are in accordance with the hypothesis of skill-biased technological change. In general there exists a negative relationship between the proportion of blue-collar workers and employer provided training. However, increased skill requirements due to a modern technology and a participative organization of work enhance the probability of further training for blue-collar workers.

Concerning the industrial relations no significant impact of works councils can be found. In contrast, the coverage by a collective bargaining agreement exerts a significant positive impact. The last finding confirms the hy-

pothesis that unions support further education for less skilled workers to enhance their employment opportunities.

It would be interesting to investigate if a finer classification of employees, i.e. a further subdivision of blue-collar workers, could lead to different results concerning the impact of independent variables on further training. Studies based on the IAB-Firm Panel indicate that the determinants of participation in further training differ between different groups of workers (Düll and Bellmann 1998, 1999). However, the data of the Hannover Firm Panel do not allow this refinement of the analysis.

4. Concluding Remarks

Firms tend to offer training for qualified employees. Employer provided training is not an instrument to reduce deficits of qualification of employees lacking skills and frequently exposed to spells of unemployment. In general it will enlarge the gap between qualified and less qualified employees. However, employer financed training is important because it provides workers with qualifications which are closely related to practical job requirements. One implication for labor market policy might be to offer financial incentives to employers in order to train also less qualified employees.

Firm size, the integration of the establishment into a multi-enterprise firm, a modern technology, innovations, R&D, as well as a participative work organization stimulate the willingness of firms to offer training activities. Evidently, a specific type of firms offers training. Those firms can be characterized by flexible production methods with a diversity of products responding to changing demand conditions. Qualification and training are important ingredients of the concept of flexible production.

Moreover, a modern technology and a participative organization of work are of particular importance for the training of blue-collar workers. Although, in general there is a negative link between blue-collar workers and employer provided training, team work, the complexity of tasks, a modern production technology and innovations promote employer provided training for blue-collar workers. Of course future research should address the issue of endogeneity of those variables. However, as far as a comparison with the study of Bellmann and Düll (1998) is feasible, the findings concerning the variables used in both investigations are very similar. This may be interpreted as an indication of the robustness of the results.

In addition, the labour market implications of this finding deserve further research. Is the training gap between qualified and less qualified workers narrowed by technological change and a participative work organization as

the investigation by Bartel and Sicherman (1998) suggests? Can an emergent new gap be detected between employees working in firms with a modern technology and employees working in firms with a more traditional production technology?

Furthermore, our investigation has shown that skill requirements of tasks are not the only factors exerting an impact on further training. Incentives and industrial relations play a crucial role in weakening market failures in human capital investment. Works councils and the coverage by a collective bargaining agreement exert a positive impact on employer provided training. There are four potential sources of market failures in employer provided training: a general agency problem, inefficient separations, holdups and poaching externalities. The positive impact of works councils on further training is in accordance with the hypothesis that codetermination promotes cooperative and trustful industrial relations which alleviate these problems.

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Appendix: Tables

Table 1
Training Activities of Firms, Means

	1993			1994			1995			1996		
	N	\bar{x}	s	N	\bar{x}	s	N	\bar{x}	s	N	\bar{x}	s
Financing of training activities (dummy)	1022	0.608	0.488	849	0.578	0.494	721	0.569	0.496	709	0.570	0.495
All firms: training expenditure divided by firm size (number of employees)	915	191.80	373.28	805	156.14	371.55	689	135.72	233.28	683	181.52	378.60
Only firms with training activities: training expenditure divided by firm size (number of employees)	517	339.45	443.39	447	281.20	462.18	379	246.72	267.56	381	325.40	458.60

N – Number of Firms, \bar{x} – Means, s – Standard Deviation.

Table 2a
Financing of Training Activities 1993 / 1994

Financing 1993	Financing 1994	No	Yes	Σ
No		258	77	335
Yes		98	413	511
Σ		356	490	846

Number of Firms

Table 2b
Financing of Training Activities 1994 / 1995

Financing 1994	Financing 1995	No	Yes	Σ
No		218	74	292
Yes		81	321	402
Σ		299	395	694

Number of Firms

Table 2c

Financing of Trainings Activities 1995/1996

Financing 1995	Financing 1996	No	Yes	Σ
No		210	66	276
Yes		64	302	366
Σ		274	368	642

Number of Firms

Table 3

Financing of Training Activities, Number of Years

Number of years with financing of training activities	0	1	2	3	4
Number of firms	141	83	68	103	226
Relative frequency (%)	(22.7)	(13.4)	(11.0)	(16.6)	(36.4)

N = 621

Table 4

Training Expenditure Divided by Firm Size (Number of Employees), Correlations

	1994	1995	1996
1993	0.383 (0.000)*** 740	0.405 (0.000)*** 627	0.219 (0.000)*** 625
1994	—	0.526 (0.000)*** 641	0.395 (0.000)*** 639
1995	—	—	0.338 (0.000)*** 601

Coefficients of Correlation, Two-Tailed levels of significance (in parentheses) and number of firms.

*, ** or *** denote levels of significance at $\alpha = 0.10, 0.05$ or 0.01 .

Table 5a: Descriptive Statistics of Firms without Training Activities and of Firms with Training Activities

	1993					1994				
	No Training		Training		t	No Training		Training		t
	N	Mean	N	Mean		N	Mean	N	Mean	
Proportion of university and college graduates	395	0.0237 (0.046)	620	0.0428 (0.058)	5.81***	358	0.0248 (0.046)	489	0.0417 (0.057)	4.75***
Proportion of skilled blue-collar workers	396	0.3999 (0.270)	620	0.3969 (0.249)	0.18	357	0.4219 (0.276)	491	0.3846 (0.245)	2.04**
Proportion of blue-collar workers	397	0.6429 (0.191)	621	0.6170 (0.182)	2.17***	358	0.6426 (0.190)	491	0.6199 (0.182)	1.76**
Proportion of part-time workers	397	0.0986 (0.143)	621	0.0667 (0.103)	3.85***	358	0.1025 (0.146)	491	0.0630 (0.090)	4.53***
Proportion of apprentices	397	0.0350 (0.058)	621	0.0498 (0.061)	3.84***	358	0.0391 (0.066)	491	0.0499 (0.059)	2.50***
Firm size (number of employees)	397	50.144 (59.27)	616	263.32 (850.8)	6.20***	357	54.624 (66.70)	487	275.03 (885.0)	5.47***
Firm is not a subsidiary and has no subsidiaries*	397	0.7491 (0.435)	619	0.4911 (0.500)	8.66***	358	0.7402 (0.439)	489	0.4785 (0.500)	8.08***
Production technology at the newest level ⁺	390	0.2615 (0.440)	598	0.4247 (0.495)	5.42***	350	0.2771 (0.448)	474	0.4177 (0.494)	4.26***
Research and development will be strengthened ⁺	396	0.0960 (0.295)	619	0.1842 (0.388)	4.10***	357	0.1064 (0.309)	489	0.1943 (0.396)	3.62***
Product innovation ⁺	396	0.3662 (0.482)	619	0.5638 (0.496)	6.30***	358	0.4078 (0.492)	491	0.5988 (0.491)	5.59***

Table 5a (Continued)

	1993						1994					
	No Training			Training			No Training			Training		
	N	Mean		N	Mean	t	N	Mean		N	Mean	t
Process innovation ⁺	396	0.1742 (0.380)		620	0.2629 (0.441)	3.41***	357	0.1176 (0.323)		491	0.2240 (0.417)	4.18***
Team work for blue-collar workers ⁺	395	0.4937 (0.501)		621	0.6103 (0.488)	3.66***	356	0.5253 (0.500)		491	0.6069 (0.489)	2.37***
Participation of employees in investment decisions ⁺	393	0.5827 (0.494)		614	0.7052 (0.456)	3.96***	354	0.6102 (0.488)		487	0.6961 (0.460)	2.58***
Works council ⁺	397	0.3501 (0.478)		618	0.7249 (0.447)	12.51***	358	0.3939 (0.489)		488	0.7316 (0.444)	10.31***
Coverage by a collective bargaining agreement ⁺	395	0.5165 (0.500)		616	0.7549 (0.431)	7.80***	356	0.5590 (0.497)		488	0.7377 (0.440)	5.41***
Profit sharing for managers ⁺	394	0.2843 (0.452)		613	0.5139 (0.500)	7.55***	358	0.3045 (0.461)		485	0.5093 (0.500)	6.15***
Profit sharing for employees ⁺	397	0.1209 (0.326)		619	0.2100 (0.408)	3.85***	358	0.1201 (0.326)		491	0.1996 (0.400)	3.19***

*** or ** denotes significance at $\alpha = 0.10$, 0.05 or 0.01. + denotes dummy variables (e.g. = 1, if a works council is present). Several questions were not answered by all firms. Therefore, for each variable the number (N) of observations is documented. Standard deviations in parentheses.

Table 5b: Descriptive Statistics of Firms without Training Activities and of Firms with Training Activities

	1995						1996					
	No Training			Training			No Training			Training		
	N	Mean		N	Mean	t	N	Mean		N	Mean	t
Proportion of university and college graduates	306	0.0225 (0.041)		406	0.0458 (0.063)	5.99***	269	0.0244 (0.041)		364	0.0456 (0.065)	5.02***
Proportion of skilled blue-collar workers	304	0.3956 (0.246)		403	0.3654 (0.221)	1.69**	268	0.3915 (0.248)		361	0.3672 (0.220)	1.27
Proportion of blue-collar workers	310	0.6507 (0.191)		409	0.6172 (0.183)	2.38***	302	0.6517 (0.187)		398	0.5848 (0.202)	4.48***
Proportion of part-time workers	310	0.0982 (0.138)		409	0.0708 (0.112)	2.85***	301	0.0839 (0.127)		399	0.0641 (0.096)	2.26**
Proportion of apprentices	310	0.0378 (0.063)		409	0.0487 (0.060)	2.35***	301	0.0374 (0.062)		398	0.054 (0.069)	3.27***
Firm size (number of employees)	309	84.790 (498.5)		405	257.22 (863.1)	3.35***	302	61.301 (84.440)		398	248.518 (812.676)	4.56***
Firm is not a subsidiary and has no subsidiaries*	309	0.7443 (0.437)		408	0.4608 (0.499)	8.09***	297	0.7643 0.452		394	0.5355 (0.499)	6.49***
Production technology at the newest level*	308	0.2727 (0.446)		408	0.3652 (0.482)	2.65***	271	0.2804 (0.405)		366	0.3525 (0.478)	1.94*
Research and development will be strengthened*	306	0.1242 (0.330)		406	0.3153 (0.465)	6.41***	290	0.1690 (0.375)		394	0.3376 (0.473)	5.19***
Product innovation*	310	0.3839 (0.487)		409	0.5672 (0.496)	4.96***	301	0.3721 (0.484)		400	0.6475 (0.478)	7.51***

Table 5b (Continued)

	1995				1996					
	No Training		Training		No Training		Training			
	N	Mean	N	Mean	t	N	Mean	N	Mean	t
Process innovation ⁺	310	0.1548 (0.362)	408	0.3088 (0.463)	5.00***	301	0.1296 (0.336)	400	0.2400 (0.428)	3.83***
Team work for blue-collar workers ⁺	310	0.2710 (0.445)	409	0.4694 (0.500)	5.61***	273	0.3187 (0.467)	367	0.4578 (0.499)	3.62***
Participation of employees in investment decisions ⁺	306	0.5850 (0.494)	408	0.7108 (0.454)	3.49***	299	0.6087 (0.489)	400	0.7100 (0.454)	2.79***
Works council ⁺	304	0.3980 (0.490)	404	0.7351 (0.442)	9.45***	269	0.4089 (0.493)	363	0.7218 (0.449)	8.20***
Coverage by a collective bargaining agreement ⁺	299	0.5753 (0.495)	391	0.6726 (0.470)	2.62***	271	0.5756 (0.495)	364	0.7005 (0.459)	3.24***
Profit sharing for managers ⁺	310	0.3226 (0.468)	409	0.5941 (0.492)	7.54***	237	0.3516 (0.478)	367	0.5668 (0.496)	5.54***
Profit sharing for employees ⁺	310	0.1000 (0.300)	409	0.1834 (0.387)	3.25***	273	0.0952 (0.294)	367	0.1962 (0.398)	3.69***

⁺, ** or *** denotes significance at $\alpha = 0.10$, 0.05 or 0.01. + denotes dummy variables (e.g. = 1, if a works council is present). Several questions were not answered by all firms. Therefore, for each variable the number (N) of observations is documented. Standard deviations in parentheses.

Table 6

Binary Probit Estimates
Dependent Variable: Financing of Training Activities (No / Yes)

Exogenous Variables	1993 – 1996 Pooled (1)		1993 – 1996 Random Effects (2)	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Proportion of blue-collar workers	-1.012***	5.497	-1.480***	4.970
Proportion of skilled blue-collar workers	0.291**	2.394	0.468**	2.501
Proportion of university and college graduates	2.072***	3.506	2.577***	3.173
Proportion of apprentices	3.048***	6.253	3.816***	5.151
Proportion of part-time workers	-0.344	1.386	-0.649	1.573
Log of firm size (number of employees)	0.483***	13.866	0.687***	10.349
Firm is not a subsidiary and has no subsidiaries ⁺	-0.212***	3.534	-0.259**	2.561
Production technology at the newest level ⁺	0.188***	3.170	0.203**	2.281
Product innovation ⁺	0.172***	2.963	0.169**	2.066
Process innovation ⁺	0.102	1.443	0.133	1.356
Research and development will be strengthened ⁺	0.138*	1.906	0.145	1.580
Team work for blue-collar workers ⁺	0.258***	4.629	0.321***	3.684
Participation of employees in investment decisions ⁺	0.193***	3.322	0.287***	2.713
Works council ⁺	0.179**	2.415	0.270**	2.196
Coverage by a collective bargaining agreement ⁺	0.096	1.533	0.087	0.904
Profit sharing for managers and employees ⁺	0.262***	2.865	0.370**	2.471
Profit sharing only for employees ⁺	-0.091	0.616	-0.444**	2.116
Profit sharing only for managers ⁺	0.118*	1.878	0.190*	1.947
1994 ⁺	-0.124*	1.752	-0.163*	1.805
1995 ⁺	-0.080	1.053	-0.091	0.968
1996 ⁺	-0.086	1.099	-0.089	0.898
Constant	-2.069***	10.273	-2.807***	8.167
ρ			0.506***	8.045
Industry dummies	included		included	
Number of firms	987		987	
Number of observations	2932		2932	
McFadden R^2	0.271		0.323	
χ^2	1078.56***		1284.42***	

*, ** or *** denote levels of significance at $\alpha=0.10$, 0.05 or 0.01. + denotes dummy variables (e.g. = 1, if a works council is present).

Table 7
Pooled Tobit Estimates
Dependent Variable: Training Expenditures Divided by Firm Size
(Number of Employees)

Exogenous Variables	1993 – 1996	
	$\hat{\beta}$	t
Proportion of blue-collar workers	-422.47***	4.920
Proportion of skilled blue-collar workers	133.71**	2.365
Proportion of university and college graduates	847.56***	3.414
Proportion of apprentices	1044.40***	4.616
Proportion of part-time workers	-93.99	0.776
Log of firm size (number of employees)	92.57***	6.239
Firm is not a subsidiary and has no subsidiaries ⁺	-56.63**	2.086
Production technology at the newest level ⁺	108.80***	4.144
Product innovation ⁺	83.04***	3.146
Process innovation ⁺	29.57	0.967
Research and development will be strengthened ⁺	89.67***	2.917
Team work for blue-collar workers ⁺	98.44***	3.877
Participation of employees in investment decisions ⁺	38.50	1.419
Works council ⁺	110.73***	3.113
Coverage by a collective bargaining agreement ⁺	60.12**	2.051
Profit sharing for managers and employees ⁺	197.10***	5.228
Profit sharing only for employees ⁺	-1.19	0.987
Profit sharing only for managers ⁺	63.25**	2.227
1994 ⁺	-67.83**	2.103
1995 ⁺	-75.60**	2.201
1996 ⁺	-12.39	0.352
Constant	-674.32***	7.172
Industry dummies	included	
Number of observations	2782	
Log Likelihood	-12784.23	

*, ** or *** denote levels of significance at $\alpha=0.10$, 0.05 or 0.01. + denotes dummy variables (e.g. = 1, if a works council is present).

Table 8

Ordered-Probit Estimates
Dependent Variable: Training for Blue Collar Workers (TRAINBLUE)

Exogenous Variables	$\hat{\beta}$	t
Proportion of skilled blue-collar workers	0.280	1.135
Proportion of blue-collar workers	-0.592*	1.798
Proportion of part-time workers	-0.128	0.249
Proportion of apprentices	-0.017	0.017
Log of firm size (number of employees)	0.199***	3.169
Firm is no subsidiary and has no subsidiaries ⁺	-0.319***	2.832
Production technology at the newest level ⁺	0.300***	2.699
Product innovation ⁺	0.227**	2.239
Process innovation ⁺	0.249**	2.128
Research and development will be strengthened ⁺	0.113	0.863
Percentage of sales attributed to the main product group	-0.073*	1.672
Team work for blue-collar workers ⁺	0.401***	3.904
Participation of employees in investment decisions ⁺	0.129	1.184
Suggestions for product innovation from quality circles ⁺	0.387**	2.240
Employees responsible for quality control ⁺	0.288***	2.714
Works council ⁺	0.110	0.751
Coverage by a collective bargaining agreement ⁺	0.281**	2.391
Profit sharing for managers and employees ⁺	0.464***	2.803
Profit sharing only for employees ⁺	0.271	0.650
Profit sharing only for managers ⁺	-0.063	0.559
Constant	-0.103	0.242
MU1	1.482***	18.725
Industry dummies	included	
Number of firms	630	
χ^2	236.763***	

*, ** or *** denote levels of significance at $\alpha = 0.10, 0.05$ or 0.01 . + denotes dummy variables (e.g. = 1. if a works council is present).