Regional Determinants of Employer-Provided Further Training

By Lutz Bellmann, Christian Hohendanner, and Reinhard Hujer

Abstract

We analyze the influence of regional determinants on the decision of employers to provide within-firm further training. We estimate the effects of the regional population density, the unemployment rate and the regional concentration of an industry against the background of several determinants of further training at establishment level. To account for the clustered and longitudinal structure of our data – with annual observations of firms and firms nested within regions – we apply multi-level random effects logit models. Our empirical analysis is based on the IAB-Establishment Panel Survey 2001 to 2007. As we do not find evidence for a correlation between most of our regional determinants, employer provided firm training can be explained first and foremost by firm determinants. Nevertheless, we identify a negative association between the regional unemployment rate and employer-provided further training in West Germany.

Zusammenfassung

Wir untersuchen den Einfluss von regionalen Einflussfaktoren auf die betriebliche Entscheidung, innerbetriebliche Weiterbildung anzubieten. Wir ermitteln die Effekte der regionalen Bevölkerungsdichte, der Arbeitslosenquote und der regionalen Konzentration eines Wirtschaftszweiges vor dem Hintergrund verschiedener Determinanten der Weiterbildung auf der Betriebsebene. Um der Längsschnitts- und der Clusterstruktur unserer Daten Rechnung zu tragen, verwenden wir Mehrebenen-Random-Effects Logit-Modelle. Damit berücksichtigen wir, dass die Betriebe jährlich beobachtet werden und verschiedene Betriebe sich in derselben Region befinden. Unsere empirische Analyse beruht auf den Daten des IAB-Betriebspanels 2001 bis 2007. Da wir keine Evidenz für Korrelationen zwischen den meisten unserer regionalen Einflussfaktoren finden, erklären wir das betriebliche Weiterbildungsangebot in erster Linie und hauptsächlich durch betriebliche Determinanten. Nichtsdestoweniger identifizieren wir für Westdeutschland eine negative Korrelation zwischen der regionalen Arbeitslosenquote und dem betrieblichen Weiterbildungsangebot.

1. Introduction

In the light of the Lisbon strategy, which aims at making Europe the most competitive and productive region of the world, the number of establishments financing a further training course or releasing employees for participation in training measures is of particular interest because of the productivity gains associated with the formation of human capital (Bassanini et al., 2009).

In regions with a relatively high unemployment rate, the participation of firms in further training seems to be lower due to the availability of qualified workers leading the establishments to increase their hiring standards (Anger, 2007; Büttner et al., 2010). However, qualified workers might seek an employment opportunity elsewhere, if the regional unemployment rate is relatively high. Employers could offer them additional further training as a signal that they want to keep them. With regard to the regional population density, the positive effect of the physical proximity of employees and firms is reduced by the negative effects caused by higher wages, more turnover and also more poaching. Thus the effect of regional population density remains unclear from a theoretical point of view.

In this paper, we assess the effect of the regional population density, the unemployment rate and the regional concentration of industry against the background of several determinants of further training at establishment level. Previous studies include Brunello/De Paola (2008) and Brunello/Gambarotto (2007) for Italy and the U.K. These studies find a negative correlation between economically denser regions and further training. However, the institutional background and the proportion of establishments financing a further training course or releasing employees for participation in measure are quite different in Germany (Brunello/De Paola, 2008, 128). The only study for Germany by Bellmann/Leber (2005) finds a positive correlation between population density and further training. The study is based on an analysis of the IAB-Establishment Panel 2001 and 2003. In our study, we use the same data and extend the observation period from 2001 to 2007.

Although more than 20 years have elapsed since the reunification, we apply separate regressions to East and West Germany. This is necessary due to persisting observed and unobserved structural differences in firm size, industries, employment as well as employer-provided further training (Stegmaier/Gerner, 2010; Bechmann et al., 2010).

From a methodological point of view, multi-level approaches are adequate allowing the separation of the effects at establishment and at regional level. To our best knowledge, there is no earlier study in which a multi-level and panel econometric approach is used to investigate the regional effects on employer-provided further training. Since the number of establishments interviewed in our survey is well above 15,000 each year, the regional variation within approximately 150 labour market regions is quite large.

The paper is organized as follows: In Section 2, we discuss the hypotheses and related research studies, especially the previous empirical analyses pertaining to the regional unemployment and population density on employer-provided further training. In Section 3, we specify the econometric model and describe the data basis. Section 4 presents the empirical results and section 5 contains a summary and research perspective.

2. Theoretical Approach and Related Research Studies

As a starting point to explain establishment-level training activities, it is useful to refer to the human capital theory (Becker, 1964). A decisive element of this theoretical approach is the distinction between specific and general human capital. The employer and his employees share both the costs and returns of specific training. However, in the case of complete competition it is not worthwhile for firms to invest in general or transferable human capital because they have no guarantee that employees who have received general training will remain in the firm once they have completed their training. If the trainees leave, the firm can no longer benefit from the increase in productivity as a result of training and only bears its costs. Thus, investment in general human capital is only worthwhile for firms if the trainees are paid wages after completion of their training which are lower than their productivity, and therefore a margin can be realized.

The new training literature discusses several reasons for this type of remuneration leading to a compressed wage structure in which, as skills increase, wages grow less quickly than productivity (Acemoglu/Pischke, 1998, 1999a, 1999b; Bassanini et al., 2009). In contrast to the human capital theory, Acemoglu/Pischke discuss the case that because of the existence of mobility costs the individual's elasticity of labour supply with respect to an outside wage offer is less than infinity. Costs can be avoided as a result of lower staff turnover and trainees remaining in the firm for a relatively long period of time – with the additional advantage of saving screening costs (Franz/Soskice, 1995). Therefore, the establishment's location is of importance, because the mobility costs and poaching differ according to the regional population density. The denser a region in which the establishment is located, the higher is the probability that a trained employee leaves the training firm: "In Silicon Valley, a trained employee can just walk down the street and pick up a new and better-paid job. If competitors are located far away, however, it takes a long walk to locate a better job, and some workers may be discouraged by the expected mobility costs." (Brunello/Gambarotto, 2007, 2). Consequently, employers will be reluctant to invest in further training if the risk is high that the employee leaves the firm after finishing the training. Assuming lower mobility costs for employees in denser regions, the willingness of employers to finance further training decreases the denser the establishments' location is. However, the argument holds only if the sector and occupation structure of the different establishments in a region are similar.

In contrast, a denser local labour market can also increase the establishment's benefits associated with further training and the incentive to finance these activities. According to Brunello/Gambarotto (2007) and Brunello/De Paola (2008) positive external effects may arise from regional "labour pooling". They argue that establishments which are located in the same region can exchange ideas and information and develop solutions to common problems. Regional economic studies demonstrate the positive effect of physical proximity on the diffusion of innovations and spillover of knowledge (Krugman, 1991). Especially the exchange of implicit knowledge depends on personal communications and networks, which are easier to develop and to sustain in geographic proximity. Regional density seems to be very relevant within the same industry. In this sense, the advantages – identified by authors such as Marshall (1920), Arrow (1962) and Romer (1986) – which firms that are near other producers in the same industry have is that geographic proximity helps in the spred of information and the exchange of ideas, the discussion of solutions to problems and the awareness of other important information (Feldman, 1993). In this context, further training organized, e.g. in the form of external seminars, is an important possibility for employees to participate in a mutual exchange of ideas. Within dense regions, the organization of further training courses is easier not only because of the larger supply of training courses offered, but also because training courses which are adapted to the needs of the employees are within a reasonable commuting distance between working and living place on the one hand and the location of the training centre on the other hand.

To summarize, it is not clear whether the relation between regional density and the employers' willingness to provide training for his employees is positive or negative: "When we compare similar firms in local labour markets with different density, this trade-off implies that (employer-provided) training incidence can be higher, or lower, in denser areas, depending on the relative weight of pooling and poaching effects." (Brunello/Gambarotto, 2007, 2). Irrespective of this ambiguity, the theoretical arguments presented justify the inclusion of regional variables in our multivariate analyses.

3. Model Specification and Data Basis

We analyze the impact of the regional context and firm characteristics on the probability to apply further training. As there are only two observable outcomes (application and non-application of training), the dependent variable is binary. For this reason, we estimate the application probability of further training using logit models. To account for the clustered and longitudinal structure of our data – with annual observations of firms and firms nested in regions – we apply a multi-level model (Rabe-Hesketh/Skrondal, 2008). Firm characteristics are available at the micro level, whereas regional data are observed at the

aggregate level. Multi-level models allow for grouping of establishments within regions and consider residuals at establishment and regional level. The residuals at regional level represent unobserved characteristics which lead to correlations between outcomes for establishments from the same region. Traditional regression analysis considers the observations as independent, however this assumption is violated and the standard errors are underestimated.

In the econometric literature, this problem of within-group correlation is known as the Moulton problem (Moulton 1986, 1990).[1] Firms within the same region share background characteristics and are exposed to the similar general economic conditions that are neither covered by observed firm characteristics nor by observed regional indicators. Therefore, it is prudent to assume that the error terms of the firms in the same region are correlated with each other (intra-class correlation) leading to wrong (typically downward biased) estimates of the standard errors (Blien, 2005; Cameron/Miller, 2011).

Therefore, multi-level approaches are suitable for modeling cross-level interaction effects between variables located at different levels. For the empirical analysis, we use a three-level logistic random intercept model (Rabe-Hesketh/Skrondal, 2008, 444 f.):[2]

The model for clustered longitudinal data with occasion I (level 1) for firm j (level 2) nested in region k (level 3) can be written as a latent response model:

$$y_{ijk}^* = \beta_0 + x'_{ijk}\beta + \zeta_{jk}^{(2)} + \zeta_k^{(3)} + \varepsilon_{ijk}\,.$$

If this latent response is greater than 0, the observed response is 1

$$y_{ijk} = 1 \quad \text{if} \quad y_{ijk}^* > 0 \quad \text{and} \quad y_{ijk} = 0 \quad \text{if} \quad y_{ijk}^* \quad \text{otherwise}\,.$$

$\zeta_{jk}^{(2)}/X_{ijk}, \zeta_k^{(3)} \sim N\left(0, \psi^{(2)}\right)$ is a random intercept varying over firms (level 2), and $\zeta_k^{(3)}/X_{ijk} \sim N\left(0, \psi^{(3)}\right)$ is a random intercept varying over regions (level 3). The random effects $\zeta_{jk}^{(2)}$ and $\zeta_k^{(3)}$ are assumed to be independent of each other and across clusters and independent of the residual error term ε_{ijk}.

The residual error term $\varepsilon_{ijk}/X_{ijk}, \zeta_k^{(3)}, \zeta_{jk}^{(2)}$ is assumed to have a logistic distribution with mean zero and variance $\pi^2/3$:

$$\Pr\left(\varepsilon_{ijk}/X_{ijk}, \zeta_k^{(3)}, \zeta_{jk}^{(2)}\right) = \exp(\tau)/(1 + \exp(\tau))\,.$$

---

[1] The Moulton problem is discussed in detail by Angrist/Pischke (2008, 308 f.).

[2] Contrary to the terminology used in this paper, in STATA terminology the basic units are not considered a level. Therefore STATA denotes the models as 'two-level' models (Rabe-Hesketh/Skrondal, 2008, 463).

We assume an independent covariance structure for the random effects that allows a distinct variance for each random effect within the random-effects equation.

Random-effects models implicitly assume that between-cluster and within-cluster effects of the covariates are the same (Rabe-Hesketh / Skrondal 2008, 113). Many empirical studies show that within-estimates (using fixed-effects panel models) get closer to the true causal effect by eliminating cluster-specific unobserved heterogeneity. Fixed-effects estimates circumvent the problem of cluster-level confounding and restrict the problem of endogeneity and ecological fallacy.

However, the 'general' effect will be more precisely estimated using both within and between variations. This holds true if there are no differences in the between and within effects of the covariates on further training. For this reason, we test whether there are differences in the between and within effects of the regional covariates of interest.[3] In the case of significant differences, within effects are included in the model in conjunction with between effects (see Rabe-Hesketh / Skrondal, 2008, 115).

To sum up, we first apply a simple logistic random-effects model ignoring the hierarchical structure, second we apply the three-level logistic random intercept model, and third we test whether it is necessary to include separate within and between effects of the regional covariates.

The data basis for the estimation of the econometric models is the IAB Establishment Panel Survey which is a general-purpose survey based on a random sample stratified by industries, establishment size, West and East Germany (Fischer et al., 2008). Each wave of the IAB Establishment Panel contains information of well above 15,000 establishments. This paper uses data from four waves of the IAB Panel for the years 2001, 2003, 2005 and 2007, because questions about employer-provided further training are asked every second year. Since in the IAB Establishment Panel questions concern the most important determinants of employer-provided further training, it is possible to study this issue with a dummy variable indicating the use of employer-provided further training at the establishment level.

To account for the *employment structure,* we include both the proportion of qualified employees, those with fixed-term contracts and part-time employees into our analyses. For the proportion of qualified employees, we expect a positive influence on further training, because qualified persons have shown that they are able to learn successfully, so that it can be assumed that they are espe-

---

[3] We first run regressions with both within and between effects separately. This is done by including cluster-means (between effects) as well as observation-specific deviations from the cluster means (within effects) of all covariates. Afterwards, we test whether the within and between effects are significantly different at the 5 % level.

cially interested in participating in training measures. For the proportion of persons with fixed-term contracts and those in part-time work, we expect negative effects, because the expected tenure or the employment volume are shorter or smaller respectively, so that the returns from human capital investments tend to be smaller as well.

Then, we investigate the effect of the *industrial relations* at establishment level for the training provision. Since the German Works Constitution Act contains regulations concerning the codetermination and consultation rights of the works councils in the field of employer-provided further training, we defined a respective dummy. Furthermore, we considered the effect of a dummy indicating whether or not the respective establishment is covered by a collective agreement negotiated at the firm or sector level, because some of these agreements include regulations about further training.

Technological changes incorporated in product and process innovations lead to further training, because they demand new competences and qualifications. In our multivariate analyses we consider the modernity of technical equipment (measured by means of a Likert scale) and dummies indicating product innovations as well as investments in information technology and machinery. Positive business expectation and a large proportion of vacancies as well as the number of voluntary terminations in relation to the total number of separations are connected with recruitments of personnel that may not be adequately qualified for the jobs to be filled. Therefore, the establishments have to provide further training to secure the *adaptation of qualification and competences* of their employees.

To capture the regional effects, we consider the regional unemployment rate, the regional population density (number of people per km² ($\log.$)) and the regional concentration of an industry (Andrews et al., 2009). The region-sectoral concentration index is based on the 3-digit sector classification and the 150 labour market regions: $\sum_{i=1}^{N} (L_i / \sum L_i)^2$ with L_i = number of employees in firm i (Gerner / Stegmaier, 2009). A low value (down to 0) can be interpreted as high sectoral competition within the labour market region whereas a high value (up to 1) means low competition.

Contrary to the political delineation of regions, we explicitly consider economic relationships between political regions by applying the travel-to-work areas identified by Eckey et al. (2006). An administrative delineation of regions that is not related to the labour market context would foster artificial regional autocorrelation and lead to nuisance in the error terms of econometric analyses (Anselin, 1988; Openshaw, 1984; Eckey et al., 2006). Methodologically, the delineation is based on a factor analysis with an oblique rotation. Thereby, the identified 150 German labour market regions fulfil the criterion of reasonable commuting time (maximum 45 to 60 minutes in dependence of the attractive-

ness of the centre) and have a size of more than 50,000 inhabitants.[4] Every travel-to-work area comprises one or more complete administrative units because all regional information is gathered on the administrative level.[5] Moreover, the areas do not overlap. The unemployment rate, the population density as well as the concentration index are measured on the basis of these labour market regions.

Following Brunello / DePaola (2008) and Brunello / Gambarotto (2007), the population density variable represents local economic density and agglomeration, whereas specialization is measured by the ratio of employment in the own industry and area and employment in the area.

Instead of using the logarithm of the population density, we avoid the assumption of a functional form by introducing four dummy variables for low, medium, high and highest population densities.

The regional unemployment rate refers to the differences between regions with respect to the availability of personnel. The higher the regional unemployment, the easier employees can be recruited (Niederalt, 2004). In regions with a relatively high unemployment rate, the participation of firms in further training seems to be lower due to the availability of workers leading the establishments to increase their hiring standards (Anger, 2007; Büttner et al., 2010). Conversely, in the case of low unemployment rates and manpower shortage, employers are likely to reinforce their investment in further training in order to assure the availability of qualified employees.

However, a high regional unemployment can also increase the shortage of employees. In particular qualified workers seek an employment opportunity elsewhere if the regional unemployment rate is relatively high (Haas / Hamann, 2008). In this case, employers could offer them additional further training as an incentive and a signal that they want to keep them. Consequently, the correlation between the unemployment rate and employer-provided further training is an open-ended – and therefore empirical – question.

Last but not least, dummies for sector affiliation and the number of employees (measured in logs) as a proxy for establishment size are included in the multivariate analyses. Since we expect those establishments which belong to a larger enterprise to show a training participation similar to the larger establishments we include a dummy indicating an independent establishment.

----

[4] Contrary to earlier delineations with a maximum commuting time of 45 minutes, the new travel-to-work areas consider a maximum commuting time of 45 up to 60 minutes because commuting time has increased in all OECD countries (Schafer, 2000). The commuting time is determined by the attractiveness of regional centres measured by the number of inhabitants.

[5] We can only combine regional information that is gathered on the administrative level. Therefore we cannot completely exclude any artificial delineation.

We use both a balanced and unbalanced panel data set to assess the validity of the empirical results because of the fundamental methodological problems of sample selection and attrition issues (Wooldrigde, 2002, 551–602; Baltagi, 2008, 181–204).[6] In the following, we present the empirical findings using the unbalanced panel data set, because the unbalanced panel structure also depicts the dynamics of establishment closures, newly founded establishments as well as panel attrition (Fischer et al., 2009). Every year, a sample of establishments is added to the panel to meet these problems. An artificial balancing of the data leads not only to a considerable loss of information and efficiency, but also to an overrepresentation of 'stable' and probably economically successful establishments that are not representative for the German economy.

The descriptive statistics of the variables of the empirical model for East and West Germany are presented in Table 1. There are only slight differences in the prevalence of further training in the two parts of Germany. About 60 per cent of all firms in the sample (West: 64%, East: 58%) offer further training to at least one of their employees. However, the regional determinants show distinctive differences between the two regions. The mean unemployment rate in East Germany is twice as high as in West Germany (West: 9%, East: 18%). The same is true for the population density: While West Germany is characterized by agglomerations of rather dense population, parts of East Germany are sparsely populated and suffer migration towards the western parts of Germany. The sample size of the balanced panel is 7596 for East Germany and 7536 for West Germany; the sample size of the unbalanced panel is 18388 for East and 27179 for West Germany.

4. Empirical Results

Table 2 displays the estimated marginal effects and the standard errors of the unbalanced random intercept models with three levels. In addition, the results of standard random-effects panel logit models without consideration of different levels are presented. The likelihood ratio test shows that the three-level random effects model provides a substantially better fit than does standard logistic regression.[7]

As regards a potential inclusion of within effects in the model, there is no significant difference between within and between effects of the regional covariates (table 3). Consequently, the random effects approach is adequate regard-

---

[6] The results of the balanced panel can be obtained on request. The differences between the estimated coefficients of the regional indicators of the two models are small and insignificant.

[7] The likelihood-ratio test compares the mixed-effects logistic model with standard logistic regression. As there is more than one boundary-affected parameter, the theory behind is complex and STATA displays significance levels that are conservative (Gutierrez et al., 2001; McLachlan / Basford, 1988).

ing the covariates of interest because it uses both within and between information.

The marginal effects of variables which account for the employment structure (i.e. the proportion of qualified employees, those with fixed-term contracts and part-time employees), industrial relations (i.a. collective agreements and works councils), technological change (product innovations, IT and machinery investment and modernity of technical equipment) and the firm size are highly significant and with theoretically expected signs. Within the group of variables referring to the adaptation of qualification and competences of the employees, this is not always the case. For example the business expectations are significant in West Germany only. Besides the firms' economic situation, the employers' decision to offer further training depends on the availability of subsidies for further training. Due to the higher unemployment rate in many East German regions, it is likely that public subsidies are more important for employer-provided further training than business expectations. Furthermore, the proportion of vacancies and the proportion of voluntary terminations are never significant anyway.

As regards the regional indicators, most effects differ considerably between the simple RE logit models and the multi-level models. The results confirm the importance of accounting for the Moulton problem. Ignoring the hierarchical structure of the data in the standard random-effects logistic regression leads to downward biased estimates of the standard errors of the regional indicators (table 2).

First, the simple RE logit model suggests non-linear significant effects of the population density in East Germany. While the dummy "higher population density" is positively correlated to further training, the dummy "highest population density" is negatively correlated. However, the correlations disappear in the multi-level models. In addition, we do not observe any correlation between the population densities and further training activities in West Germany, neither in the random effects models nor in the multi-level models. Our results do not confirm the results of Bellmann / Leber (2005). The authors find a significant negative relationship between the population density and further training probably because they do not explicitly take the clustered structure of their data into account.

The influence of the sector / regional concentration index is not significant in any of the regression models estimated. This result is in line with the study of Brunello / De Paola (2008) for Italy and Brunello / Gambarotto (2007) for the UK. In their analysis, this regional specialization, measured by the ratio of employment in the own industry and area and employment in the area, does not seem to have any significant additional effect on training.

The East German unemployment rate is neither correlated with further training in the RE logit models nor in the multi-level models. However, we find a

significant negative effect of the unemployment rate in West Germany in both models, the RE logit model and the multi-level model.

The negative association between the regional unemployment rate and further training in Western Germany supports the hypothesis that employer-provided further training is correlated with the availability of employees. The higher the regional unemployment, the easier it is to recruit qualified employees in terms of money and time (Niederalt, 2004). Moving to a region with better job opportunities is linked to high mobility costs for employees. For this reason, qualified employees seeking a job within their home region can be recruited 'just-in-time' and will accept lower wages. Under these conditions, employers will rather hire new qualified employees than invest in further training.

This holds only true, if we assume a positive relationship between the availability of qualified personnel and the regional unemployment rate. However, the unemployment rate of qualified workers is generally also lower in regions with a high general unemployment rate. Moreover, unemployed people not finding a job in the current region often migrate to another region. Additionally, the willingness to commute over long distances has increased in particular for qualified individuals (Haas / Hamann, 2008; Pischke et al., 1994). The non-significant effect of the unemployment rate in East-Germany supports the argument that a generally negative association between the regional unemployment rate and employer-provided further training is moderated by the readiness of employees to migrate or commute in regions with better job prospects.

5. Summary and Conclusion

In this paper, we have studied the effects of the regional population density, the unemployment rate and the regional concentration of an industry against the background of several determinants of further training at establishment level. From a methodological point of view, multi-level approaches are adequate allowing the separation of the effects at establishment and at regional level.

In models that do not take into account cluster correlation within regions, we still find a negative correlation between the unemployment rate and further training in West Germany and a non-linear correlation between the population density and further training in East Germany. However, considering the multi-level structure of our data, we do not find any effect of the population density on employer-provided training in the multi-level models. As regards the regional concentration of an industry, we find no effects in any of the models either.

Employer-provided firm training can be explained first and foremost by firm determinants because we do not find evidence for a correlation between most of our regional determinants. However, the negative association between the

regional unemployment rates in West Germany supports the hypothesis that employer-provided further training is correlated with the regional availability of employees. The higher the regional unemployment, the easier it is in terms of money and time to recruit qualified employees. Employers will rather hire new qualified employees than invest in further training.

It is likely that unemployment rates will decrease in the next years due to the demographic change in the German working population (Fuchs / Zika, 2010). In this context, our results suggest a more intensive involvement of employers in further training in regions and industries with an increasing shortage of skilled workers in the next decades.

For further research studies, it would be useful to estimate random coefficient approaches to model stochastic varying coefficients especially for the regional variables in comparison to random intercept models. Furthermore, it is necessary to calculate the between and within effects and then to discuss whether the effects of clusters should be treated as random or fixed.

In summary, individuals, firms and institutional players are embedded in regional political, social and economic structures that influence economic behaviour. Consequently, the regional context should be considered in empirical research strategies if data is available. Moreover, the variations in regional labour market conditions can be used as an identification strategy in papers on training choices (i.e. Parent, 2006). However, accounting for the regional and firm context simultaneously requires empirical methods that explicitly consider this multi-level character of economic structures.

References

Acemoglu, D. / *Pischke,* J.-S. (1998): Why do firms train? Theory and evidence, Quarterly Journal of Economics 113, 79 – 119.

Acemoglu, D. / *Pischke,* J.-S. (1999a): Beyond Becker: Training in imperfect labour markets, The Economic Journal 109, F112 – F142.

Acemoglu, D. / *Pischke,* J.-S. (1999b): The structure of wages and investment in general training, Journal of Political Economy 107, 539 – 572.

Andrews, M. / *Bellmann,* L. / *Schank,* T. / *Upward,* R. (2009): The takeover and selection effects of foreign-owned establishments: An analysis using linked employer – employee data, Review of World Economics 145, 293 – 317.

Anselin, L. (1988): Spatial econometrics. Methods and models, Dordrecht / Boston / London.

Arrow, K. J. (1962): Economic welfare and the allocation of resources for invention, in: R. R. Nelson (ed.), The rate and direction of inventive activity, Princeton, 609 – 624.

Baltagi, B. (2008): Econometric analysis of panel data, Chichester.

Bassanini, A. / *Booth,* A. / *Brunello,* G. / *De Paola,* M. / *Leuven,* E. (2009): Workplace training in Europe, in: G. Brunello / P. Garibaldi / E. Wasmer (eds.), Education and Training in Europe, Oxford, 143 – 342.

Bechmann, S. / *Dahms,* V. / *Fischer,* A. / *Frei,* M. / *Leber,* U. (2010): 20 Jahre Deutsche Einheit – Ein Vergleich der west- und ostdeutschen Betriebslandschaft im Krisenjahr 2009, IAB Forschungsbericht 6 / 2010, Nürnberg.

Becker, G. S. (1964): Human Capital. A theoretical and empirical analysis, with special reference to education, Chicago.

Bellmann, L. / *Leber,* U. (2005): Betriebliche Weiterbildung im regionalen Kontext, Beiträge zur Arbeitsmarkt- und Berufsforschung 295, Nürnberg, 107 – 122.

Blien, U. (2005): Die Mehrebenenanalyse regionaler Fragestellungen, in: Grözinger, Gerd / Matiaske, Wenzel (2005) (eds.): Deutschland regional, München / Mering, 133 – 156.

Brunello, G. / *De Paola,* M. (2008): Training and economic density: Some evidence form Italian provinces, Labour Economics 15, 118 – 140.

Brunello, G. / *Gamberotto,* F. (2007): Do spatial agglomeration and local labor market competition affect employer-provided training? Evidence from the UK, Regional Science and Urban Economics 37, 1 – 21.

Cameron, C. / *Miller,* D. (2011): Robust Inference with Clustered Data, in: A. Ullah / A. Giles (eds.), Handbook of Empirical Economics and Finance, Boca Raton, 1 – 28.

Eckey, H.-F. / *Türck,* M. / *Kosfeld,* R. (2006): Abgrenzung deutscher Arbeitsmarktregionen, Volkswirtschaftliche Diskussionsbeiträge 81.

Feldman, M.–P. (1993): An examination of the geography of innovation, Industrial and Corporate Change 4, 451 – 470.

Fischer, G. / *Janik,* F. / *Müller,* D. / *Schmucker,* A. (2009): The IAB Establishment Panel. Things users should know, Schmollers Jahrbuch / Journal of Applied Social Science Studies 129, 133 – 148.

Franz, W. / *Soskice,* D. (1995): The German Apprenticeship System, in: F. Buttler / W. Franz / R. Schettkat / D. Soskice (eds.), Institutional frameworks and labor market performance, London / New York, 208 – 234.

Fuchs, J. / *Zika,* G. (2010): Arbeitsmarktbilanz bis 2025: Demografie gibt die Richtung vor, IAB-Kurzbericht 12/2010, Nürnberg.

Gerner, H.-D. / *Stegmaier,* J. (2009): Unsicherheit und betriebliche Weiterbildung. Eine empirische Analyse der Weiterbildungsaktivität unter Unsicherheit in KMU und Großbetrieben, Zeitschrift für Betriebswirtschaft, Special Issue 6, 135 – 163.

Gutierrez, R. G. / *Carter,* S. / *Drukker,* D. M. (2001): On boundary-value likelihood-ratio tests. Stata Technical Bulletin 60: 15 – 18, College Station.

Haas, A. / *Hamann,* S. (2008): Pendeln – ein zunehmender Trend, vor allem bei Hochqualifizierten. Ost-West-Vergleich, IAB-Kurzbericht 06 / 2008, Nürnberg.

Krugman, P. (1991): Geography and trade, Cambridge.

Marshall, A. (1920): Principles of economics, London.

McLachlan, G. J. / *Basford,* K. E. (1988): Mixture Models, New York.

Moulton, B. R. (1986): Random group effects and the precision of regression estimates, Journal of Econometrics 32, 385 – 397.

Moulton, B. R. (1990): An illustration of a pitfall in estimation the effects of aggregate variables on micro units, Review of Economics and Statistics 72, 334 – 338.

Niederalt, M. (2004): Zur ökonomischen Analyse betrieblicher Lehrstellenangebote in der Bundesrepublik Deutschland, Frankfurt am Main.

Openshaw, S. (1984): The modifiable areal unit problem, Norwich.

Parent, D. (2006): Work while in high school in Canada: Its labour market and educational attainment effects, Canadian Journal of Economics 39, 1125 – 1150.

Pischke, J. S. / *Staat,* M. / *Vögele,* S. (1994): Arbeitslosigkeit, Löhne und Weiterbildung: Warum pendeln Ostdeutsche in den Westen, in: H. König / V. Steiner (eds.): Arbeitsmarktdynamik und Unternehmensentwicklung in Ostdeutschland, Baden-Baden, 311 – 343.

Rhabe-Hesketh, S. / *Skrondal,* A. (2008): Multilevel and longitudinal modeling using Stata, College Station.

Romer, P. (1986): Increasing returns and long-run growth, Journal of Political Economy 94, 1002 – 1037.

Tables

Table 1: **Descriptives**

Unbalanced Panel	East Germany N = 18388				West Germany N = 27179			
	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max
Further training (d)	0.59	0.49	0	1	0.64	0.48	0	1
% qualified employees	0.70	0.27	0	1	0.62	0.28	0	1
% employees with fixed-term contracts	0.06	0.15	0	1	0.04	0.11	0	1
% part-time employees	0.16	0.24	0	1	0.22	0.24	0	1
Collective agreement (d)	0.39	0.49	0	1	0.58	0.49	0	1
Works council (d)	0.29	0.45	0	1	0.40	0.49	0	1
Employment subsidies (d)	0.35	0.48	0	1	0.25	0.43	0	1
Product innovations (d)	0.43	0.49	0	1	0.50	0.50	0	1
Investment in IT (d)	0.46	0.50	0	1	0.55	0.50	0	1
Machinery investment (d)	0.46	0.50	0	1	0.49	0.50	0	1
Modernity of technical equipment (1 = state of the art, 5 = old)	2.23	0.78	1	5	2.18	0.78	1	5
Business expectations (−1: negative, 0: constant, +1: positive)	−0.03	0.67	−1	1	0.06	0.68	−1	1
Proportion vacancies/total number of employees	0.02	0.18	0	20	0.02	0.17	0	25
Proportion of voluntary terminations/total number of separations	0.11	0.27	0	1	0.20	0.34	0	1
Independent establishment (d)	0.79	0.41	0	1	0.70	0.46	0	1
Number of employees (log)	2.96	1.66	0	9.56	3.38	1.84	0	10.8
Unemployment rate	0.18	0.03	0.09	0.25	0.10	0.03	0.04	0.19
Low population density	0.39	0.49	0	1	0.11	0.31	0	1
Medium population density								
Higher population density	0.03	0.18	0	1	0.38	0.48	0	1
Highest population density	0.19	0.39	0	1	0.17	0.37	0	1
Sector/regional concentration index (0: high competition, 1: high concentration)	0.07	0.11	0.00	1	0.05	0.09	0.00	1
2001	0.27	0.44	0	1	0.28	0.45	0	1
2003	0.24	0.43	0	1	0.23	0.42	0	1
2005	0.20	0.40	0	1	0.19	0.40	0	1
2007	0.28	0.45	0	1	0.30	0.46	0	1

IAB Establishment Panel 2001 – 2007.

Table 2: **Determinants of further training 2001 – 2007 (Marginal effects)**

Variable	RE-Logit East		RE-Logit West		3-Level-RE-Logit East		3-Level-RE-Logit West	
	dy/dx	Std. Err.	dy/dx	Std. Err.	dy/dx	Std. Err.	dy/dx	Std. Err.
Low population density	−0.0201**	0.0087	−0.0026	0.0100	−0.0010	0.0010	0.0003	0.0024
Higher population density	0.1102***	0.0242	0.0035	0.0072	0.0074	0.0047	0.0008	0.0022
Highest population density	−0.0504***	0.0112	−0.0038	0.0096	−0.0029	0.0041	0.0038	0.0032
Unemployment rate	0.0611	0.1347	−0.2250**	0.1132	−0.0015	0.0192	−0.0709**	0.0361
Sector/regional concentration index*	−0.0176	0.0310	−0.0094	0.0284	−0.0014	0.0021	−0.0011	0.0058
% qualified employees	0.1359***	0.0141	0.1571***	0.0103	0.0086***	0.0024	0.0305***	0.0056
% employees with fixed-term contracts	−0.1336***	0.0241	−0.0019	0.0252	−0.0086***	0.0026	−0.0003	0.0049
% part-time employees/all employees	−0.0472***	0.0172	−0.0776***	0.0123	−0.0030**	0.0013	−0.0151***	0.0035
Collective agreement (d)	0.0594***	0.0084	0.0596***	0.0060	0.0036***	0.0011	0.0117***	0.0023
Works council (d)	0.0570***	0.0115	0.0530***	0.0076	0.0035***	0.0012	0.0105***	0.0023
Employment subsidies (d)	0.0224***	0.0079	0.0348***	0.0071	0.0013**	0.0006	0.0068***	0.0018
Product innovations (d)	0.0959***	0.0075	0.0804***	0.0056	0.0060***	0.0016	0.0158***	0.0029
Investment in IT (d)	0.0974***	0.0076	0.0688***	0.0058	0.0061***	0.0016	0.0135***	0.0026
Machinery investment (d)	0.0465***	0.0078	0.0385***	0.0060	0.0028***	0.0009	0.0075***	0.0017
Modernity of technical equipment	−0.0464***	0.0047	−0.0373***	0.0035	−0.0030***	0.0008	−0.0071***	0.0014
Business expectations	0.0050	0.0051	0.0207***	0.0038	0.0003	0.0003	0.0041***	0.0010

Proportion vacancies	0.0195	0.0156	−0.0172	0.0220	0.0012	0.0010	−0.0042	0.0041
Proportion of quits (voluntary terminations)	−0.0036	0.0122	0.0101	0.0079	−0.0003	0.0008	0.0019	0.0016
Independent establishment (d)	−0.0708***	0.0105	−0.0535***	0.0073	−0.0044***	0.0013	−0.0105***	0.0023
Number of employees (log)	0.0871***	0.0035	0.0870***	0.0025	0.0056***	0.0014	0.0170***	0.0029
2003	0.0621***	0.0086	0.0366***	0.0069	0.0039***	0.0011	0.0076***	0.0018
2005	0.0610***	0.0092	0.0518***	0.0074	0.0039***	0.0011	0.0104***	0.0022
2007	0.0787***	0.0086	0.0404***	0.0067	0.0049***	0.0014	0.0083***	0.0019
Random-Effects Parameters								
Level 3: region					0.4613	0.0712	0.2531	0.0441
Level 2: firm					1.4819	0.0523	1.4744	0.0489
LR test vs. logistic regression:								
χ²(2)					806.92		810.98	
Prob > χ²					0.0000		0.0000	
Observations					18388		27179	
Number of groups (firms)					8730		14860	
Number of groups (regions)					42		112	
Gauss-Hermite Procedure (Integration Points)					7		7	

Table 3

Test of differences of 'within' and 'between' effects

	East-Germany			West-Germany		
	$\beta_{between}$	β_{within}	$\beta_{between} - \beta_{within} = 0^a$	$\beta_{between}$	β_{within}	$\beta_{between} - \beta_{within} = 0^a$
Population density[b]	−0.016 (0.0835)	0.386 (0.2421	−0.401 (0.255)	0.049 (0.0384)	−0.069 (0.1203)	0.118 (−0.0819)
Population density (squared)[b]	−0.001 (0.0037)	0.000 (0.0077)	−0.001 (0.008	−0.004* (0.0022)	0.004 (0.0039	−0.008* (−0.0017)
Unemployment rate	5.724*** (1.6049)	−14.049 (31.9637)	19.774 (32.083	0.178 (1.8593)	−22.442 (16.6540)	22.621 (−14.7946)
Industry concentration index	−1.242 (0.7912	−0.169 (0.2551	−1.073 (0.831	0.087 (0.9024	−0.152 (0.2610	0.239 (0.6414)

[a]Test of H_0 that the corresponding coefficients are the same: H_0: $\beta_{between} - \beta_{within} = 0$.

[b]In case of minor changes of the population density within regions, dummy variables (as applied in the models) are not suitable to measure within variation. Instead, we included the population density and the population density squared to capture minor within changes and allow for a non-linear functional form.

***/**/*significant on the 1%/5%/10%-Level, standard errors in parentheses.