

Katja Goerlitz

# The Development of Employers' Training Investments Over Time

A Decomposition Analysis  
Using German Establishment Data

#87



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**Katja Goerlitz\***

## **The Development of Employers' Training Investments Over Time – A Decomposition Analysis Using German Establishment Data**

Abstract

Using establishment data covering the time period 1997 to 2007, this paper investigates trends of employer-sponsored further training in Germany, with a focus on the share of establishments investing in training. In West and East Germany alike I find a positive time trend in the share of training active establishments. Applying Oaxaca-Blinder decomposition techniques shows that changes in some establishment characteristics affect the trend, however not only in a positive way. While the increase of the fraction of skilled workers, changes in industry composition and the risen share of innovative establishments contributed positively to the trend, the decreased fraction of establishments engaged in collective bargaining operates in opposite direction. In spite of these findings, the overall characteristics effect is rather small.

JEL Classification: J24

Keywords: Continuous training, employers, time trends, decomposition analysis

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## 1. Introduction

It is a well established fact that substantial financial resources are spent by employers for continuous training in the US and Europe (Frazis et al. 2000, Bassanini et al. 2007). This also hold true for Germany: in 2007 German firms spent around 27 billion Euros on training (Leske and Werner 2009). Training issues touch upon the decisions of workers and employers alike, since individual's training participation seems to be strongly related to their employer's training investments. Training of employees is often fully sponsored or at least co-financed by their employers (Pischke 2001, Bender et al. 2008). Policy makers concerned with low participation rates of employees should therefore also be concerned with investments of firms in continuous training.

Yet there is only little evidence on the extent and development of training activities of firms and their underlying sources. This paper contributes to the literature first by presenting time trends in continuous training investments of German establishments. Second, it answers the questions whether the observed trends can be attributed to changes in average establishment characteristics. Of course training trends might also be due to changes in political or economic factors (that are unrelated to changes in establishment characteristics) such as globalization, demographics or training subsidies. They might also be due to changing preferences or returns to training. Focusing on changing establishment characteristics is however important because these characteristics turn out to be robust correlates of training within the large literature on the determinants of training. Therefore, I also consider these determinants to explain whether changes in these characteristics affect recent training trends.

Using the IAB-Establishment Panel, I find an upward trend in the probability of German private sector establishments to undertake further training activities between 1997 and 2007 for West and East Germany. Employers are viewed as active in training when they sponsor fully or partly further training of their workforce.<sup>1</sup> To find out whether the positive trend can be attributed to changes in average establishment characteristics, Blinder-Oaxaca decomposition analysis is applied showing that some characteristics indeed changed in a way affecting the training trend. In particular, the increase of the fraction of workers with vocational degree and changes in industry composition contributed positively to the trend as well as the risen share of innovative establishments. In contrast, other variables changed in opposite direction contributing negatively to the trend like the decreasing tendency of establishments engaged in collective bargaining. Although changes of single variables were found to influence the time trend, the overall *characteristics effect* explains only a minor part of the trend, i.e. taking all changes together plays only a minor role in explaining the trend.

The remainder of this paper is structured as follows. The next section provides an overview of the previous literature. In the third section, the data is described and descriptive statistics on training trends are shown. The fourth section reports the results of a decomposition analysis. In the last section, a discussion of the findings and concluding remarks are contained.

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<sup>1</sup> The fraction of trained workers within establishments (training intensity) is not used as an alternative measure of training investments because it does not vary noticeably over time and exhibits no time trend.

## 2. Previous Literature

According to *human capital theory*, training is an investment that increases labor productivity (Becker 1964). Two types of training are distinguished that differ in the potential to increase productivity in other firms after a job change. General training increases marginal productivity in many firms. Specific training, by contrast, is only applicable in the firm where it was acquired. If labor markets are perfectly competitive, cost sharing between employers and employees depends crucially on the type of training. For example, employers have no incentive to invest in general training because they are unable to recoup their training investments if workers are poached by other firms after participating in training. However, the predictions of this theory were found to be at odds with the empirical evidence because firms invest substantial amounts in general training (Loewenstein and Spletzer 1999, Barron, Berger and Black 1999, Pischke 2001, Booth and Bryan 2007). The finding that employers sponsor general training is in accordance with the *new training literature* that assumes labor markets to be imperfect (Katz and Ziderman 1990, Chang and Wang 1996, Acemoglu and Pischke 1998). Labor market imperfections can endow employers with monopsony power which in turn can lead to a compressed wage structure, i.e. trained workers are paid below their marginal productivity. The larger the difference between wages and productivity, the higher are training rents and hence training incentives for employers. However, the empirical literature testing the wage compression theory provides inconclusive results (Bassanini et al. 2007).

Within the large literature on the determinants of training, several correlations between firm characteristics and training were found. For the case of Germany, a number of studies have derived a stable set of results regarding employers' determinants of the probability to invest in training using different data sets (Neubäumer and Kohaut 2007, Kuckulenz and Meyer 2006, Zwick 2004, Gerlach and Jirjahn 2001, Bellmann et al. 2001). The main results are summarized in the following. Investments in physical capital are positively related to training; especially investments in information technology (IT) were identified as training determinant in a variety of studies. Moreover, a higher standard of technical equipment is associated on average with a higher probability to sponsor training. Product and process innovations also turn out to be positive correlates of training, although the correlations appear to be less robust across different data sets. Introducing organizational changes is positively correlated with training. The economic reason behind including proxies for technological and organizational change is that their introduction at the firm level could require training in order to fully exploit their potential to increase productivity. This correlation might also capture other unobserved factors such as managerial ability or unobserved worker ability. As the literature on the determinants of training does not allow a causal interpretation of each determinant, I will only mention some possible explanations or economic reasons for the sign of the correlations that are far from being complete. For a more detailed discussion see the references mentioned above.

In addition, a works council, coverage by a collective wage agreement and firm size are positively associated with training. The reasons for incorporating these variables are manifold. Paying wages according to a collective wage agreement could enable firms to compress wages. It could also indicate the power and influence of unions aiming amongst other things for higher training investments. Works councils could also follow this aim; and they could target additionally at higher job security. Higher job security comes along with lower turnover rates of employees decreasing the hazard of poaching which could stimulate

training. Including firm size could e.g. represent economies of scale, sunk costs or financial capacities of the firm. Besides employer characteristics, the average characteristics of the workforce turn out to be important determinants of training incidence. The share of skilled employees and apprentices is positively associated and the share of part-time employees is negatively associated with training. The complementarity between education and training could be because employees with higher education might learn more rapidly or effectively. The correlation between apprenticeship training and continuous training could be due to the fact that sunk costs of training (e.g. class rooms, teachers) were already made. It could also hint at skill-shortages at the firm level which are combated by firms' invests in human capital, i.e. by investing simultaneously in apprenticeship and further training. Less frequently incorporated as training determinants are research and development investments (R&D) and export activities. Both were found to be positively correlated with different training measures.

Training determinants based on German data mostly coincide with findings from other countries. For instance, the skill level of the workforce, size (Lynch and Black 1998) and the proportion of part-time workers (Frazis et al. 2000) are positively associated with firms' training activities in the US. There is also evidence of a positive correlation between the introduction of information technology (Bresnahan et al. 2002) and the introduction of high performance work organizations (Osterman 1995). Using British data, there is a positive association between size and high performance workplaces such as teamworking or briefing groups (Whitfield 2000). Moreover, exporting plants and R&D active establishments provide on average more training and undertake higher training expenditures in Ireland (Barry et al. 2004).

There is only little evidence how time trends in firms' training activities can be explained. To my knowledge there is only one paper investigating whether the decline in the fraction of firms offering apprenticeship training in Switzerland can be explained by compositional changes of firm characteristics (Schweri and Mueller 2007). Applying the same methodological approach, I will focus on time trends in continuous training of German establishments. The decomposition analysis highlights the importance of the characteristics effect. It also reveals which particular variable contributes to which extent to the trend. For the analysis I consider changes in those characteristics often used as determinants of training that were already presented above. Training trends are not necessarily a result of changing characteristics but could also be due to other reasons that are aggregated in the *coefficients effect*. Amongst other things this effect displays omitted variables, changes in training returns, preferences or experiences as well as other political or economic factors. Unfortunately, it is impossible to disentangle the role of each of these other potential reasons based on the coefficients effect only.

### 3. Data and Summary Statistics

The analysis is based on the IAB-Establishment Panel that is conducted annually by the Institute for Employment Research since 1993 for West Germany and 1996 for East Germany.<sup>2</sup> The panel is representative for all German establishments having at least one employee covered by the social security system. This population corresponds to 80% of the

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<sup>2</sup> See Kölling (2000) for a description of the data.



German labor force. Weights are provided in the data that allows me to account for oversampling of large establishments.<sup>3</sup> For a definition and description of the variables used in this paper, see Table A-1 in the Appendix. The IAB-Establishment Panel contains training information that is collected in a regular two-year cycle since 1993. Establishments are asked whether they have contributed financially to any kind of worker training in the last six months either by sharing direct costs or by releasing employees from work. This information is used to create a binary variable for training incidence denoting whether training investments were undertaken or not. Non-profit organizations and public administrations are excluded because they exhibit distinct training patterns. Because East German establishments are only surveyed since 1996 the main analysis comprises the time period 1997-2007.

There is a positive time trend in the fraction of establishments engaged in training (Table 1) which increased by roughly 7.6 percentage points in West Germany and by 9.9 percentage points in East Germany between 1997 and 2007. According to the appropriate t-tests the differences in training incidence between West and East Germany are statistical significant at the 5% level in 1999, 2003, 2005 and 2007. Apart from these differences in the training level, the time trends for West and East German establishments exhibit a similar pattern. Both increase substantially from 1997 to 2007, with a temporary trough in 2001.<sup>4</sup> The reasons for East German establishments to have a higher share of employers undertaking training investments could be due to higher training subsidies, higher skill demands in East Germany or differences in the kind of training that is sponsored, e.g. formal courses (like courses, seminars or lectures) vs. informal learning activities (like on-the-job training, participation in presentations or expositions, job-rotation).

**Table 1: Average fraction of establishments with training investments, weighted results**

		1997	1999	2001	2003	2005	2007
West Germany	Mean	0.37	0.37	0.36	0.41	0.42	0.44
	Standard Deviation	0.48	0.48	0.48	0.49	0.49	0.50
	Observations	3,710	3,920	8,905	9,163	9,186	8,814
East Germany	Mean	0.38	0.41	0.37	0.44	0.44	0.48
	Standard Deviation	0.49	0.49	0.48	0.50	0.50	0.50
	Observations	4,008	4,519	5,048	5,159	5,176	5,492

The training trends documented in the IAB-Establishment Panel are different from those observed in other data sets. According to the *Continuous Vocational Training Survey* (CVTS) II and III, the fraction of enterprises (with more than 10 employees) with training investments declined from 75% in 1999 to 70% in 2005 (Egner 2002, Statistisches Bundesamt 2007). A decreasing trend was also found in the *IW Training Survey*. Compared to 1998, there was a decrease by 2.6% from 99.7% to 97.1% in 2001 (Weiß 2003). In 2004, the share was even lower but remained at this low level in 2007 (Leske and Werner 2009). These data sets differ not only in terms of the definition of training and the reference period but also in the unit of surveying.

<sup>3</sup> For surveying the data, industries were classified in 17 and size was classified in 10 categories.

<sup>4</sup> The low training incidence in 2001 does not reflect the economic downturn that was starting in the second half of 2001. The sparse evidence on the relationship between cyclical trends and training suggests training to be countercyclical (Sepulveda 2004, Bassanini et al. 2007).

The IAB data also contains a large set of establishment characteristics. In the decomposition analysis it will be investigated to which extent changes of these characteristics over time contribute to the positive trend in training incidence. Specifically, the characteristics considered in the analysis are apprenticeship training, the existence of a works council and the existence of a collective wage agreement. Furthermore, information on investments in real capital (e.g. IT, real estate, machines, logistics and transport systems) and newest technical equipment of machines are used as control variables. Employee characteristics cover the average skill level of employees and the fraction of female and of part-time workers. The export share, i.e. the share of sales generated abroad,<sup>5</sup> is also included as well as the size of the employer in logarithmic form. Information on industry (at the 1-digit level) and on whether the establishment is an independent firm, a headquarter or a subsidiary are also incorporated. The age of the establishment is introduced in the regression in five categories. Because these variables are available annually, I utilize an unbalanced panel covering the years 1997, 1999, 2001, 2003, 2005 and 2007 for the main analysis. All in all, there are 43,800 observations for West Germany and 29,421 observations for East Germany. The decomposition analyses are conducted separately for West and East Germany in order to take into account that training trends and processes differ on a regional level.

Every third year since 1998, the data also contains questions on product innovations (i.e. improved or newly developed products), R&D and the introduction of organizational change (e.g. team-work, re-organization of departments, introducing units with own cost accounting). These variables can be regarded as measures for technological and organizational change. As pointed out in the previous section, these variables were found to be significant determinants of training which is why I will also consider them in the decomposition analysis. Since these characteristics are only available every third year, they can only be considered when running a separate decomposition analysis relying on data from 2001 and 2007 only. Of course, in this analysis all of the other controls variables are included as well. There are 23,272 observations for West Germany and 19,379 observations for the East in this sample.

Table 2 documents how important establishment characteristics have changed over time. The upper Panel displays changes of key establishment characteristics between 1997 and 2007. The fraction of establishments setting wages based on collective wage agreements, investing in real estate and having newest technical equipment declined in West and East Germany. In West Germany, the percentage of establishments with a works council decreased and with IT investments increased. In East Germany, the proportion of employers that offer apprenticeship training decreased. The share of skilled and part-time workers as well as the export share increased in both parts of Germany. The development of establishment characteristics between 2001 and 2007 are reported in the lower Panel of Table 2. Most of the characteristics already presented in the upper Panel develop similarly between 2001 and 2007. Three exceptions are worth noting. First, there is a statistical significant negative trend of ICT investment in West and East Germany. Second, the difference between the share of

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<sup>5</sup> Unfortunately, the export share is missing for establishments that do not document their total revenue as business volume but rather as balance sheet total, total premiums paid or budget volume. For instance, this is the case for establishments operating in the banking and insurance sector. Therefore, the results might not be representative for all industries. However, when re-estimating the results without incorporating the export share, results remain virtually unchanged. This is why I conclude that my results are not sensitive to the exclusion of these establishments.

establishments with newest technical equipment across time is now insignificant. Third, the size of the employer increased between 2001 and 2007 in West Germany on a statistical significant level. When looking at the additional variables on technological and organizational change only available in 2001 and 2007, the proportion of establishments with innovations and with organizational change increased significantly. East German establishments also display increasing R&D activity.

**Table 2: Average establishment characteristics, weighted results**

<i>Comparison of variables between 1997 and 2007</i>								
	West Germany				East Germany			
	1997	2007	$\Delta_{97,07}$	t -value	1997	2007	$\Delta_{97,07}$	t -value
Apprenticeship	0.25	0.25	0.00	0.25	0.23	0.20	-0.04	2.96 ***
Works council	0.09	0.07	-0.02	3.07 ***	0.07	0.07	-0.001	0.19
Collective wage agreement	0.59	0.37	-0.22	13.7 ***	0.41	0.23	-0.19	11.45 ***
Investments in IT	0.31	0.35	0.04	2.78 ***	0.32	0.29	-0.03	1.90
Investments in real estate	0.09	0.07	-0.02	2.04 **	0.13	0.08	-0.06	5.40 ***
Investments in machines	0.34	0.33	-0.01	0.37	0.37	0.30	-0.07	4.32 ***
Investments in transport systems	0.18	0.18	-0.004	0.33	0.20	0.16	-0.04	2.97 ***
Excellent state of techn. equipm.	0.22	0.18	-0.04	3.07 ***	0.22	0.16	-0.05	3.90 ***
Fraction of skilled employees	0.69	0.77	0.08	8.82 ***	0.80	0.87	0.08	8.25 ***
Fraction of female employees	0.47	0.47	0.00	0.08	0.46	0.46	-0.004	0.37
Fraction of part-time employees	0.25	0.29	0.04	4.35 ***	0.15	0.21	0.06	6.79 ***
Export share (in percent)	2.65	3.46	0.81	2.11 **	0.85	1.95	1.10	4.43 ***
Log employer size	1.84	1.83	-0.01	0.50	1.69	1.69	-0.003	0.10

  

<i>Comparison of variables between 2001 and 2007, including information on technological and organizational change</i>								
	West Germany				East Germany			
	2001	2007	$\Delta_{01,07}$	t -value	2001	2007	$\Delta_{01,07}$	t -value
Apprenticeship	0.25	0.25	0.00	0.41	0.23	0.20	-0.04	2.68 ***
Works council	0.09	0.07	-0.02	3.24 ***	0.08	0.07	-0.02	2.20 **
Collective wage agreement	0.47	0.37	-0.10	7.11 ***	0.26	0.23	-0.03	2.07 **
Investments in IT	0.42	0.35	-0.07	5.13 ***	0.36	0.29	-0.06	3.75 ***
Investments in real estate	0.08	0.07	-0.01	1.28	0.11	0.08	-0.03	3.03 ***
Investments in machines	0.33	0.33	0.00	0.20	0.30	0.30	0.00	0.23
Investments in transport systems	0.18	0.18	0.00	0.14	0.18	0.16	-0.02	1.68
Excellent state of techn. equipm.	0.19	0.18	-0.01	1.05	0.17	0.16	0.00	0.20
Fraction of skilled employees	0.73	0.77	0.04	5.25 ***	0.82	0.87	0.05	5.72 ***
Fraction of female employees	0.47	0.47	0.00	0.06	0.46	0.46	0.00	0.01
Fraction of part-time employees	0.26	0.29	0.03	3.46 ***	0.16	0.21	0.05	5.06 ***
Export share (in percent)	2.64	3.46	0.81	2.29 **	1.22	1.95	0.73	2.25 **
Log employer size	1.77	1.83	0.05	2.36 **	1.66	1.69	0.03	0.91
Product innovation	0.28	0.40	0.13	9.95 ***	0.29	0.36	0.07	4.54 ***
R&D	0.05	0.05	-0.004	0.66	0.03	0.05	0.02	2.67 ***
R&D in other parts of the enterprise	0.01	0.01	0.00	0.43	0.01	0.01	-0.01	1.87
Organizational change	0.30	0.33	0.04	3.07 ***	0.31	0.37	0.06	3.37 ***

Notes: The t-test for independent samples is used, although these samples are not exclusively independent due to the panel design of the data. Looking at a long time period (in this case of ten/six years) is however regarded as being associated with less strong dependence. In addition, using a paired t-test would lead to considerable data reduction and it would ignore that changes in the composition of firm characteristics could also be driven by newly established firms. Significance level: \*\*\* 1%, \*\* 5%

#### 4. Decomposing the Time Trend

To provide a more comprehensive analysis of the role of observable establishment characteristics for explaining the positive trend in training incidence, I conduct a decomposition analysis. This method allows me to disentangle the extent to which differences between two groups or points in time can be ascribed to either observable characteristics or

estimated coefficients (Blinder 1973, Oaxaca 1973). For this application, differences in training investments between 1997 and 2007 are separated into a characteristics effect, i.e. a part explained by changes in those establishment characteristics considered in the analysis and into a coefficients effect, i.e. a part that is explained by changing coefficients.<sup>6</sup> As the dependent variable training incidence is a binary variable, a Blinder-Oaxaca decomposition for non-linear models has to be used (Fairlie 2003, Bauer and Sinning 2008). The decomposition is implemented as:

$$\hat{P}(Y_{r07}) - \hat{P}(Y_{r97}) = \left[ \sum_{i=1}^{N_{r07}} p_{ir07} \Phi(x_{ir07}' \hat{\beta}_{r07}) - \sum_{i=1}^{N_{r97}} p_{ir97} \Phi(x_{ir97}' \hat{\beta}_{r07}) \right] + \left[ \sum_{i=1}^{N_{r07}} p_{ir97} \Phi(x_{ir97}' \hat{\beta}_{r07}) - \sum_{i=1}^{N_{r97}} p_{ir97} \Phi(x_{ir97}' \hat{\beta}_{r97}) \right], \quad (1)$$

or, alternatively, as

$$\hat{P}(Y_{r07}) - \hat{P}(Y_{r97}) = \left[ \sum_{i=1}^{N_{r07}} p_{ir07} \Phi(x_{ir07}' \hat{\beta}_{r97}) - \sum_{i=1}^{N_{r97}} p_{ir97} \Phi(x_{ir97}' \hat{\beta}_{r97}) \right] + \left[ \sum_{i=1}^{N_{r07}} p_{ir07} \Phi(x_{ir07}' \hat{\beta}_{r07}) - \sum_{i=1}^{N_{r97}} p_{ir07} \Phi(x_{ir07}' \hat{\beta}_{r97}) \right], \quad (2)$$

where  $Y$  is a binary variable representing training incidence,  $x$  is a vector of establishment controls,  $i$  indicates establishments and  $r$  the region ( $r=West, East$ ).  $N_{rt}$  represents the size of the sample in  $t=97, 07$  and  $p_{irt} = w_{irt} / \sum_{i=1}^{N_{rt}} w_{irt}$  is the establishment-specific weight ( $w_{irt}$ ) related to the overall number of establishments per region  $r$  in time  $t$ .  $\Phi(\cdot)$  denotes the cumulative density function of the standard normal distribution. See Sinning et al. (2008) for more details on how the estimation is accomplished.

In expressions (1) and (2), respectively, the first term in brackets is the characteristic effect and the second term represents differences in estimated coefficients. Equations (1) and (2) only differ in terms of which year is used to create the counterfactual, i.e. the combination of the coefficients of 2007 and the characteristics of 1997 or of the coefficients of 1997 and the characteristics of 2007, respectively. I will provide estimates of both decompositions as a sensitivity check. The establishment characteristics included in the vector  $x$  are similar to the characteristics used in the previous literature that were already described in the data section of this paper. To consider additional characteristics, the decomposition will be repeated again for both counterfactuals comparing the years 2001 and 2007 as

$$\hat{P}(Y_{r07}) - \hat{P}(Y_{r01}) = \left[ \sum_{i=1}^{N_{r07}} p_{ir07} \Phi(x_{ir07}' \hat{\beta}_{r07}) - \sum_{i=1}^{N_{r01}} p_{ir01} \Phi(x_{ir01}' \hat{\beta}_{r07}) \right] + \left[ \sum_{i=1}^{N_{r07}} p_{ir01} \Phi(x_{ir01}' \hat{\beta}_{r07}) - \sum_{i=1}^{N_{r01}} p_{ir01} \Phi(x_{ir01}' \hat{\beta}_{r01}) \right], \quad (3)$$

$$\hat{P}(Y_{r07}) - \hat{P}(Y_{r01}) = \left[ \sum_{i=1}^{N_{r07}} p_{ir07} \Phi(x_{ir07}' \hat{\beta}_{r01}) - \sum_{i=1}^{N_{r01}} p_{ir01} \Phi(x_{ir01}' \hat{\beta}_{r01}) \right] + \left[ \sum_{i=1}^{N_{r07}} p_{ir07} \Phi(x_{ir07}' \hat{\beta}_{r07}) - \sum_{i=1}^{N_{r01}} p_{ir07} \Phi(x_{ir07}' \hat{\beta}_{r01}) \right]. \quad (4)$$

These specifications only differ from equation (1) and (2) in two respects. First, 2007 is now compared to 2001 and second the vector  $x$  is extended by additional control variables for technological and organizational change.

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<sup>6</sup> Trends in other years could be compared as well. In this paper, I will only report results for one period (1997 versus 2007) in order to maintain clarity.

The estimation of the decomposition analysis is carried out (separately for West and East) by running Probit regressions of training incidence on establishment characteristics separately for the years 1997 and 2007 (and 2001 and 2007, respectively). Based on these results the counterfactual outcomes are created. Results of these Probit regressions for 1997 and 2007 are documented in Table A-2 in the Appendix; regressions considering also technological and organizational change are contained in A-3 in the Appendix. The main results are summarized in the following. Investing in apprenticeship training and physical capital (especially IT investments) as well as a collective wage agreement are positively related to training. A higher standard of technical equipment is on average associated with a higher probability to sponsor training which is particularly pronounced in the more recent past (2001, 2007). There is also a positive association between training incidence with the fraction of skilled employees and in some years the fraction of females as well as with log employer size. Separate enterprises invest less often in training compared to establishments that are part of a larger firm e.g. subsidiaries. Product innovations also turn out to be positive correlates of training as well as the introduction of organizational changes. All in all, my results are mostly in line with previous findings for Germany (see e.g. Kuckulenz and Meyer 2006, Hempell 2003, Gerlach and Jirjahn 2001, Zwick 2004). West-East differences occur with respect to the size of the coefficients but also in terms of significance (e.g. investments, new technical equipment). In conclusion, training processes differ between West and German establishments.<sup>7</sup>

The decomposition results are depicted in Table 3 showing that changes of all establishment characteristics cannot account for the increase of training incidence, regardless which counterfactual is used. A similar result emerges when comparing 2001 with 2007 and incorporating additional controls, specifically innovations, R&D and organizational changes (see Table 4). Although the characteristics effect is even statistical significant in one out of four specifications in West Germany, it explains only 8% to 25% of the trend. The characteristics effect is always insignificant in East Germany. Much of the time trend can thus be attributed to the coefficients effect. The coefficients effect could reflect many underlying sources, e.g. changes in the preferences for training or the experiences made with training. Training could have also become more effective for a larger fraction of firms if returns to training increased in the last decade. It could also capture any changes in determinants omitted from the analysis due to data limitations, for instance the stock and use of new technologies (rather than its introduction), the attitude of the workforce towards further training, demographic change or skill gaps. As discussed in the second section distinguishing between these alternative explanations is however not possible. It would be rather necessary to expand the usual set of training determinants to consider alternative explanations. Since I do not have proxies for these variables, testing empirically the role of alternative explanations remains a topic for future research.

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<sup>7</sup> This conclusion is also justified on statistical grounds. I applied a Chow-test of regional differences in training determinants using data for the time period 1997 to 2007 and including year dummies. The null hypothesis of no differences is rejected at a significance level of 1% ( $F(31, 28189)=2.11$ ).

**Table 3: Decomposition results (1997/ 2007)**

	Characteristics of 1997 are combined with coefficients of 2007 <sup>+</sup>		Characteristics of 2007 are combined with coefficients of 1997 <sup>++</sup>	
	West Germany	East Germany	West Germany	East Germany
<b>Change</b>	0.076 *** (0.017)	0.091 *** (0.018)	0.076 *** (0.017)	0.091 *** (0.018)
<b>Characteristics effect in %</b>	0.018 (0.010) 23.8	-0.010 (0.011) -10.9	0.006 (0.012) 8.0	-0.019 (0.012) -20.7
<b>Coefficients effect in %</b>	0.058 *** (0.016) 76.2	0.101 *** (0.018) 110.9	0.070 *** (0.017) 92.0	0.110 *** (0.019) 120.7

Notes: Bootstrapped standard errors with 1000 repetitions are shown in parentheses. <sup>+</sup> The calculation is based on equation 1 and <sup>++</sup> on equation 2. The characteristics that were incorporated in the regressions are apprenticeship, works council, collective wage agreement, investments in physical capital, new technical equipment and the fraction of females, workers with vocational degree and with part-time contract. Size is introduced in logarithmic form. Seven dummies for industry, five dummies for the age of the establishment and three dummies indicating if the establishment is a single firm, subsidiary or headquarter are incorporated. Significance level: \*\*\* 1%, \*\* 5%.

**Table 4: Decomposition results considering additionally innovation, R&D and organizational change (2001/2007)**

	Characteristics of 2001 are combined with coefficients of 2007 <sup>+</sup>		Characteristics of 2007 are combined with coefficients of 2001 <sup>++</sup>	
	West Germany	East Germany	West Germany	East Germany
<b>Change</b>	0.077 *** (0.014)	0.110 *** (0.018)	0.077 *** (0.014)	0.110 *** (0.018)
<b>Characteristics effect in %</b>	0.019 ** (0.008) 24.8	0.008 (0.010) 7.6	0.017 (0.009) 21.9	0.008 (0.010) 7.4
<b>Coefficients effect in %</b>	0.058 *** (0.013) 75.2	0.102 *** (0.017) 92.4	0.060 *** (0.013) 78.1	0.102 *** (0.018) 92.6

Notes: Bootstrapped standard errors with 1000 repetitions are shown in parentheses. <sup>+</sup> The calculation is based on equation 3 and <sup>++</sup> on equation 4. Besides the characteristics already introduced in Table 3, control variables for innovation, R&D and organizational change are introduced. Significance level: \*\*\* 1%, \*\* 5%.

The descriptive statistics on the development of establishment characteristics in Table 2 demonstrated that some characteristics changed in a direction that could potentially facilitate training and others could cause a countervailing effect. Therefore, it could be important to decompose the influence of every single regressor, even though the overall characteristics effect is rather small. Table 5 contains the results comparing 1997 with 2007 separately for West and East Germany using coefficients of 2007, as equivalent to the first two columns of Table 3.<sup>8</sup> There are large differences between West and East Germany which is not surprising as the development of average characteristics also differs between regions. In West Germany, most importantly changes in the fraction of skilled workers and to a smaller extent also investments in real capital and the industry composition contribute significantly to the positive trend. Some other explanatory variables developed in a direction being rather in line

<sup>8</sup> The estimation was conducted by 'FARILIE: Stata module to generate nonlinear decomposition or binary outcome differentials' (Jann 2006). The results may be sensitive to the ordering of the explanatory variables (Fairlie 2003). Therefore, Table 5 and Table 6 contain results from regressions where the variables are randomly ordered. To check the sensitivity of the results, I have also used other random orderings which has shown that the results are robust.

with a negative time trend of training incidence, in particular collective wage bargaining.<sup>9</sup> The contribution of variables explaining a positive trend (especially the fraction of skilled workers, the industry composition and investments) is partly offset by those variables having a negative contribution (especially by the decrease of collective wage agreements). In East Germany, there is also a positive contribution from an increased fraction of skilled workers and from changes in the industry composition. This positive contribution is totally offset by a decline of the fraction of establishments covered by a collective wage agreement (as evident in West Germany) but additionally by a decrease of establishments investing in apprenticeship training and physical capital.

In Table 6, results are reported when comparing 2001 with 2007 and incorporating technological and organizational changes. In West Germany, there is a positive contribution of the fraction of skilled workers and industry dummies but also of product innovations. Establishments negotiating collectively and the investment activity changed in a sense countervailing a positive training trend. The reason that investments now have an opposite effect compared to the decomposition of 1997 and 2007 can be attributed to the fact that IT investments increased between 1997 and 2007 but decreased between 2001 and 2007 (see Table 2). In East Germany, the most important factors explaining the positive trend are the fraction of skilled workers, the industry composition as well as product innovations. Again there is a countervailing effect from a declining number of establishments providing training and investing in real capital. The effect of collective bargaining on the time trend is still negative but less pronounced. Although the contribution of organizational change might be smaller, it contributes significantly positively to the trend. In conclusion, technological and organizational changes measured as the number of innovative establishments and those adopting organizational change also affect the training trend positively.

**Table 5: Decomposition results separately by explanatory variables (1997/2001)**

Establishment characteristics	Decomposition Results for Single Regressors	
	West Germany	East Germany
Time trend in training incidence	0.076	0.091
Characteristics effect	0.018	-0.010
Apprenticeship training	0.000 (0.000)	-0.007 *** (0.001)
Work council	0.000 (0.001)	0.000 (0.000)
Collective wage agreement	-0.020 *** (0.004)	-0.016 *** (0.005)
Investments in real capital	0.006 *** (0.001)	-0.014 *** (0.003)
Excellent state of techn. equipm.	-0.003 *** (0.001)	-0.003 (0.002)
Fraction of skilled employees	0.027 *** (0.003)	0.022 *** (0.003)
Fraction of female employees	0.000 (0.000)	-0.001 (0.001)
Fraction of part-time employees	-0.001 (0.001)	-0.001 (0.002)
Export share	0.000 (0.001)	0.000 (0.001)
Log employer size	-0.001 (0.001)	-0.002 *** (0.001)
Industry dummies	0.011 *** (0.002)	0.013 *** (0.003)

Notes: The decomposition is carried out by combining characteristics of 1997 with coefficients of 2007 (see equation 1). The regression also contains five dummy variables capturing the age of the establishment and three dummies indicating if the establishment is a single firm, subsidiary or headquarter. Standard errors are presented in parentheses. Significance level: \*\*\* 1%, \*\* 5%.

<sup>9</sup> The state of the technical equipment also contributes significantly to the trend, however its contribution is rather minor. In the following I will not interpret all factors with small size (<0.005).

**Table 6: Decomposition results separately by explanatory variables (2001/2007)**

Establishment characteristics	Decomposition Results for Single Regressors	
	West Germany	East Germany
<b>Time trend in training incidence</b>	<b>0.077</b>	<b>0.110</b>
<b>Characteristics effect</b>	<b>0.019</b>	<b>0.008</b>
Apprenticeship training	0.000 (0.000)	-0.006 *** (0.001)
Work council	0.000 (0.001)	0.000 (0.001)
Collective wage agreement	-0.008 *** (0.002)	-0.003 *** (0.001)
Investments in real capital	-0.008 *** (0.002)	-0.012 *** (0.002)
Excellent state of techn. equipm.	-0.001 (0.000)	0.000 (0.000)
Fraction of skilled employees	0.013 *** (0.002)	0.015 *** (0.002)
Fraction of female employees	0.000 (0.000)	0.002 ** (0.001)
Fraction of part-time employees	-0.001 (0.001)	-0.001 (0.002)
Export share	0.000 (0.000)	0.000 (0.001)
Log employer size	0.004 *** (0.001)	0.000 (0.000)
Industry dummies	0.006 *** (0.001)	0.006 *** (0.002)
Product innovation	0.010 *** (0.002)	0.007 *** (0.002)
R&D dummies	0.000 (0.000)	0.000 (0.001)
Organizational change	0.003 *** (0.001)	0.003 *** (0.001)

**Notes:** The decomposition is carried out by combining characteristics of 2001 with coefficients of 2007 (see equation 3). The regression also contains five dummy variables capturing the age of the establishment and three dummies indicating if the establishment is a single firm, subsidiary or headquarter. Standard errors are presented in parentheses. Significance level: \*\*\* 1%, \*\* 5%.

## 5. Conclusion

Using the IAB-Establishment Panel, this paper investigates how the fraction of establishments investing in training developed between 1997 and 2007 in the German private sector. Furthermore, it asks whether changes in establishment characteristics can account for recent training trends. The results indicate that the proportion of establishments investing in continuous training increased by approximately 8 percentage points in West Germany and by around 10 percentage points in East Germany. Furthermore, it is discovered that some of the establishment characteristics changed noticeably within the time period under investigation. Applying decomposition techniques shows that these changes had the potential to affect the training trend. In particular, the increase in the fraction of skilled workers and innovation activity as well as changes in the industry composition account for the positive training trend. In contrast, especially the decline of collective bargaining coverage contributed negatively to the trend. In East Germany, the drop of the share of establishments investing in real capital or apprenticeship training had an additional negative effect on the training trend.

However, the overall characteristics effect is still small indicating that the rising tendency of training incidence cannot be fully explained by compositional changes of the standard covariates. While the statement is undisputed that, in terms of this study, the coefficient effect accounts for most of the recent training trends, a topic for future research should be to explore the importance of other factors as determinants of training. Yet fairly unexplored are several alternative candidate determinants such as globalization, demographic factors or skill shortages. It will be even more difficult to account for strategic aspects of managerial decision making and unobservable worker and firm characteristics. In addition, there is also little evidence on how the balance between firm-specific and general training evolved in recent years. As this differentiation matters for who bears the costs of training, it would be interested to investigate this topic in more detail.



This paper also detects huge differences between West and East German establishments. The fraction of training active establishments is larger in the East, although changes in average characteristics are more pronounced especially for those variables contributing negatively to the trend. This might be why the characteristics effect is also rather small in East Germany. In addition, this small effect could indicate that explanations other than changes in the standard training determinants play a more important role in East Germany in comparison to West Germany. When analyzing alternative candidate determinants, one should therefore pay particular attention to regional differences in training investments.

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## Appendix

**Table A-1: Variable description and sample means (1997, 1999, 2001, 2003, 2005, 2007)**

Variables	Description	West Germany		East Germany	
		Obs.	Mean	Obs.	Mean
<b>Training</b>	Dummy: 1 if establishment invest in training, 0 else	43,698	0.64	29,402	0.60
<b>Apprenticeship training</b>	Dummy: 1 if at least one apprentice at establishment, 0 else	43,785	0.51	29,416	0.46
<b>Work council</b>	Dummy: 1 if work council exists, 0 else	42,513	0.37	28,839	0.28
<b>Collective wage agreement</b>	Dummy: 1 if covered by collective wage agreement, 0 else	43,676	0.60	29,348	0.43
<b>Investments in IT</b>	Dummy: 1 if investments in information technologies, 0 else	43,546	0.55	29,297	0.46
<b>Investments in real estate</b>	Dummy: 1 if investments in real estate, 0 else	43,546	0.18	29,297	0.19
<b>Investments in machines</b>	Dummy: 1 if investments in machines, 0 else	43,546	0.49	29,297	0.47
<b>Investments in transport systems</b>	Dummy: 1 if investments in logistic or transport systems, 0 else	43,546	0.25	29,297	0.25
<b>Excellent state of techn. equipm.</b>	Dummy: 1 if technical equipment is up to date, 0 else	43,523	0.19	29,318	0.18
<b>Fraction of skilled employees</b>	Share of workers holding an apprenticeship or university degree	43,606	0.72	29,302	0.82
<b>Fraction of female employees</b>	Share of female employees	43,679	0.42	29,400	0.40
<b>Fraction of part-time employees</b>	Share of employees working part-time	43,462	0.21	29,302	0.14
<b>Export share (in percent)</b>	Share of sales with exports (in percent)	37,210	8.69	25,678	4.24
<b>Log employer size</b>	Logarithm of the number of employees	43,800	3.50	29,421	3.09
<b>Product innovation</b>	Dummy: 1 if (improved or new) product innovation, 0 else	22,978	0.51	19,249	0.49
<b>R&amp;D</b>	Dummy: 1 if R&D is conducted in the establishment, 0 no R&D	23,090	0.14	19,300	0.13
<b>R&amp;D in other parts</b>	Dummy: 1 if R&D in other parts of the firm, 0 no R&D	23,090	0.03	19,300	0.03
<b>Organizational change</b>	Dummy: 1 if organizational change introduced, 0 else	22,999	0.52	19,167	0.49
<i>Industry</i>					
<b>Agriculture &amp; forestry</b>	Dummy: 1 if industry is agriculture & forestry (NACE 1-14, 40/41)	43,800	0.04	29,421	0.06
<b>Manufacturing</b>	Dummy: 1 if industry is manufacturing (NACE 15-37)	43,800	0.26	29,421	0.32
<b>Construction</b>	Dummy: 1 if industry is construction (NACE 45)	43,800	0.09	29,421	0.12
<b>Trade</b>	Dummy: 1 if industry is trade (NACE 50-52)	43,800	0.16	29,421	0.12
<b>Communication &amp; information</b>	Dummy: 1 if industry is comm. & inf. transmission (NACE 60-64)	43,800	0.05	29,421	0.04
<b>Banking and insurance</b>	Dummy: 1 if industry is banking and insurance (NACE 65- 67)	43,800	0.04	29,421	0.02
<b>Service sector</b>	Dummy: 1 if industry is service sector (NACE 55, 70-90, 92/93)	43,800	0.36	29,421	0.32
<i>Type of firm</i>					
<b>Separate enterprise</b>	Dummy is 1 if separate enterprise/ single firm, 0 else	42,886	0.69	29,086	0.78
<b>Headquarter</b>	Dummy is 1 if headquarter, 0 else	42,886	0.11	29,086	0.05
<b>Subsidiary</b>	Dummy is 1 if subsidiary (or equivalent), 0 else	42,886	0.20	29,086	0.17
<i>Control variables for age of the establishment</i>					
<b>Age: 1 year</b>	Dummy: 1 if establishment is younger than 1 year, 0 else	43,800	0.01	29,421	0.02
<b>Age: 2 years</b>	Dummy: 1 if establishment is 1-2 years old, 0 else	43,800	0.03	29,421	0.03
<b>Age: 3 years</b>	Dummy: 1 if establishment is 2-3 years old, 0 else	43,800	0.03	29,421	0.04
<b>Age: 4 years</b>	Dummy: 1 if establishment is 3-4 years old, 0 else	43,800	0.02	29,421	0.04
<b>Age: more than 5 years</b>	Dummy: 1 if establishment is 5 and more years old, 0 else	43,800	0.91	29,421	0.87

Notes: Innovation, R&D and organizational change is only available in 2001 and 2007. The export share is only available for establishments that document their total revenue as business volume and not as balance sheet total, total premiums paid or budget volume.

**Table A-2: Marginal effects of the propensity to invest in training, separately for 1997 and 2007**

Establishment characteristics	West Germany				East Germany			
	1997		2007		1997		2007	
	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.
Apprenticeship training	0.26 ***	0.037	0.20 ***	0.024	0.10 ***	0.038	0.21 ***	0.030
Work council	0.01	0.051	0.02	0.044	0.11	0.063	0.02	0.053
Collective wage agreement	0.09 **	0.034	0.11 ***	0.022	0.09 ***	0.033	0.10 ***	0.030
Investments in IT	0.22 ***	0.036	0.15 ***	0.024	0.16 ***	0.036	0.21 ***	0.029
Investments in real estate	-0.01	0.052	0.01	0.038	0.12 **	0.047	0.00	0.047
Investments in machines	0.03	0.033	0.04	0.024	0.05	0.035	0.08 ***	0.028
Investments in transport systems	0.02	0.037	0.04	0.027	-0.04	0.037	0.03	0.034
Excellent state of techn. equipm.	0.06	0.038	0.10 ***	0.028	0.05	0.037	0.06	0.033
Fraction of skilled employees	0.30 ***	0.057	0.44 ***	0.045	0.22 ***	0.068	0.37 ***	0.062
Fraction of female employees	0.04	0.057	0.09 **	0.040	0.06	0.060	0.18 ***	0.043
Fraction of part-time employees	0.00	0.069	-0.04	0.047	0.01	0.078	-0.03	0.055
Export share	0.00 **	0.001	0.00	0.001	0.00 ***	0.002	0.00	0.001
Log employer size	0.11 ***	0.015	0.14 ***	0.012	0.12 ***	0.017	0.11 ***	0.014
Seperate enterprise	-0.16 ***	0.052	-0.20 ***	0.040	-0.12 **	0.054	-0.16 ***	0.042
Headquarter	-0.10	0.069	-0.12 **	0.058	-0.07	0.089	0.06	0.103
Subsidiary	Base Group		Base Group		Base Group		Base Group	
Age: 1 year	0.10	0.071	0.08	0.075	-0.10	0.068	-0.03	0.075
Age: 2 years	0.07	0.059	0.05	0.051	-0.03	0.050	-0.02	0.058
Age: 3 years	0.13 **	0.057	-0.04	0.048	0.00	0.053	-0.08	0.054
Age: 4 years	-0.02	0.061	0.01	0.054	-0.02	0.049	-0.08	0.060
Age: more than 5 years	Base Group		Base Group		Base Group		Base Group	
Industry: Agriculture & forestry	-0.10	0.081	-0.03	0.056	-0.26 ***	0.035	-0.07	0.060
Industry: Manufacturing	-0.06	0.043	-0.19 ***	0.027	-0.12 ***	0.043	-0.16 ***	0.030
Industry: Construction	-0.13 ***	0.048	-0.18 ***	0.032	-0.15 ***	0.052	-0.13 ***	0.040
Industry: Trade	-0.02	0.040	-0.09 ***	0.027	-0.10 **	0.040	-0.08 **	0.031
Industry: Comm. & inform.	-0.02	0.073	-0.14 ***	0.042	-0.09	0.070	-0.13 **	0.059
Industry: Banking and insurance	0.23	0.201	0.19 **	0.096	-0.10	0.143	0.08	0.173
Industry: Service sector	Base Group		Base Group		Base Group		Base Group	
Observations	2824		7288		3233		4802	
Log-pseudolikelihood	-1453.41		-4043.81		-1842.32		-2798.89	
Pseudo $R^2$	0.20		0.19		0.14		0.16	

Notes: A Probit regression was estimated using weighting factors. The dependent variable represents a binary variable whether the establishment financed further training. Marginal effects are estimated at the vector of mean characteristics. Standard errors are clustered at the establishment level. Significance level: \*\*\* 1%, \*\* 5%.

**Table A-3: Marginal effects of the propensity to invest in training, separately for 2001 and 2007**

Establishment characteristics	West Germany				East Germany			
	2001		2007		2001		2007	
	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.
Apprenticeship training	0.22 ***	0.030	0.18 ***	0.025	0.13 ***	0.039	0.20 ***	0.031
Work council	0.04	0.045	0.00	0.044	-0.04	0.051	0.02	0.053
Collective wage agreement	0.06 **	0.025	0.10 ***	0.023	0.11 ***	0.035	0.11 ***	0.030
Investments in IT	0.14 ***	0.027	0.13 ***	0.024	0.13 ***	0.034	0.17 ***	0.030
Investments in real estate	0.00	0.044	0.00	0.039	0.05	0.051	0.01	0.048
Investments in machines	0.07 **	0.028	0.02	0.024	0.08 **	0.033	0.05	0.029
Investments in transport systems	0.08 **	0.034	0.04	0.028	0.06	0.038	0.03	0.034
Excellent state of techn. equipm.	0.08 **	0.031	0.08 ***	0.028	0.11 **	0.045	0.05	0.034
Fraction of skilled employees	0.36 ***	0.048	0.43 ***	0.047	0.23 ***	0.078	0.37 ***	0.063
Fraction of female employees	0.16 ***	0.043	0.10 ***	0.041	0.07	0.058	0.18 ***	0.044
Fraction of part-time employees	-0.01	0.054	-0.06	0.048	0.05	0.078	-0.03	0.056
Export share	0.00	0.001	0.00	0.001	0.00	0.002	0.00	0.001
Log employer size	0.10 ***	0.014	0.13 ***	0.012	0.11 ***	0.016	0.10 ***	0.014
Product innovation	0.11 ***	0.031	0.10 ***	0.023	0.11 ***	0.035	0.13 ***	0.028
R&D	0.09	0.061	0.10	0.054	0.15	0.083	0.01	0.059
R&D in other parts of the enterpris	0.20	0.109	0.12	0.099	0.12	0.154	0.02	0.137
No R&D activity	Base Group		Base Group		Base Group		Base Group	
Organizational change	0.12 ***	0.029	0.11 ***	0.024	0.04	0.033	0.08 ***	0.027
Seperate enterprise	-0.25 ***	0.049	-0.18 ***	0.042	-0.12 **	0.052	-0.14 ***	0.044
Headquarter	-0.17 ***	0.047	-0.15 ***	0.055	-0.12	0.072	0.03	0.103
Subsidiary	Base Group		Base Group		Base Group		Base Group	
Age: 1 year	-0.17 ***	0.059	0.07	0.070	0.06	0.131	-0.02	0.077
Age: 2 years	0.03	0.061	0.03	0.052	-0.08	0.068	-0.03	0.056
Age: 3 years	-0.06	0.062	-0.06	0.050	-0.11	0.073	-0.08	0.054
Age: 4 years	-0.02	0.071	0.00	0.053	-0.07	0.075	-0.10	0.061
Age: more than 5 years	Base Group		Base Group		Base Group		Base Group	
Industry: Agriculture & forestry	-0.13 **	0.061	-0.04	0.058	-0.04	0.072	-0.07	0.060
Industry: Manufacturing	-0.16 ***	0.031	-0.20 ***	0.027	-0.14 ***	0.033	-0.17 ***	0.030
Industry: Construction	-0.14 ***	0.033	-0.16 ***	0.034	-0.16 ***	0.040	-0.11 ***	0.041
Industry: Trade	-0.12 ***	0.028	-0.08 ***	0.027	-0.02	0.043	-0.07 **	0.032
Industry: Comm. & inform.	-0.08	0.047	-0.11 ***	0.046	-0.18 ***	0.057	-0.09	0.060
Industry: Banking and insurance	0.01	0.116	0.22 **	0.097	0.11	0.181	0.10	0.184
Industry: Service sector	Base Group		Base Group		Base Group		Base Group	
Observations	6859		7174		4111		4743	
Log-pseudolikelihood	-3331.48		-3887.59		-2177.32		-2714.65	
Pseudo R <sup>2</sup>	0.25		0.20		0.19		0.1717	

Notes: See notes in Table A-2. Significance level: \*\*\* 1%, \*\* 5%.