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Works Councils, Training Activities and Innovation: A Study of German Firms

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Abstract

Building on the notion of general and specific human capital proposed by Becker (1962), the paper highlights the importance of employee training practices undertaken in firms as an important tool for human resource and knowledge management and focuses on the role of works councils as a specific form of employee representation system therein. Using establishment data on various aspects of training practices and innovation activities in Germany, the paper examines the degree, type and extent to which establishments invest in employee training and finds significant differences for firms with and without works councils. Specifically, findings suggest that works councils are related more with the provision of generalized training rather than in firm-specific technical training of employees. In addition, the paper finds strong support for using works councils as an instrument for a firm's total training activities that correlate with innovation, and weak support when we consider only generalized training and innovation. Finally, no significant relation is found between training practices and radical innovativeness of firms after accounting for reverse causality.

Keywords: employee training practices; knowledge management; generalized training, firm-specific technical training; works councils; innovation; radical innovation

JEL classification: J5, M53, O3

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1. Introduction

In the innovation literature the importance of human capital investment in technological innovation and economic growth is widely acknowledged. Prior research has identified the amount and quality of schooling, investments in tertiary and vocational education, and more recently, investments in on-the-job training to be the most common indicators of human capital. This paper particularly focuses on firm-sponsored training activities as an important tool for knowledge building and human resource management, which allow employees to draw on knowledge and competencies inside and outside the firm in an efficient way, and the influence of works councils therein. Such training activities are usually aimed at developing the competencies and human capital of employees with the ultimate aim to increase their creativity, their abilities to cooperate and exchange knowledge (absorptive capacity, Cohen and Levinthal 1989) as well as their productivity. This contributes not only to firms' competitiveness in the short-run but also to their long-term sustainable development.

Although the link between human capital investment and technological innovation has been extensively examined, more remains to be understood about the components of human capital investments in firms and any measures to promote them. Standard theory on human capital composition in firms (Becker 1962; Davenport and Prusak 1998; Nahapiet and Ghoshal 1998) suggests that private enterprises are in general path-dependent in nature and therefore invest in firm-specific technical training that allows the employees to understand routinized complex production processes. However, investments in general vocational skills (or generalized training in our terminology) are suboptimal lower (Acemoglu 1997). In-line with this theory, previous researchers (Loewenstein and Spletzer 1998a) argue that if employers and employees are able to coordinate efficiently by using long-term contracts, then firms might agree to invest in general vocational training of the employees. But in the absence of long-term contracts, there is a high risk of labor turnover and therefore firms might not be willing to invest in general vocational skills. In view of this divergence of interests in the investment in human capital between firm owners or managers and employees, two questions come up: the first one concerning the type of human capital into which investment may be considered and the second one on the role of labor market institutions like works councils.

Looking first more closely at human capital, a major research gap is found in the fact that although prior studies have established a close link between on-the-job and off-the-job training, investments in intellectual capital, social capital and human capital and various firm performance indicators, very few studies have actually distinguished between the different forms of human capital investments firms undertake and how that affects their innovation capabilities (Subramaniam and Youndt 2005; Dakhli and Clercq 2004). Since firm performance relies much on innovative successes, the abilities of employees to contribute to innovation have to be considered as a resource that firm management should focus on. Consequently, human resource and knowledge management practices should rank high on a firm's strategy agenda.

In our attempt to fill the above mentioned research gap we refer to Huselid (1995) who, in his seminal study on the impact of high performance work practices on organizational performance, categorized human resource management practices into two categories: those that mainly influence employees' abilities and those that mainly influence employees' motivation. Building on this analytical categorization of human resource and knowledge management practices (see also Laursen and Mahnke 2001), in our paper, we categorize firm-sponsored training into two groups. The first group is generalized training that mostly aims at improving competency, communication, leadership and problem-solving skills in employees. The second group comprises different types of technical training that relates to firm-specific training in production, technical task-related and IT related mechanisms. In this context we suggest that since decisions on implementing knowledge management tools and human resource practices require an involvement of the employees themselves and their intra-firm representatives, it is essential to investigate the role of labor market institutions like works councils in promoting such practices in firms and establishments.

Looking into our second dimension, the role of labor market institutions, the question about the involvement of work councils comes up. Works councils usually correspond to a well-established system of employee representation at the establishment and firm level, established in Germany and many other countries in Europe as well as in the U.S., which gives workers a number of rights to information, consultation, and co-determination on company decisions. In Germany, works councils have a particularly strong position due to legal regulation (German Works Constitution Act 1952) that guarantees employees in establishments or firms with five or more permanent employees the right to establish a works council. Often, but not necessarily, works council candidates are nominated by the union or unions corresponding to the specific industry. However, the works councils have to represent all regular employees of their establishment or firm and are committed to support its economic stability in the first line and union interests in the second. Starting from 200 employees, at least one works council member per establishment or firm has the possibility to work fulltime as employee representative, while in larger establishments or enterprises this number can be more than one (Frick and Möller 2003; Rogers and Streeck 2009). The main tasks of works councils comprise the protection of employee rights in various human resource management practices such as recruiting, layoffs, reorganization, vocational education and training, co-determination of incentive schemes, vacations and leave grants, flexi-time and overtime regulation, conflict handling, and prevention of work accidents and work-related stress.

Although the study of works councils has become quite popular in Europe and in the United States in the last two decades, there is still limited research about their economic effects. Recent literature on labor market institutions has investigated the impacts of works

councils on employee productivity, employment dynamics, firm performance and productivity, and investments in physical capital. Existing research has also focused on the direct and indirect links between works councils and innovation (for example, Addison et al. 1996; 2001; 2004, Dilger 2003, Blume and Gerstlberger 2007). However, no studies have so far examined the role of works councils in the provision of different types of training in firms and how that subsequently affects firm innovation performance. This paper therefore proposes to relate the existence of works councils with different forms of employee training practices (firm-specific and generalized) undertaken by private sector firms and analyze how that affects innovation.

The remainder of the paper is organized as follows: Section 2 gives a view of literature and discusses our research questions and hypotheses in more detail. Section 3 introduces the data, along with some descriptive statistics and the empirical strategy applied to test our hypotheses. Section 4 presents the empirical findings and section 5 concludes the paper with some policy implications, limitations and steps for further research.

2. Literature review, research questions and hypotheses

In this section we develop our research questions and hypotheses on the relationship between works councils, training activities and innovation on the firm level. The hypotheses will be tested in our empirical analysis in the following sections.

2.1 Human capital and firm performance

Labor economists, since the last few decades, have extensively discussed various types of human capital investments in firms by considering components such as skill structure and education of workforce, training and apprenticeship, organizational learning and then related them to various economic variables such as employment growth, labor dynamics, earnings, profitability, economic growth, and innovation (Nelson and Phelps 1966; Acemoglu and Pischke 1996; Acemoglu 1997; Barrett and O'Connell 2001; Zwick 2003; Hatch and Dyer 2004; Blundell et al. 2005; Scicchitano 2010; Gallie and Legros 2011). Most of these studies have verified a positive relationship between investments in human capital on the one side and employment, productivity, economic growth and innovation on the other.

2.2 Labor market institutions and firm performance

There also is a growing literature on the impact of labor market institutions viz. works councils and collective bargaining agreements on productivity, innovative activities, personnel fluctuations and performance of firms (FitzRoy and Kraft 1990; Addison et al. 2001; Dilger 2003; Hübler and Jirjahn 2003; Frick and Möller 2003; Addison et al. 2004; Schank et al. 2004; Jirjahn and Smith 2006; Blume and Gerstlberger 2007; Allen and Funk 2008; Jirjahn 2010; Pfeifer et al. 2012). For our paper important is the labor market institution of work councils with relation to this specific literature.

The economic analysis of works councils had been first introduced by Freeman and Lazear (1995) in their seminal paper that examines the operation of works councils 'as a means of improving social output by creating more cooperative labor relations'. They argue that employee rights to consultation and co-determination in company decisions not only improve enterprise surplus but also social well-being. They further stress that this increased communication opportunity between the management and employees also urges the workers to put in greater effort in bad times that would not occur absent such institutions. Addison et al. (2001) empirically test the relationship between works councils and various performance measures in Germany and find that greater employee involvement is associated with higher worker productivity, reduced labor fluctuations, higher wages but lower firm profitability. However, they find no significant influence of works councils on the introduction of product or process innovation. Dilger (2003) verifies the findings of Addison et al. (2001) in terms of reduced labor fluctuations and lower establishment performance, and finds a statistically significant relationship between product innovation and presence of works councils, however only when interacted with the presence of a collective bargaining regime.

On the same line, Addison and Wagner (1997) as well as Schnabel and Wagner (1994) examine the effects of works councils on the introduction of new products and R&D expenditures and find a statistically significant effect only when interacted with union density. Hübler and Jirjahn (2003) investigate the interaction between establishment-level works councils and industry-level collective bargaining in Germany and find different results in terms of productivity and rent seeking activities for establishments covered both by works councils and collective bargaining compared to establishments within the uncovered industrial regime. Allen and Funk (2008) examine the role of works councils and collective bargaining arrangements in supporting radical, incremental and mimetic innovation in Germany. Their analysis delivers that works councils may help to promote all three forms of innovation, while sectoral collective agreements have a statistically significant and negative relationship with radical and incremental innovation, but no link with mimetic innovation. They also investigate the interaction between works councils and collective bargaining and find statistical significance only in case of radical innovation.

2.3 Work councils and human capital

The literature mentioned above certainly addresses the impact of works councils on firm performance and here even innovative activities. However, the very mechanisms by which this is accomplished have not been identified yet. What is so far discussed in the literature is that the workers' representation and the collective bargaining power lead to higher wages and therefore to more effort which in turn leads to higher firm performance measured among others in terms of innovations. This may be one channel, another one may work through the abilities and competencies of the employees and any measures that improve on these. Analyzing this dimension, for example Pfeifer et al. (2012) take into account the effects of

works councils on apprenticeship training in Germany and find that firms with works councils make significantly higher investments in training than firms without works councils. Consistent with prior literature, they also find that all works council effects are much more pronounced for firms covered by collective bargaining agreements. Addison (2005) reports evidence of significant interaction effects of high performance work practices and worker representation in Germany and the United States but no well-defined effect on firm productivity. The role of works councils in the link between continuous training activities and innovation has also been briefly touched upon in previous studies (e.g. Heblich et al. 2009).

However, above and beyond that, more remains to be understood about the relationship between presence of works councils and different forms of training firms undertake. Drawing on the distinction between general and specific human capital as proposed by Becker (1962), we consider two different types of training activities, namely generalized training aiming at upgrading general human capital in a firm and firm-specific technical training aiming at the improvement of specific human capital. On this basis we examine the role of works councils in different aspects of firm-sponsored training and knowledge management and we subsequently look at how that affects innovation.

2.4 Hypotheses

For investigating the above summarized relationships, we split our analysis into two steps: In the first step, we examine whether there is a significant difference in the formsof training establishments with works councils provide to their employees vis-à-vis establishments without works councils. In the next step, we examine the indirect role of works councils in stimulating innovative activities through provision of training in establishments. Based on these arguments, we formulate our four main hypotheses.

To start with the human capital investment dimension, generalized training can be considered to improve the human capital of all work forces within a firm as well as their general employability – not only in the concurrent firm but also elsewhere. As Becker (1962) has suggested, firms have a low incentive to invest into general forms of training just because capabilities and knowledge improved that way can be used elsewhere free of cost, an externality. Work councils as representatives of the total work force, however, should on the one hand have a sustained interest in this employability and therefore are expected to politically engage in favor of respective investments. On the other hand, firm-specific technical training is often meant to sustain human capital relevant for firm-specific competitiveness; not all of a firm's work force will experience this type of training but only those employees working in strategically high priority departments and management units.

Becker (1962) has shown that firms are willing to invest into this form of training, and from a competitive point of view, it should rank high in the firm's management agenda. However, we expect work councils to be less interested in it based on the arguments discussed above. The two following hypotheses reflect these considerations:

H1: Provision of generalized training is significantly and positively correlated with the presence of works councils.

H2: Provision of firm-specific technical training is not correlated with the presence of works councils.

The analysis of Becker (1962) not only indicates differences in firms' incentives to invest into the two forms of human capital training; it also allows to indirectly infer broad types of knowledge and competences a firm is willing and respectively not willing to invest in. We look into that from the point of view of how these training activities contribute to firm performance, and here we concentrate on innovation performance. Due to the resource-based (Barney 2001; Wernerfelt 1984) and capabilities-based views of the firm (Teece et. al 1997), the abilities to generate new ideas and to innovate are specific resources; these resources are considered to be characterized by value creating, rare, inimitable, and non-substitutable (VRIN).

In this sense, the specialized training activities could be considered to just address these competences and hence resources. A firm undertakes them deliberately in order to improve its knowledge base which is required to be successful in innovation. Generalized training, contrariwise, which Becker (1962) has considered being useful not only in the firm under investigation but also elsewhere, in this context should not be related to innovation performance. Since innovation is a rather broad concept and also includes ideas new to the firm and hence imitation, we suggest that generalized training may be helpful in improving the absorptive capacities of a firm allowing it to take up more easily new ideas and innovation generated elsewhere. In this sense, generalized training may contribute to the absorptive capacity a firm holds, and subsequently its innovation performance.

On this conceptual basis, we analyze the relationship between the different training activities and the types of innovations firms have successfully accomplished. For that we distinguish incremental from radical innovations. The former comprises also imitative innovation in the sense of innovations new/slightly improved to the firm being considered whereas in the latter case innovations are certainly new to the market and to the world. Looking on that through the lens of the two forms of training activities and the firms willingness to invest into these, one could expect on the one hand incremental innovation to be associated not only with firm-specific technical training but also with generalized training. On the other hand, since radical innovation necessitates a strong technical knowledge base of the employees, we expect it to be associated more with firm-specific technical training.

However, an important limitation related to the aforementioned arguments arises from the fact that while greater investment in human capital and employee training increases the likelihood of successful innovation, successful innovators are also more likely to invest in training activities. It is therefore important to account for the reverse-causality issue, in order to determine the exact relationship between training activities and innovation. Given this, we propose that the involvement of the works councils in the decision to and how (form, content,

intensity, time etc.) to run firms' human resource training programs is a point in case and therefore presents an interesting aspect to address the endogeneity issue. We suggest that works councils are more effective and interested in promoting generalized training and hence via this they are expected to be more related to incremental and imitative innovations.

However, since works councils are expected to be unrelated to the provision of firm-specific technical training, we expect them to be not related to radical innovations. On this basis we propose the following hypotheses relating training activities, innovations and use of work councils as an appropriate instrument:

H3a: Generalized training shows a significant and positive correlation with incremental innovation.

H3b: Generalized training shows no significant correlation with radical innovation.

H4a: Firm-specific technical training shows a significant and positive correlation with incremental innovation.

H4b: Firm-specific technical training shows a significant and positive correlation with radical innovation.

3 Data and empirical approach

3.1 Variables and descriptive statistics

For our investigation, data from a representative German establishment survey for private sector establishments has been employed. The data has been collected in personal interviews with the managers or CEO of the establishments and the overall response rate corresponds to around 6%, with a sample size of 356 establishments. The public sector has been excluded due to specific rules for employee participation and works councils. Our sample mostly consists of medium to large sized manufacturing and service establishments with more than fifty employees, for which the analysis of works council's role is more appropriate. The analysis comprises cross-sectional data for the year 2011 and includes questions on knowledge management, human resource practices in general and in particular training and education approaches for different employee groups and interactions between management and works councils for a period of three years (2008-2010).

Dependent variables

To investigate the topics mentioned above (knowledge management, human resource training practices), established scales are used, with very few exceptions. The unique nature of the questionnaire employed in this project is that, rather than providing only information just on training expenditures accrued by firms, it covers unique questions about forms and intensity of training and various aspects of knowledge management techniques provided by firms and therefore provides a more detailed description of these issues. For example, training variables corresponded to questions like (1) how frequently internal and external courses/seminars were provided in the last three years, (2) how frequently and to what degree training on production,

technical and IT-related topics (3) teamwork and communication, leadership and problem-solving skills were provided to employees, with and without managerial responsibility. The questions asked make it possible to distinguish between *firm-specific technical and generalized training* and to rank them on a scale of 0-6 with 0 being never provided and 6 being very frequently provided. In addition to that we also use a variable *total training* encompassing both types of training activities by simply adding up firm-specific technical training and generalized training.

Examples for firm-specific technical training are, for instance, training in machine-operations, technical instructions, new software solutions, and routines used when performing operational duties within the firm. However, contrary to the classic definition of general training used by Becker (1962) which corresponded to training in general computer knowledge and language courses, in our paper, generalized training refers to provision of sales workshops, leadership and managerial workshops, training for improving teamwork and communication, training on topics related to problem-solving skills and on topics that employees can freely choose from and not necessarily related to designated tasks; in this sense our operationalization relates more to Huselid's categorization of human resource management practices.

It should be noted here that, in our sample, almost all firms with and without works councils are found to invest both in firm-specific technical training and generalized training with varying degree. However, from the data descriptives it is evident that in establishments with works councils, the intensities for both types of investment and especially for investment in generalized training are much higher than in establishments without works councils. Further, we find that training with respect to production, task-related and IT-related topics is given mostly to regular employees, whereas training with respect to problem solving, analytical and managerial skills, and provision of leadership workshops corresponds mostly to the team/department leaders.

A measure for i*ncremental innovation* has been given by whether or not (binary 0-1) an establishment has introduced new or significantly improved products/services to the market during the entire period of analysis (2008-2010); for measuring *radical innovation* (binary 0-1), establishments have been asked whether there were products/services amongst the introductions that were completely new to the market at the point of introduction, again for the entire period of analysis.

Independent Variables

Regarding employee representation, we have a dummy for our key variable of interest, *works councils*, which takes the value 1 if an establishment has a works council and 0 otherwise.

In addition to this key variable, we take into account a range of controls on firm-level and industry-level characteristics which we consider relevant for innovation as well as for investment into employee training. A first set of controls relates to innovation activities in a

broad sense. Drawing on literature that finds a significant relationship between firm's size and the probability of conducting R&D (Cohen et. al 1987; Cohen and Klepper 1996), we use establishment size to control for the level of R&D activities. *Establishment size* is defined by the natural logarithm of the total number of employees. To additionally account for effects arising from being part of a larger firm, we count for that via *establishment type* as a binary variable taking the value 1 if an establishment is part of a multi-establishment firm and 0 otherwise.

Innovation performance may be influenced by a firm's internal remuneration schemes for improvements through employee idea/suggestion systems or continuous process improvement systems. The importance of incentive schemes is covered by the variable *remuneration bonus*, a categorical variable scaled on 0-7 with 0 being not advantageous for innovation and 7 being very advantageous for employee creativity, productivity and subsequently on innovativeness. Of special importance for innovation activities is the presence of external linkages, following which we include a categorical variable ranging from 0-7 denoting the *importance of introduction of new forms of external relationships* in the form of alliances, cooperation or customer relationship management with 0 being not at all important and 7 being highly important. To account for industry differences in innovation activities we use sector dummies corresponding to *manufacturing*, *services*, and *transport and ICT* industry classes.

A second set of controls relates to firm respectively establishment level human capital and factors conditioning investment into training. We expect that skill and education structure of the employees is a major determinant of training intensity in firms, following which we control for the *percentage of employees having university degrees or higher* and the *percentage of employees having an advanced industrial title* like "Meister" or "Techniker". It is also likely that a higher share of apprentices and trainees in the total labor workforce is related to a higher intensity and likelihood of training; hence we also control for the *share of apprentices* in establishments. We also consider the presence of a *collective labor agreement* in establishments, also known as a general tariff agreement, between the management and the works councils which has been found to "lead to a compressed wage structure encouraging employers to invest more in human capital as they have to share returns only partially with trained employees" (Stegmaier 2010). We propose that such union contracts should potentially strengthen the role of works councils, following which we include a dummy variable taking the value 1 for presence of a collective labor agreement and 0 otherwise. For an overview of the variables used, see **Table A in Appendix**.

Table 1 presents the mean values of all dependent and independent variables used in our regression models and delivers a comparative analysis between establishments with and without a works council foundation (WC).For the differences in the mean values in these variables between establishments with and without WC we check for statistical significance.

For all dummy variables, Pr-tests have been used to test the equality of proportions. For all other variables, two-sample t-tests have been used.

Table 1: Descriptive statistics

Variable	Means for firms with WC	Means for firms without WC	p-value	Method
Firm specific technical training	4.270	3.764	.001**	t-test
Generalized training	3.240	2.393	.000**	t-test
Total training	3.981	3.360	.000**	t-test
Innovation	.779	.607	.001**	Pr-test
Radical innovation	.479	.303	.004**	Pr-test
Size (log of employees)	5.603	4.571	.000**	t-test
Establishment status	.8052	.449	.000**	Pr-test
Manufacturing sector	.6329	.472	.007**	Pr-test
Service sector	.228	.438	.000**	Pr-test
Transport and ICT	.139	.0899	.231	Pr-test
Remuneration bonus	4.629	3.213	.000**	t-test
External relationships	3.745	3.371	.183	t-test
Share of employees with university degree	16.039	16.775	.757	t-test
Share of employees with industrial title	13.369	11.315	.097	t-test
Share of apprentices	.0452	.048	.647	t-test
Collective labor agreement	.648	.191	.000**	Pr-test
Number of firms	**267**	**89**	**Total**	**356**

Firms with a works council versus firms without a works council

Method: Two-sample mean tests, *p <.05, **p<.1

Table 1 delivers first that from all 356 observations only 89 (or 25%) have not established a work council. As to our control variables used, we find the following differences between firms with and without works council. First, works councils, on average, are established more in larger firms (*size*) and firms which are part of a multi-establishment (*establishment status*). Firms in the *manufacturing* and *service sectors* are relatively more sensitive to the presence or absence of works councils than firms in other sectors, with service-sector firms being less likely to have works councils. Significant mean differences are found with respect to the provision of a *remuneration bonus* to employees which are significantly more important for firms with works councils. No significant differences are found with respect *external relationships*. Considering the human capital structure of firms via *share of employees with university degree*, *share of employees with industrial title* and *share of apprentices,* there are no significant differences between firms with and without

works council. Finally, *collective labor agreements* are more frequent in establishments with works councils than without.

The most interesting results are obtained from our key variables, training and innovation. According to the t-test results, establishments with works councils tend to invest more in training, *generalized* as well as *firm-specific technical*. This finding is consistent with the theoretical relationship between training activities and presence of works councils and allows for further investigation into the role of works councils in the provision of different formsof training, which is the main focus of this paper. We also observe highly significant mean differences between incremental innovation and radical innovation between firms with and without works councils.

From further data descriptives (not presented here), we have also found that the presence of works councils is often associated with an open exchange of information and knowledge sharing between management and employees. However, we do not know how the long-term learning process of the employees is influenced, if at all, by the works councils; which can be an avenue for further research. In the majority of the firms, accounting to almost 90%, the works councils are actively involved in the regular working of the firms as well as in the development and introduction of technological or organizational innovative projects. So, although innovation projects are very rarely initiated by works councils, consultation and co-determination activities are quite common in the majority of firms. We have also seen that not only changes in training programs related to work procedures and processes within the establishment have to be confirmed with the works council, but co-design of process innovation also constitutes a major business of the works councils.[1]

3.2 Econometric methodology

For our first two hypotheses, we argue here that given the intrinsic motivation of firms to provide path-dependent firm-specific technical training to their employees, there might not be a significant difference between establishments with and without works councils regarding the provision of technical task-related training. This is because not pursuing training that draws in specific competencies and specific competitiveness is detrimental for the firm itself and therefore is generally always provided to the regular employees without any intervention from worker unions. However, it is also equally important to provide generalized training to employees that allows for their systematic career and personal development. We propose that this is where the role of works councils lies and therefore we expect that presence of works

[1]One reason for this might be due to the fact that process innovation is usually labor-saving, and therefore works councils whose one of the major roles is to protect workers' job security, are particularly more interested in monitoring process innovation.

councils should have a positive and significant correlation with the provision of generalized training and not with the provision of firm-specific technical training.

In order to test this, we use bivariate ordered probit regressions (bioprobit) for the categorical dependent variable training, analyzing simultaneously for firm-specific technical training and generalized training. We do not consider training investments for a single period; rather we focus on the intensity of training activities conducted during the years 2008-2010. It should be mentioned here that the choice of the bivariate ordered probit model, for examining the provision of different firms of training and the role of works councils therein stems from the fact that the two categories of training are quite correlated (correlation of 0.39,see **Table B in Appendix**). This might imply that, in establishments, the decision of implementing one form of training is correlated with the decision of implementing the other form, and therefore running two separate regressions independently would bias our results. In order to account for this correlatedness issue between training forms, we run a bivariate probit estimation.

To test the final two hypotheses, we first start by using simple logit regressions for the binary dependent variable innovation and radical innovation. For this, we do not take into account any reverse-causality or a potential omitted variable bias in the model and simply test for the direct effect of training on innovativeness. However, in order to capture the unbiased effect of training on innovation, in the next step, we employ instrumental variable estimation where we use works councils as an instrument for training. This again we investigate in two steps. First, we follow the literature on the complementarity of human resource management practices (Huselid 1995; Ichniowski et al. 1997; Baron and Kreps 1999) and analyze the effectiveness of the training practices, without differentiating between firm-specific technical and generalized, in innovation. For this, we construct an overall-training index by simply taking the average of the prior-mentioned training variables and use works councils as an instrument for this overall index.

In the next step, we examine how individual practices affect incremental and radical innovation, and therefore use works councils as an instrument only for generalized training. In both cases, we expect a strong 'instrumented' effect of overall-training and individual training on firm innovativeness. It is important to note here that we do not use works councils as an instrument for firm-specific technical training given our proposition that works councils are not related with the provision of firm-specific technical training, and suggest other measures that can be taken as possible instruments. We also replicate the analysis with regard to radical innovation, i.e. whether or not a firm has introduced a completely new product or service to the market.

4 Empirical findings

4.1 Training forms and the presence of works councils

The objective of the first part of the empirical analysis is to build upon the Beckerian theory of underinvestment in general human capital (Becker, 1962) and to identify the role of works

councils in encouraging higher provision of generalized training (defined as training for improving competency, communication, leadership and problem-solving skills)vis-à-vis firm-specific technical training for the regular employees. **Table 2** summarizes the findings from the bivariate ordered estimation.

Table 2: Estimation results on training forms

Dependent variable: Generalized Training			
Independent variables	Model 1(base)	Model 2	Model 3
Size (Log of employees)	.245***	.225***	.194***
	(.057)	(.061)	(.062)
Establishment status	.353***	.339***	.274**
	(.128)	(.1300)	(.133)
Manufacturing sector	-.007	-.0103	-.022
	(.171)	(.171)	(.171)
Service sector	.233	.247	.284
	(.188)	(.189)	(.190)
Share of employees with university education		.001	.001
		(.003)	(.003)
Share of high-skilled employees		.007	.006
		(.006)	(.006)
Share of apprentices		2.482**	2.594**
		(1.202)	(1.204)
Collective labor agreement		.115	.031
		(.125)	(.130)
Presence of Works councils			**.355****
			(.151)
Dependent variable: Firm-specific Technical Training			
Independent variables	Model 1 (base)	Model 2	Model 3
Size (Log of employees)	.138**	.139**	.121*
	(.057)	(.061)	(.063)
Establishment status	.175	.161	.123
	(.129)	(.131)	(.135)
Manufacturing sector	.220	.218	.213
	(.173)	(.174)	(.174)
Service sector	-.043	-.050	-.031
	(.190)	(.191)	(.192)
Share of employees with university education		.005	.005
		(.003)	(.003)
Share of high-skilled employees		.004	.004
		(.006)	(.006)
Share of apprentices		2.927**	2.983**
		(1.227)	(1.229)
Collective labor agreement		-.001	-.047
		(.126)	(.131)
Presence of Works councils			**.193**
			(.153)
Athrho	.428***	.417***	.411***
Constant	(.058)	(.058)	(.058)
Wald Chi2	35.24***	41.95***	47.35***
N	356	356	356
LR test of independent eq.:	chi2(1) = 53.33***	chi2(1) = 50.47***	chi2(1) = 49.05***

Bivariate Ordered Probit estimation for training-types and presence of works councils

Standard errors in parentheses; *p <.1; **p<.05; ***p<.01

As to the control variables, the estimation results confirm establishment size to be positively related both to generalized training and firm-specific technical training, implying that larger establishments, on average, tend to invest more in employee training. However, the

effect is stronger for generalized training than for firm-specific technical training. Furthermore, establishment status tends to play a significant role in the provision of generalized training suggesting that establishments belonging to a group or trust or are part of a multi-establishment are more likely to invest in generalized training of their employees.

However, no significant effect of establishment status is found with respect to firm-specific technical training. The coefficients of the industry dummies are neither significant for generalized nor for firm-specific technical training. As to the educational status of establishments only the share of apprentices in the total workforce is found to be significantly and positively correlated with both forms of training. Intuitively, this finding suggests that a higher share of apprentices in the workforce is related to a higher probability that firms invest in apprenticeship training which can be of both generalized and firm-specific technical nature. Finally, collective labor agreements are also not related to both training activities.

With regard to our main variable of interest, works councils, the bivariate results show that presence of works councils is not correlated with the provision of firm-specific technical training; but strongly and positively correlated with the provision of generalized training (significant at 5%). Also, we can see from the coefficient values that presence of works councils increases more the probability of providing generalized training (a coefficient of 0.355) than firm-specific technical training (coefficient value of 0.193). These two findings confirm our hypotheses H1 and H2 that a works council foundation, on average, is related more to the provision of generalized training because it is often found to be highly underinvested as compared to firm-specific technical training. This result points towards a policy implication that an effective way of encouraging the provision of generalized training might be through the establishment of works councils. Interestingly and contrary to previous findings (Pfeifer et al. 2012), we do not find any correlation of the strength of works councils, given by an interaction term for presence of works councils together with a .collective labor agreement in the establishment, with the provision of generalized training. These results have not been included in the final estimation table.

4.2 Training forms and innovation performance

Following our procedure outlined in section 3.2, we start by examining the direct relationship between training forms and variables of incremental and radical innovation as suggested by hypotheses 3 and 4. As the main independent variables of interest we use generalized training, firm-specific technical training and total training and other relevant firm-specific and industry-specific control variables. **Table 3 and 4** below present the findings from the simple logit regressions.

Table 3 shows the results on incremental innovation. Model 1 represents the base model which includes only the innovation related control variables viz. establishment size, sectors, remuneration bonus and external relationships. Model 2 includes additionally the human capital related controls while the subsequent models include all further explanatory

variables, along with the controls. Models3 to 5 report the final estimation specifications for the relationship between innovativeness and firm-sponsored training, with and without distinguishing between the training forms respectively. As to the controls, throughout all five models we first do not find any significant correlation between establishment size and innovation, which might add to the ongoing debate on whether large firms have a higher probability of coming up with an innovation than smaller firms. Another reason could be the fact that establishment size and training forms have been found to be highly correlated (correlation of 0.25 and 0.19), and therefore inclusion of both variables in the estimation might reduce the predictability of individual estimators.

Table 3: Logit estimation on incremental innovation

Dependent variable: Incremental innovation					
Independent variables	Model 1(base)	Model 2	Model 3	Model 4	Model 5
Size (Log of employees)	.034 (.137)	.0443 (.146)	-.027 (.151)	-.039 (.153)	-.054 (.154)
Manufacturing sector	1.442*** (.362)	1.466*** (.371)	1.613*** (.384)	1.554*** (.389)	1.612*** (.389)
Service sector	.354 (.378)	.369 (.386)	.339 (.395)	.392 (.403)	.421 (.404)
Remuneration bonus	.115** (.053)	.125** (.054)	.0998* (.056)	.080 (.057)	.086 (.057)
External relationships	.121** (.056)	.094* (.057)	.0792 (.058)	.064 (.060)	.064 (.060)
Share of employees having university education		.009 (.007)	.008 (.007)	.006 (.007)	.007 (.007)
Share of employees having industrial degree		.0251* (.0141)	.025* (.015)	.025* (.0147)	.026* (.0148)
Share of apprentices		5.299* (3.145)	4.355 (3.109)	4.124 (3.153)	4.236 (3.152)
Collective labor agreement		-.098 (.295)	-.216 (.304)	-.208 (.308)	-.201 (.308)
General Training			.297*** (.094)	.210** (.101)	-
Firm-specific technical training				.293*** (.109)	-
Total training					.513*** (.121)
Constant	-.893 (.789)	-1.533* (.832)	-1.804** (.850)	-2.484*** (.903)	2.599*** (.903)
LR chi2	44.35***	54.00***	64.27***	71.69***	73.52***
Pseudo R2	.1079	.1314	.1564	.1744	.1789
N	356	356	356	356	356

Logit estimation for incremental innovation and training-types

Standard errors in parentheses; *p <.1; **p<.05; ***p<.01

As expected, we find a positive and significant correlation between manufacturing sector and innovativeness, implying that firms belonging to the manufacturing industry, on average, innovate more than firms belonging to other sectors (services or ICT). The provision of incentive schemes (*remuneration bonus*) for employees in establishments shows a weakly significant correlation to innovativeness only when firm-specific technical training activities are not included (Models 1to 3) suggesting that firms with remuneration schemes also provide

firm-specific technical training. As to *external relationships*, in Models 1 and 2 the coefficient is significant and shows the expected sign (in the sense that external relationships are found to be significantly important for innovation) but loses explanatory power when firm human capital (*share of employees having industrial degree*) is introduced in Model 2 and then the training variables in Models 3 to 5.With regard to further controls, from Model 2 onward we find no significant coefficient for share of employees having university education; contrariwise, for employees with an industrial degree or higher one unit change in that variable significantly increases the mean probability of innovation by 0.025. The variable *share of apprentices* shows a positively significant coefficient in Model 2 but loses explanatory power when the training variables are included in Models 3-5; hence, firms' investment into training activities and having apprentices go hand in hand. Contrary to previous findings, we do not find any significant effect of presence of a general tariff agreement on firm innovativeness.

Table 4: Logit estimation on radical innovation

Dependent variable: Radical innovation					
Independent variables	Model 1(base)	Model 2	Model 3	Model 4	Model 5
Size (Log of employees)	.3274*** (.116)	.271** (.127)	.205 (.130)	.205 (.131)	.199 (.131)
Manufacturing sector	1.052*** (.372)	1.077*** (.377)	1.158*** (.382)	1.133*** (.386)	1.159*** (.385)
Service sector	.389 (.412)	.359 (.418)	.318 (.420)	.366 (.425)	.384 (.424)
Remuneration bonus	.070 (.050)	.080 (.051)	.062 (.052)	.047 (.053)	.051 (.052)
External relationships	.091* (.052)	.074 (.053)	.059 (.054)	.050 (.054)	.051 (.054)
Share of employees with university education		.010* (.006)	.010 (.006)	.009 (.006)	.009 (.006)
Share of employees with industrial degree		.009 (.011)	.008 (.012)	.008 (.012)	.007 (.012)
Share of apprentices		3.371 (2.502)	2.838 (2.526)	2.482 (2.553)	2.602 (2.547)
Collective labor agreement		-.037 (.259)	-.073 (.262)	-.068 (.264)	-.062 (.263)
General- Training			.225*** (.082)	.167* (.086)	-
Firm-specific technical training				.223** (.106)	-
Total training					.382*** (.110)
Constant	-3.121*** (.722)	-3.522*** (.764)	-3.695*** (.772)	-4.315*** (.846)	-4.379*** (.827)
LR chi2	35.94***	41.73***	49.65***	54.21***	54.77***
Pseudo R2	.0737	.0856	.1018	.1112	.1123
N	356	356	356	356	356

Logit estimation for radical innovation and training-types

Standard errors in parentheses; *p <.1; **p<.05; ***p<.01

As to the training variables, the findings from Model 4 confirm the importance of both forms of training on an establishment's innovativeness, although suggesting that for every one unit change in the provision of firm-specific technical training, the log odds of introducing an innovation in the market increases by 0.293 while for that of generalized training, it increases slightly lower by 0.21. When we instead use the total training index in Model 5, we find that for every one unit change in the provision of overall training, the log odds of introducing an innovation in the market significantly increases by 0.51. These findings are in line with our hypotheses 3a and 4a.

Conducting logit analyses with respect to radical instead to incremental innovativeness and employee training yield rather similar results with respect to the core variables. In **table 4**, the control variables show in nearly all cases except manufacturing no explanatory power. In Model 4 we find a strong positive correlation between firm-specific technical training and radical innovation, and weak correlation with respect to generalized training – compared to incremental innovations the magnitude of the correlation as well as level of significance are lower. Finally, when we include the total training index in Model 5, we find that for every one unit change in the provision of overall training, the log odds of introducing a radical innovation in the market significantly increases by 0.38 which again is quite lower than in the case of incremental innovation. This can be interpreted in terms of a lower likelihood being successful with a radical innovation and hence in terms of the higher degree of uncertainty involved. These findings confirm hypothesis 4b but are not in line with hypothesis 3b.

While the results from the logit regressions definitely throw some light at the relationship between training types and innovative activities in firms, it is essential to account for the fact that firms with newer innovative technologies might invest more in employee training than firms who do not innovate. In order to account for this reverse-causality problem or omitted variable bias, we next apply IV methods to examine the unbiased effect of training-types on a firm's innovative propensity (Hypothesis 3 and Hypothesis 4). As outlined in section 3.2, we first analyze the effectiveness of total training practices, without differentiating between firm-specific technical and generalized, and use works councils as an instrument. However, given our interest in understanding the composition of human capital training investments in establishments and firms, we then examine if individual practices on average have significantly different impact on innovativeness. For this, we use the results from the first two hypotheses and conduct IV estimation by using works councils as in instrument for generalized training. In this regard, a cause for concern is that one might include firm-specific technical training as an explanatory variable in the model, since it might also have an influence on firm innovativeness. However firm-specific technical training might still suffer from a reverse-causality problem. One way to deal with this would be to use a relevant instrument for firm-specific technical training and run IV estimation with two independent instruments. It would also be then possible to examine the individual effect of technical training practices on innovation. But, in the absence of a relevant instrument for

firm-specific technical training, we specify an alternate IV specification where we consider only generalized training instrumented by works councils and include firm-specific technical training just as an explanatory variable. Finally, we run a similar analysis for investigating radical innovation by establishments and the role of firm-sponsored training therein. All estimation findings are presented in table 5 with Models 1 and2 related to incremental innovation and Models 3 and 4 to radical innovation.

Given the fact that larger establishments are more likely to have a works council foundation, we do not include establishment size as a separate explanatory variable in the IV estimation. As anticipated, in all four models we find that establishments belonging to the manufacturing sector, on average, are more likely to come up with innovations as compared to establishments belonging to other industries.

Table 5: Instrumental variable estimation on innovation

Dependent variable:	**Incremental innovation**		**Radical innovation**	
Independent variables	Model 1	Model 2	Model 3	Model 4
Manufacturing sector	.297*** (.080)	.333*** (.087)	.259*** (.085)	.289*** (.093)
Service sector	.107 (.088)	.053 (.087)	.078 (.094)	.032 (.093)
Remuneration bonus	-.009 (.020)	.001 (.014)	-.006 (.021)	.003 (.015)
External relationships	-.006 (.016)	.004 (.013)	-.003 (.017)	.005 (.013)
Share of employees with university education	-1.49E-06 (.002)	.001 (.001)	.001 (.002)	.002 (.001)
Share of employees with industrial degree	.001 (.003)	.002 (.003)	.001 (.003)	.0004 (.003)
Share of apprentices	.12 (.684)	.344 (.600)	.05 (.730)	.24 (.638)
Collective labor agreement	-.087 (.064)	-.106 (.072)	-.021 (.068)	-.038 (.077)
Total Training	.320** (.157)		.274 (.167)	
Generalized training		.217* (.122)		.186 (.131)
Firm-specific technical training		-.0211 (.054)		-.017 (.057)
Constant	-.612 (.445)	-.058 (.136)	-.766 (.475)	-.294 (.145)
Wald Chi2 N	49.30*** 356	60.65*** 356	35.94*** 356	43.94*** 356

IV estimation for training practices and innovation; instrument: works councils

Standard errors in parentheses; *p <.1; **p<.05; ***p<.01

However, we do not find any significant correlation for the other controls. Analyzing our main variable of interest, we find that the effect of total training on incremental innovation is highly significant with a coefficient value of 0.32. This finding confirms that firm-sponsored training has a significant impact on firm innovativeness and therefore works councils might

be used as a tool for providing training in establishments and firms. However, when we disentangle the total training index and use works councils as an instrument only for generalized training, we find a weakly significant coefficient of 0.217 with regard to incremental innovation. This is in-line with hypothesis 3a that works councils allow for higher investment in generalized training for employees, even in the presence of positive externalities and spillover risks and therefore clarifies to some extent the existing debate regarding underinvestment of generalized training by firms. These findings also highlight the role of such an employee representation system not only as a measure for promoting generalized training for employees but also in innovation.

Unlike in the simple logit regression, in Model 3 of table 5 we do not find any significant correlation between total training activities and generalized training respectively in establishments and their propensity to introduce radical innovations when we use works councils as an instrument. This is in line with our hypothesis 3b.As to firm-specific technical training and incremental and radical innovation, we find no significant correlation and hence no support of hypotheses 4a and 4b. The reason, as already pointed out earlier, might be the absence of an appropriate instrument for firm-specific technical training, which provides avenue for further research.

5 Conclusion and Future Research

The goal of the paper is to examine the nexus between training activities and innovation in firms by investigating the role of employee representation system like works councils therein. In doing so, we use establishment data on various aspects of human-resource training practices and innovation activities in Germany and examine the degree, form and extents to and with which establishments respectively firms invest in employee training and how that is related to innovation. We first find support for our hypotheses that indeed provision of generalized training is significantly and positively correlated with the presence of works councils, while no such relation exists with respect to the provision of firm-specific technical training. For the second part of our analysis with regard to innovativeness, we use instrumental variable estimation and find strong support for using works councils as an instrument for total training activities, and weak support when we consider only generalized training. However, our results do not confirm any significant correlation between firm-specific training activities and radical innovativeness in establishments.

The study highlights the importance of employee representation systems, namely works councils in Germany, in the provision of basic general training for skill formation in employees, and therefore has important policy implications.

First, from a worker union perspective our finding regarding the positive interaction between the existence of a works council in a firm or establishment and its general training activities points to a long-term benefit of union support for the single employee which is not restricted to a labor contract with one single firm. Even if the single employee needs to find a

new employer, she or he can benefit from individual human capital development supported by her or his former works council and the supporting union or unions. In other words: the support of firms' or establishments' works councils in their activities regarding general training activities can be an instrument to strengthen the loyalty of individual members with their specific union.

Second, from a more general local, regional or even national policy perspective, the intensified involvement of firms' works councils and the supporting unions in vocational training programs beyond the firm level is supported by one important finding of our study. For example from recent literature on local, regional and national innovation systems we know that the further development of general training programs is an important driver for improving the performance of innovation systems on various geographic levels (for example, Cooke and Morgan 2004, Tödtling and Trippl 2005). One example for how this can be done in practice was the implementation of coordinated regional, local and firm-specific general training programs in collective bargaining agreements for several German regions and industries between unions and employer associations starting in the mid-1990s (Bahnmüller and Fischbach 2004).

Although the cross-sectional findings that we have so far in our study do not allow us to examine the long-term dynamics of the relationship between different aspects of firm-sponsored training and innovation, this might be the first step towards identifying the role of employee representation systems in firm performance through investment in internal human capital. Therefore a possible extension would be to incorporate a longer time frame in order to examine the causal relationship between human capital composition and innovation and also consider other firm characteristics and performance indicators (e.g. sales, labor turnover, employee value added etc.).

Another possible extension of the IV analysis might be to employ a non-parametric bounds approach on treatment effects for firm-sponsored training using works council and credit-constrainedness as monotone instrumental variables used by Manski and Pepper 2000) where, unlike in IV estimation, where the mean response is constant across subpopulations, one assumes that mean response varies weakly monotonically across subpopulations in the sample. Finally, the analysis could be replicated using richer data on share of part-time or fixed-term workers, gender structure of workforce, staff and wage structure of employees, detailed information on physical capital investments, R&D expenditure related to new product and services development, or by using a relevant instrument for firm-specific technical training like credit-constrainedness.

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APPENDIX

Table A: Descriptive statistics of all variables (N= 356)

Variable	Type	Measurement	Mean	Std. Dev
Establishment size	Continuous	Natural logarithm of the total number of employees	5.345	1.059
Establishment status	Binary	= 1 if establishment part of a multi-establishment firm; 0 otherwise	.716	.451
Manufacturing sector	Dummy	Sector dummies, ICT industry classes	.593	.492
Service sector	Dummy	Sector dummies, ICT industry classes	.281	.450
Transport and ICT	Dummy	Sector dummies, ICT industry classes	.126	.333
Share of employees with university degree	Continuous	Percentage of employees having university degrees or higher in total workforce	16.223	19.410
Share of employees with industrial title	Continuous	Percentage of employees having advanced industrial title (e.g. “Meister”, “Techniker)	12.855	10.120
Share of apprentices	Continuous	Share of apprentices and trainees in total labor workforce	.0459	.0461
Collective labor agreement	Binary	=1 if establishment has general tariff agreement between management and works councils; 0= otherwise	.534	.499
External relationships	Ordinal	Scale: 0-7 with 0= no importance of introduction of new forms of external relationships in innovation and 7= high importance	3.652	2.294
Remuneration bonus	Ordinal	Scale: 0-7 with 0= incentive schemes not advantageous for innovation and 7= very advantageous	4.275	2.512
Works councils	Dummy	=1 if establishment has works council; 0= otherwise	.75	.434
Firm-specific technical training	Ordinal	Scale: 0-6 with 0=never provided and 6= very frequently provided	4.143	1.328
Generalized training	Ordinal	Scale: 0-6 with 0=never provided and 6= very frequently provided	3.028	1.542
Total training	Ordinal	Average of firm-specific technical training and generalized training, and then recoded on scale 0-6	3.826	1.216
Innovation	Binary	1= if establishment introduced new or significantly improved products/services to the market during (2008-2010); 0= otherwise	.736	.441
Radical innovation	Binary	1= if products/services were amongst the introductions that were completely new to the market at the point of introduction during (2008-2010); 0= otherwise	.435	.496

Table B: Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Establishment size	1															
2. Establishment type	.2929*	1														
3. Manufacturing	.1940*	-.0271	1													
4. Services	-.2425*	-.0642	-.7539*	1												
5. Transport and ICT	.0412	.1269*	-.4589*	-.2377*	1											
6. University education	.0017	.1136*	-.1536*	.1628*	.007	1										
7. Industrial title	.0662	.081	.0432	-.0451	-.0029	.1370*	1									
8. Share of apprentices	.005	-.0473	.0955	-.0974	-.0094	-.097	.068	1								
9. General tariff agreement	.3777*	.2111*	-.007	-.0422	.0675	-.2364*	-.0156	-.0117	1							
10. Works councils	.4252*	.3418*	.1419*	-.2021*	.0634	-.0165	.088	-.0243	.3966*	1						
11. External relationships	.1224*	.0947	.1485*	-.1259*	-.0492	.0431	.0765	.1485*	.057	.0708	1					
12. Remuneration bonus	.3139*	.1758*	.1981*	-.1682*	-.0653	-.0782	.0566	.0127	.1901*	.2443*	.2586*	1				
13. Generalized training	.2507*	.2098*	-.0406	.0292	.0205	.041	.0936	.0907	.1634*	.2381*	.1668*	.2234*	1			
14. Technical training	.1880*	.1150*	.1629*	-.1524*	-.0347	.0661	.0835	.1192*	.05	.1651*	.2227*	.2618*	**.3917***	1		
15. Total training	.2586*	.1817*	.0647	-.075	.0058	.0501	.1039	.1131*	.1209*	.2216*	.2194*	.2664*	.8349*	.7970*	1	
16. Innovation	.1011	.1743*	.2946*	-.1928*	-.1748*	.0404	.1319*	.1316*	-.0106	.1692*	.1843*	.2054*	.1972*	.2954*	.2971*	1
17. Radical innovation	.1961*	.1379*	.2321*	-.1581*	-.1294*	.0607	.0856	.0915	.0372	.1537*	.1558*	.1769*	.2011*	.2384*	.2612*	**.5260***

Mean VIF= 1.48(Maximum VIF= 2.59 for manufacturing)

Correlation matrix: Correlations greater than or equal to .12 (in absolute terms) are significant ($p< .05$)