Regional Effects on Employer-Provided Training: Evidence from Apprenticeship Training in Switzerland*

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This paper uses regional variation in labor markets, the industry structure and the education system to explain the training decisions of firms. Using a representative firm-level data set, the results show that firms are less likely to provide training if the number of competing firms situated in the same geographical area is high. Furthermore, the supply of potential apprentices affects the training decision positively through an improved matching process. In addition, the expected ability of apprentices also has a positive impact, whereas a more developed system of full-time schooling options for young people who have completed their compulsory schooling reduces the likelihood of a firm providing training.

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1 Introduction

Apprenticeship training is believed to be a very efficient form of training, providing skills to young people, so that they have fewer problems in the transition into the labor market, e. g. OECD (2000).[1] The precondition for an apprenticeship training system operating successfully is, however, that there is a sufficiently large number of firms willing to train young people. The factors influencing the willingness of firms to provide training have been analyzed in a limited number of empirical studies. This study adds to the existing literature by analyzing the firms' training decisions with the help of data on regional labor market conditions and the structure of the regional education system.

This paper contributes to the literature on training in different ways. Firstly, regional variance in the data is used within one national training system. This is an advantage because local effects on the training decision can be captured, which would not be possible if the analysis were performed at national level. Furthermore, unobserved time effects, which would almost certainly be present in a longitudinal study, can be avoided. Secondly, this study differs from the few existing studies using data at regional level, e. g. Brunello and de Paola (2004), Brunello and Gambarotto (2004) or Niederalt (2005), by using travel distances rather than political borders in defining the regional area. Thirdly, a representative firm-level data set is at our disposal which has been designed explicitly to analyze questions related to the training decisions of firms. This enables us to make use of detailed information that is relevant in this context, such as variables concerning the number of skilled workers in the training occupation of (potential) apprentices as well as the retention and quit rates of apprentices in training firms. Two main questions are addressed in this paper. Firstly, we analyze the effect that the possibility of trained workers quitting after completion of training has on the training decision, using information about the local industry structure. And secondly, the impact of the ability of potential apprentices on the training decision is analyzed by using different proxy variables, which also contributes to the existing literature. Both sets of information, industry structure and the supply of school-leavers, show a large degree of regional variation and are therefore suited to use in an inter-regional comparison.

The paper is organized as follows: Section 2 briefly describes the Swiss apprenticeship system. Section 3 discusses the theory on firm training and presents the testable empirical hypotheses. Section 4 introduces the data and the sample design. In Section 5, the training probability of firms is estimated and the results are discussed. Section 6 concludes.

2 The apprenticeship system in Switzerland

The apprenticeship system is still the backbone of the upper secondary level education system in German-speaking countries. In Switzerland, about 60 percent of young people who have completed compulsory schooling choose an apprenticeship training program each year. The so-called "dual-education" provides them with formal and on-the-job training within their firm, and one to two days of formal schooling in a vocational school. The two main types of apprenticeship training program last either three or four years. As an alternative to the apprenticeship training, young people completing their compulsory schooling can also opt to remain in full-time education at upper secondary level. Almost half of the remaining 40 percent of young people who do not choose an apprenticeship program attend grammar school (Gymnasium), which prepares them for university and a more academic career. Although one of the virtues of the apprenticeship system is its inclusiveness for not so academically inclined school-leavers (Switzerland has one of the lowest percentages of the over-16 population that has not attended any form of non-compulsory schooling in the OECD), apprentices can qualify for further education at tertiary level. The proportion of apprentices continuing their education at tertiary level has risen steadily over the last decade. From the perspective of an individual educational career, an apprenticeship training is therefore in no way a dead end.

Apprentices graduate with a diploma recognized throughout Switzerland which certifies their professional qualification. The national certification and the substantial share of formal education during the training program gives the apprentices a guarantee of vertical and horizontal mobility after they have completed their training. The quality of the training provided in Switzerland is recognized internationally as meeting the highest standards. International comparisons show, in terms of scholastic and professional qualifications, that Swiss apprentices are more than a match for their upper secondary level peers who attend school full-time (Bierhoff and Prais 1997).

The employment period ends automatically on completion of training. Any extension of the employ-

[1] There is evidence that apprenticeship training is even efficient in countries where this form of training has a lesser tradition, see e. g. Bonnal et al. (2002).

ment period must be negotiated in a separate contract. Mobility is fairly high among young people who complete their apprenticeships, with only 36 percent still working at their original training site one year later (Schweri et al. 2003).[2]

3 Theory

This section summarizes the theory of the firms' decisions to train apprentices and generates the testable hypotheses about the factors that influence the firms' behavior. We begin by briefly discussing the implications of human capital theory and its refinements on the decision of firms to train apprentices. Then the paper addresses the question of how the expectations of firms about the ability of apprentices influences the training decision.

3.1 Competitive vs. frictional labor markets

According to classical human capital theory, firms will not pay for general training if the labor market is competitive (Becker 1964). Recent training literature, however, has focused on the reasons why firms might pay for general training of their workers, which is a frequently observed phenomenon and contradicts human capital theory. The main result of this literature states that a firm is willing to pay for general training if there is a positive probability that the apprentice will remain within the firm after the training period and that he will accept a wage below his productivity, at least for some time. The necessary condition for this to happen is that there are frictions in the labor market. Frictions give the training firms enough monopsony power to keep their trainees from switching to a competitor, even if the training firm is paying a wage below the trainees' productivity. In addition, the difference between wage and productivity must be higher for skilled workers than for unskilled workers (Acemoglu and Pischke (1998, 1999) refer to this as a compressed wage structure), otherwise firms would still not have an incentive to invest in training their workforce. A compressed wage structure occurs if there are, for example, search costs, asymmetric information, firm-specific human capital, efficiency wages, minimum wages or other wage floors. Although a compressed wage structure induces firms to pay for general training, there will still be under-investment because not all returns to training are internalized. Stevens (1994) also shows that if the trained skills are transferable, there will be externalities leading to under-investment in training. For a comprehensive summary of the literature on firm training see Leuven (2005).

The labor market in Switzerland is considered to be rather competitive by international standards. Hence, one would expect that the costs of an apprenticeship training program would have to be borne by the apprentices themselves in order for firms to provide training. Consistent with this hypothesis, a Swiss survey shows that on average, an apprenticeship program results in a net profit for the training firm (Wolter and Schweri 2002). In other words, the productive contribution of an average apprentice is high enough to cover the company's training expenses and the salary of the apprentice. Hence, the possibility to cover all training expenses already within the contract period of the apprenticeship program is a necessary condition for firms to offer training posts in the context of a highly competitive labor market.[3] However, not all firms have the structure which would guarantee that their expenses were covered if they decided to train apprentices. Wolter et al. (2006) show that differences in the expected net costs of training during the training period can explain why a large number of firms decide not to train apprentices. Finally, Muehlemann et al. (2005) show that the elasticity with which firms react to the expected net costs of training is substantial for the training decision, yet the provision of apprenticeship positions by training firms would not be increased by a marginal reduction in the net costs of training. Despite the observation that an average apprenticeship program has no uncovered training expenses at the end of the training period, about a third of training companies face positive net costs after an apprentice has completed training. Therefore, at least some of the training companies must be able to use frictions in the labor market to recoup their training expenses. The hypothesis tested in this paper is that within a region, a larger number of firms in the same industry will lower the likelihood of a firm training apprentices. We argue that an increasing number of competitors that are geographically close will increase the probability of the trained workers leaving the training company.[4] The

[2] In Germany, the corresponding figure is closer to 70 percent, see Winkelmann (1996) or Euwals and Winkelmann (2002).

[3] Consistent with these findings for Switzerland, research in Germany, where labor market frictions are high, has shown that on average training firms have substantial net costs after training (Beicht et al. 2004).

[4] Franz and Zimmermann (2002) showed for Germany that outside options have a significant influence on the probability of apprentices leaving the training company after the apprenticeship period.

reason for this is the danger that the training company can lose its trained workers, and the training companies will have a lower probability of making a gain by paying wages below productivity once the training is completed.

Overall, firms only provide apprenticeships if it is already profitable during the training period or if they are able to recoup their investments after the training period.

3.2 The expected ability of apprentices

The expected ability of apprentices is of twofold interest for training companies. On the one hand, more able school-leavers will lower the net costs of training, because they need fewer training hours to reach the required training levels. On the other hand, if a company decides to employ an apprentice after training, and labor market frictions allow the company to pay wages below productivity, the gain is higher in the case of more able workers (apprentices). In line with these hypotheses, one would expect that the easier it is for a company to recruit able school-leavers, the more likely it will decide to engage in training. Since we cannot directly observe an apprentice's ability, we will test three types of proxy variable. Each of them varies substantially between regions, should theoretically have an independent impact on the training decision and should therefore be suitable for our empirical analysis. For the first variable, we argue that the number of young people of school-leaving age (within a region)[5] per company is a proxy for the quality of the match between apprentices and training firms. If there are more young people per firm, then a firm should also find more suitable applicants to fill their training posts. Therefore, irrespective of the average quality of school-leavers in a region, the number of people of school-leaving age per firm in a region should increase the quality of the match. Secondly, PISA tests (OECD 2002, 2004) have shown that pupils with a foreign mother tongue are on average less well-qualified than native speakers. As a proxy for this effect, the share of pupils of foreign nationality in the region is used to capture the average quality of potential apprentices. Thirdly, the structure of the education system at upper secondary level is taken into account. It is assumed that the existence of a well developed full-time upper secondary school system in the region will attract the more able young people into these forms of education and detract them from apprenticeship training. Full-time schooling programs require a costly infrastructure, so they are regionally concentrated, and not all pupils have the same access to these programs because they might live in a more secluded region. Furthermore, because the infrastructure cannot be adjusted at will in the short run, there are fluctuations in the admission requirements due to demographic changes. At times when many young people finish compulsory schooling at the same time, admission requirements rise because the schools have a limited number of classrooms and teachers available. In contrast, if the number of young people completing compulsory schooling is low, then it will be easier to enroll in a full-time upper secondary program, since the school might not want to lay off teachers or leave a lot of classrooms empty. Furthermore, because the academically oriented programs (grammar schools) at upper secondary level offer high social prestige, these programs are generally preferred to apprenticeship programs (at least by the parents of young people of school-leaving age). One can assume that if the infrastructure for full-time upper secondary schooling is well developed in a region, a training firm in that region will have a smaller pool of able applicants for an apprenticeship program. Consequently, full-time schooling programs will have an exogenous effect on the firms' training decision. As a proxy for the size of the full-time schooling offer in a region, we use the share of young people completing compulsory education that opted for grammar schools in 1995.[6]

4 Data

4.1 Survey design and data

The data used here is from a representative survey conducted in Swiss firms in the year 2001 by the Center for Research in Economics of Education at the University of Berne and the Swiss Federal Statistical Office.[7] The original data set contains 2352 training firms and 2230 non-training firms, but firms that cannot make independent decisions about

[5] We do not have exact data on the number of school-leavers per district. Therefore we approximate this figure with the number of young people aged between 15–19. This approximation makes sense as not all school-leavers start their apprenticeships immediately after completion of compulsory schooling.

[6] As the firm survey covers training and non-training firms at the end of the year 2000, the earliest possible data of an apprentice being hired is the year 1996. It is assumed that the grammar school rate in previous years is not correlated with unobservable effects on the training decision in later years, and can therefore be treated as an exogenous variable.

[7] For details on the survey characteristics see Wolter and Schweri (2002).

Table 1
Summary statistics

Variable	Mean	Std. Err.	Obs.
Training firms	0.2984	0.4576	4090
Number of firms in the region (‘000)	1.2344	1.4956	4090
Number of young people per firm (‘000)	0.1159	0.3778	4090
Large metropolitan area	0.5573	0.4968	4090
High school quota in 1995	0.1410	0.0567	4090
Share of pupils with non-native mother tongue > 0.2	0.6529	0.4761	4090
High quit rate	0.3495	0.4769	1718
High retention rate	0.8322	1.8882	1874
High layoff rate	0.7348	1.3145	1874
Training duration 3 years	0.6148	0.4867	3861
Training duration 4 years	0.2597	0.4385	3861
1–4 employees	0.3242	0.4681	4090
5–9 employees	0.3982	0.4896	4090
10–49 employees	0.2305	0.4212	4090
50–99 employees	0.0254	0.1572	4090
> 100 employees	0.0215	0.1450	4090
Log number of skilled workers	0.9718	0.9010	4090
French part of Switzerland	0.2281	0.4197	4090
Italian part of Switzerland	0.0304	0.1718	4090
Construction sector	0.1122	0.3156	4090
Industrial sector	0.1280	0.3341	4090
Public sector	0.0618	0.2408	4090
Foreign-owned firm	0.1097	0.3126	4090
Difficulties in finding skilled workers on labor market	0.3975	0.4895	4090
Commercial employee	0.1991	0.3994	4090
Polymechanics technician	0.0177	0.1318	4090
IT specialist	0.0266	0.1610	4090
Cook	0.0695	0.2544	4090
Electromechanics technician	0.0185	0.1349	4090
Mason	0.0238	0.1524	4090
Architectural draftsperson	0.0285	0.1664	4090
Salesperson (2 years)	0.0585	0.2346	4090
Auto mechanic	0.0191	0.1369	4090
Carpenter	0.0233	0.1507	4090
Salesperson (3 years)	0.0243	0.1541	4090
Office worker	0.0359	0.1862	4090
Assistant in doctor‘s office	0.0205	0.1418	4090
Structural draftsperson	0.0095	0.0971	4090
Hairdresser	0.0159	0.1253	4090
Automation technician	0.0038	0.0613	4090
Electronics technician	0.0038	0.0619	4090

Figure 1
Cantons of Switzerland

Source: Swisstopo

training, because they are part of a larger enterprise, were excluded.[8] Furthermore, firms that operate in the whole country and use a centralized training scheme were excluded from the sample. The final data set used in this paper has a total of 4090 firms. Detailed data on the number of workers, skilled workers in the (potential) training occupation, training occupation, retention and quit rates of apprentices and the personnel situation is available at firm level (see Table 1).

4.2 Regional labor markets

We have constructed regional labor markets to accommodate the geographical structure of Switzerland. Since Switzerland is a small country with 26 cantons, it is likely that economic activities take place across the borders of cantons, especially in small cantons (see Figure 1 for a map of the cantons of Switzerland).

The regions are defined as follows: the largest Swiss cities and towns are taken as the centers of a region. Then, all towns and districts that could be reached within half an hour by car constitute the area of a specific region.[9] In total there are 67 different regions[10] that cover all of the country; especially in densely populated areas, the regions may overlap (see Figure 2).

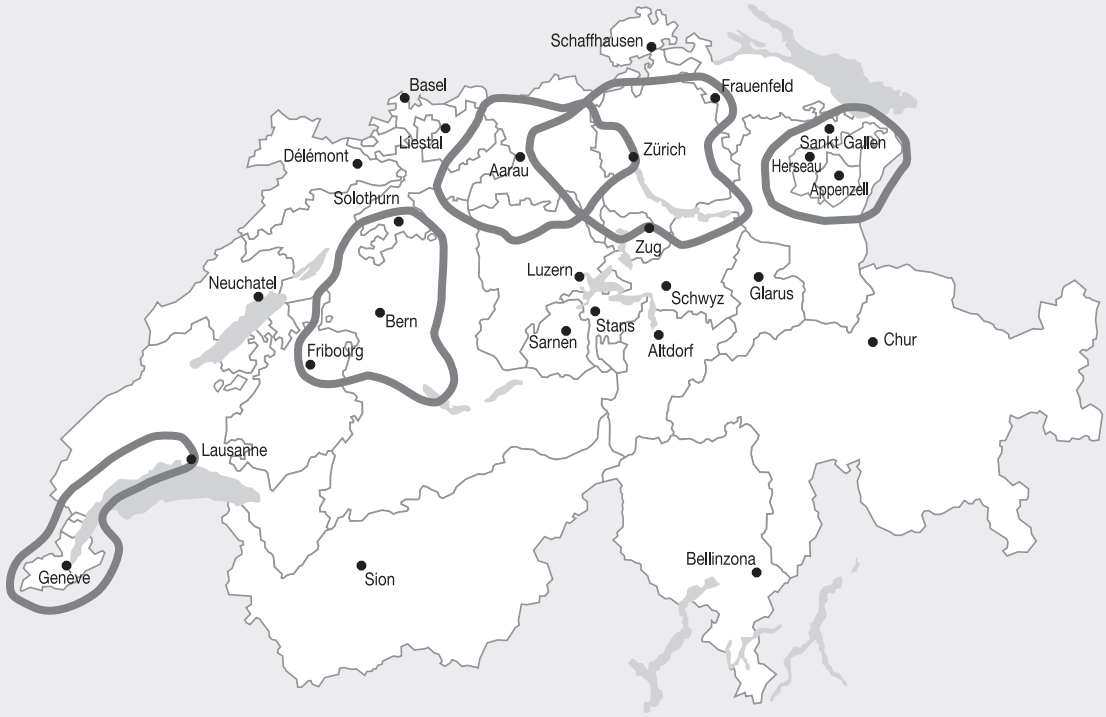
It should be noted that a firm always belongs to a single region. If a firm is situated in an overlapping area between two regional centers, then it will belong to the region whose town center is closer. The "overlapping" regions are only relevant for the construction of the independent variables, such as the number of potential firms that could poach an apprentice or the supply of young people. To illustrate this, consider a young school-leaver that lives in an overlapping area between two regions with town A and town B as the center of each region. The young person is able to travel to either of the towns in less

[8] The results do not change if public firms are excluded from the sample.

[9] To measure the traveling time, we used the software "Microsoft Autoroute 2005".

[10] The number of regions was determined by the number of sufficiently large towns in Switzerland that can constitute an independent center of economic activity. Independent means that the region can not simply be seen as a sub-region of a larger region. These centers are also characterized by the fact that they have their own VET schools where apprentices can be educated. To a certain extent the exact number of regions remains arbitrary because some larger regions could have been further subdivided. However, in these cases, the sub-regions would have become too small to constitute a meaningful entity.

Figure 2
Regions including several cantons



Source: Swisstopo

Table 2
Descriptives of regional variables

Variable	Mean	Median	Min.	Max.
Share of training firms in a region	0.335 (0.129)	0.333	0.036	0.635
Number of firms in the same industry within a region	608.462 (607.8)	438.182	104.782	3846.224
Number of young people per firm and industry in a region	134.008 (91.117)	105.825	7.76	408.374
High school quota in 1995	0.139 (0.064)	0.127	0.038	0.357
Share of pupils with non-native mother tongue > 0.2	0.507	1	0	1

than thirty minutes and could therefore potentially be hired by firms in the center of region A or the center of region B. Thus, that young person influences the training decisions of firms in both regions, which in turn justifies the construction of overlapping regions.

If regions did not overlap, a person living on the border of a region would by assumption only be of importance for firms in the same region, but not for a firm that might be much closer to the place of residence, but in another region. By the use of travel distances and the construction of overlapping regions we can overcome this drawback.[11]

This definition of a region thus captures the economic and geographical reality in a much better way

[11] Of course it would be optimal to construct a region including the supply of young people, the number of potential poaching firms, etc. for each firm in our sample, but it is doubtful whether the construction of over 4,000 individual regions would improve the analysis substantially.

than using political and administrative entities, such as cantons or districts. For each region, all relevant data was collected at community level, then aggregated to the regional level and finally matched to our data set. The variables include the number of firms within an industry, the population size by age group, the number of pupils and their origin as well as the number of students at different levels of secondary education (see Table 2 for descriptive statistics). Variables about expected future revenue, productivity, competitiveness, profit, growth of the company and technical state of the infrastructure were included in the initial estimations but they did not show any significant influence on the firms' training decisions. These results are therefore not reported in the paper.

5 Econometric models and empirical analysis

In order to estimate the effect of our variables of interest on the training decision, different probit binary choice models are used. Since the observations within a certain region are likely to be more similar than between different regions, the estimation procedure has to accommodate this type of data structure. First, a probit model with cluster-robust standard errors is estimated with different specifications for the explanatory variables.[12] Then we also estimate a model with dummy variables for each canton in Switzerland to account for the possibility that there might be canton-specific effects influencing the firms' training decisions. Finally, a random effects probit model is estimated to account for possible unobserved heterogeneity between different regions.[13]

5.1 Estimation of the effects on the training decision

We assume that the decision to provide training depends on firm characteristics j and on some regional variables r. Let

$$y_{jr} = \begin{cases} 1 & \text{if firm } j \text{ trains} \\ 0 & \text{if firm } j \text{ does not train} \end{cases}$$

then the probability that a firm provides training is

$$P(y_{jr} = 1 \mid x_{jr}) = P(y_{jr}^{*} > 0 \mid x_{jr}) = \Phi(x_{jr}\beta), \quad j = 1,\ldots 4090;\ r = 1,\ldots 67$$

where $\Phi(\cdot)$ is the standard normal cdf.[14] We use the following specification for the training decision:

$$y_{jr} = 1[x'_{jr}\beta + \varepsilon_{jr} < 0]$$

where x_{jr} contains regional variables r concerning the number of firms in a certain industry, the number of young people aged 15 to 19 within a region per firm, the percentage of young people aged between 15 and 19 at grammar school and the percentage of pupils at elementary school that have a non-native mother tongue.

In addition, there are variables at firm level j about the firm size, number of skilled workers in the training occupation, firm ownership, industry, training occupation and a variable indicating whether the firm has difficulties in recruiting skilled workers on the external labor market.

5.2 Results

5.2.1 The influence of the number of firms within a region

The results show that the number of firms in a regional labor market has a significant and negative effect on the provision of training. The firm effect is largest when we exclude the other regional variables that are available (Model 1 of Table 3). The training decision of firms responds to the number of firms per industry in a region with an elasticity of -0.19.[15] In other words, the effect of a 10 % increase in the number of firms in the region and industry reduces the training probability by 1.9 %.[16] Once the num-

[12] We assume that there is no spatial correlation between regions. It is further assumed that the within-cluster unobservables are uncorrelated with the regressors. In this case, it is sufficient to adjust the standard errors of the regression coefficients, because the point estimates of the coefficients themselves are still valid. To estimate the regression models, we make use of the "cluster" command implemented in Stata. For a detailed treatment of data with a cluster structure, see e. g. Cameron and Trivedi (2006: 829). All assumptions hold for all of the estimated models in this paper.

[13] We do not estimate a model with regional dummy variables because, with the exception of the variable "number of firms", all of the other independent regional variables have no variance within a region. The inclusion of a regional dummy variable would therefore in many cases capture most of the effect of the variables of interest.

[14] The probit random effects model assumes that the region-specific effects are normally distributed, with $\alpha_r \sim N[0, \sigma_\alpha^2]$, where the standard normal cdf now takes the form $\Phi(\alpha_r + x'_{jr}\beta)$ (for more details, see e. g. Cameron and Trivedi (2006: 795)).

[15] All elasticities reported in the text are significantly different from zero. For reasons of space they are not shown specifically in Table 3.

[16] The average training probability in the sample is 29.8 %, see also Table 1 in the appendix.

Table 3
Probit regression: Training decision of firms

Variable	Model 1	Model 2	Model 3	Model 4
Number of firms in the region ('000)	–0.121**	–0.107**	–0.094**	–0.066**
	(0.018)	(0.017)	(0.018)	(0.022)
Number of young people per firm ('000)		0.485**	0.519**	0.560**
		0.111	0.110	0.113
High school quota in 1995			–1.894**	–1.183*
			0.608	0.568
Share of pupils with non-native mother tongue > 0.2				–0.168*
				0.075
Large metropolitan area				–0.069
				0.073
1–4 employees	–0.440**	–0.352*	–0.35*	–0.376*
	(0.159)	(0.161)	(0.162)	(0.160)
5–9 employees	–0.270	–0.182	–0.177	–0.200
	(0.168)	(0.170)	(0.171)	(0.170)
10–49 employees	–0.231	–0.147	–0.138	–0.160
	(0.137)	(0.136)	(0.136)	(0.134)
50–99 employees	–0.060	–0.063	–0.049	–0.076
	(0.197)	(0.197)	(0.197)	(0.197)
Log number of skilled workers	0.461**	0.463**	0.463**	0.461**
	(0.048)	(0.048)	(0.048)	(0.048)
French part of Switzerland	–0.245**	–0.23**	–0.120	–0.097
	(0.068)	(0.068)	(0.072)	(0.068)
Italian part of Switzerland	–0.368	–0.327	0.029	–0.050
	(0.210)	(0.209)	(0.242)	(0.241)
Foreign-owned firm	–0.608**	–0.614**	–0.606**	–0.605**
	(0.150)	(0.152)	(0.154)	(0.153)
Difficulties in finding skilled workers on labor market	0.282**	0.279*	0.28**	0.277**
	(0.053)	(0.053)	(0.052)	(0.052)
Intercept	–0.576**	–0.714**	–0.514*	–0.489*
	(0.202)	(0.208)	(0.224)	(0.224)
Job & Industry dummies	Yes	Yes	Yes	Yes
N	4090.000	4090.000	4090.000	4090.000
Log-likelihood	–2086.573	–2075.034	–2069.438	–2062.791

*Significance levels: *: 5 % **: 1 %. Standard errors in parentheses are adjusted for clustering. Number of clusters: 67. The reference category is a Swiss-owned company located in the German-speaking part of Switzerland that has more than 100 employees and belongs to the goods and services sector.*

ber of young people and the schooling variables are introduced, the firm effect becomes smaller but remains negative and significant. In our preferred specification (Model 4 of Table 3), a 10 % increase in the number of firms reduces the training probability by 1 %. Therefore it can be argued that the outside options for workers are important for a firm's training decision, at least at regional level.[17] Our results are in line with the findings of

[17] It should be noted that the inclusion of the dummy variable "large metropolitan area" does not influence the results. This is an indication that our explanatory variables should in fact reflect the effects that are interpreted above.

Table 4

Probit regression: Quits and layoffs of apprentices after training

Dependent variable	High quits‡	High layoffs
Number of firms in the region ('000)	0.060† (0.035)	
Relative productivity in last year of training		–0.335† (0.179)
Training duration 3 years	0.227 (0.198)	0.635** (0.189)
Log number of skilled workers	–0.195** (0.056)	0.080 (0.060)
1–4 employees	–0.022 (0.265)	0.363 (0.267)
5–9 employees	–0.153 (0.233)	0.231 (0.214)
10–49 employees	–0.027 (0.169)	0.042 (0.178)
50–99 employees	–0.041 (0.176)	0.132 (0.203)
Foreign-owned firm	–0.169 (0.161)	0.027 (0.199)
French part of Switzerland	–0.069 (0.130)	0.038 (0.134)
Italian part of Switzerland	0.023 (0.449)	0.188 (0.319)
Intercept	–0.173 (0.290)	–0.890** (0.303)
Job & Industry dummies	Yes	Yes
N	1718	1516
Log-likelihood	–998.815	–965.059

*Significance levels: †: 10 % *: 5 % **: 1 %. ‡: Cluster-robust standard errors. Number of clusters: 67. The reference category is a Swiss-owned company located in the German-speaking part of Switzerland that has more than 100 employees and belongs to the goods and services sector.*

Harhoff and Kane (1997), Brunello and de Paola (2004), Brunello and Gambarotto (2004). The effect of the number of firms in a region is somewhat smaller if the cantonal dummy variables are included (Table 5) and of similar magnitude but only marginally significant using the random effects model (Table 6).

A further indication that the number of firms within a region influences the training decision can be found by analyzing only the training firms. We find that a firm is more likely to suffer from a high exogenous quit rate if there are more firms in the same

Table 5

Probit with canton dummy variables

Variable	Coefficient	(Std. Err.)
Number of firms in the region ('000)	–0.042 †	(0.023)
Number of young people per firm ('000)	0.531 **	(0.107)
High school quota in 1995	–1.746	(1.253)
Share of pupils with non-native mother tongue > 0.2	–0.172 *	(0.085)
Large metropolitan area	0.064	(0.097)
1–4 employees	–0.41 **	(0.155)
5–9 employees	–0.229	(0.166)
10–49 employees	–0.18	(0.129)
50–99 employees	–0.078	(0.195)
Log number of skilled workers	0.469 **	(0.050)
French part of Switzerland	–0.051	(0.160)
Italian part of Switzerland	0.004	(0.322)
Canton dummies:		
AI	0.213	(0.267)
AR	0.107	(0.295)
BE	–0.319 *	(0.140)
BL	–0.382	(0.333)
BS	–0.579 **	(0.080)
FR	–0.227	(0.267)
GE	–0.251	(0.274)
GL	0.069	(0.132)
GR	0.051	(0.185)
JU	–0.05	(0.281)
LU	–0.152	(0.171)
NE	–0.413 **	(0.187)
NW	–0.387 **	(0.115)
OW	–0.755 **	(0.170)
SG	–0.201 †	(0.116)
SH	0.239 *	(0.106)
SO	–0.034	(0.169)
SZ	–0.006	(0.119)
TG	–0.132	(0.119)
TI	–0.089	(0.367)
UR	–0.637 **	(0.110)
VD	–0.215	(0.185)
VS	–0.103	(0.170)
ZG	–0.282 **	(0.087)
ZH	–0.371 **	(0.131)
Job & industry dummies	YES	YES
Constant	–0.274	(0.281)
N	4090	
Log-likelihood	–2041.094	

*Significance levels: †: 10 % *: 5 % **: 1 %. The reference category is a Swiss-owned company located in the canton of Aargau that has more than 100 employees and belongs to the goods and services sector.*

Table 6
Random effects probit

Variable	Coefficient	(Std. Err.)
Number of firms in the region ('000)	–0.040	(0.027)
Number of young people per firm ('000)	0.094 *	(0.038)
High school quota in 1995	–1.640 *	(0.791)
Share of pupils with non-native mother tongue > 0.2	–0.174 *	(0.074)
1–4 employees	–1.018 **	(0.109)
5–9 employees	–0.802 **	(0.094)
10–49 employees	–0.694 **	(0.087)
50–99 employees	–0.317 **	(0.091)
Log number of skilled workers	0.359 **	(0.029)
French part of Switzerland	–0.115	(0.088)
Italian part of Switzerland	0.240	(0.212)
Construction sector	0.280 **	(0.088)
Industrial sector	0.016	(0.076)
Public sector	0.354 **	(0.081)
Foreign-owned firm	–0.599 **	(0.073)
Difficulties in finding skilled workers on labor market	0.278 **	(0.048)
Commercial employee	–0.056	(0.060)
Polymechanics technician	–0.378 **	(0.132)
IT specialist	–0.435 **	(0.137)
Cook	0.023	(0.116)
Electromechanics technician	0.094	(0.175)
Mason	–0.541 **	(0.165)
Architectural draftsperson	0.528 **	(0.136)
Salesperson (2 years)	–0.046	(0.135)
Auto mechanic	0.261	(0.181)
Carpenter	0.390 *	(0.170)
Salesperson (3 years)	0.206	(0.181)
Office worker	–0.423 **	(0.139)
Assistant in doctor's office	0.477 **	(0.164)
Structural draftsperson	0.718 **	(0.228)
Hairdresser	1.029 **	(0.200)
Automation technician	0.565 †	(0.294)
Electronics technician	–0.026	(0.262)
Constant	0.567 **	(0.153)
ρ	0.024	(0.010)
N	4090	
Log-likelihood	–2136.086	
Chi^2(33)	963.923	

*Significance levels: †: 10 % *: 5 % **: 1 %. The reference category is a Swiss-owned company located in the German-speaking part of Switzerland that has more than 100 employees and belongs to the goods and services sector.*

industry within a region; although the effect is only marginally significant, a 10 % increase in the number of firms increases the probability of a high exogenous quit rate by 2 percentage points (Table 4).[18]

5.2.2 The influence of the firms' expectations regarding the ability of apprentices

As discussed in section 3.2, the effect of apprentices' abilities on firm behavior cannot be observed directly. Instead, proxy variables for the firms' expectations about the ability of potential apprentices are used. We find that these variables are important determinants of a firm's decision process. The size of the cohort, the quality of pupils and the structure of the education system influence the training decisions of firms significantly.

First, the number of young people per firm within a region and industry has a significant and positive effect on training. If the number of young people increases by 10 %, then the training probability of a firm increases by 0.8 % (see Model 4 in Table 3). The reason why the number of young people has a separate effect on the training decision is the improved matching between firms and candidates. If a firm has a larger pool of applicants, then it is more likely that there will be somebody suitable amongst those who apply for an apprenticeship. This effect is also significant and positive in the model with canton dummy variables (Table 5), whereas the effect is smaller but still significant in the random effects model. In addition, the findings are in line with a longitudinal study conducted in Switzerland by Müller and Schweri (2006), who find a positive effect of the population of 16-year-old school-leavers on the firms' training decisions. Hence, the effect of demographic changes on firms' training decisions seems to be quite robust.

Second, firms are less likely to provide training in regions with a well developed full-time school system at upper secondary level. Again, firms expect the ability of an average applicant to be lower, because the more able pupils are more likely to opt for full-time schooling instead of a (sophisticated) apprenticeship training program when they reach the age at which this decision has to be made. The results show that an increase in the ratio of the high school enrolment rate by 10 percentage points decreases the training probability by 3.8 percentage points (Model 4, Table 3). The effects are of similar

[18] The quit rate within a firm is a binary variable defined as high if at least half of the trained apprentices quit the firm after training, despite the firm offering them contracts as skilled workers.

magnitude in the model with canton dummy variables as well as the random effects model, although not significant at the 5 % level in the canton fixed effects model. Third, an increase in the percentage of foreign children in elementary schools reduces the training provision of firms. If a firm is located within a region in which more than 20 % of the pupils in elementary schools are foreigners, then the training probability is reduced by 5.6 percentage points (Model 4, Table 3). This reflects the fact that firms expect higher training costs because of the lower ability of the average potential apprentice, which is in line with the results from student pupil achievement tests, e. g. OECD (2002, 2004). This effect is also negative and significant in both the random effects model and the model with canton fixed effects.

In conclusion, it can be shown that the firms' expectations about the ability of apprentices influences their training decisions. The behavior of training firms (Table 4) also seems to be consistent with the model of Acemoglu and Pischke (1998), which predicts that a firm only keeps on an apprentice as a skilled worker if his/her ability is above some minimum threshold. The variable used to approximate ability is the average relative productivity of the firm's apprentices in the last year of the training program. The results show that the lower the relative productivity, the higher the probability that a firm does not keep on their apprentices after training.[19]

After the inclusion of regional variables, the effects of the firm-level variables are similar to previous studies, e. g. Muehlemann et al. (2005) or Wolter et al. (2006).[20] The number of skilled workers in the occupation to be trained in a firm has a very strong and positive influence on the training decision. A 10 % increase in the number of skilled workers leads to a 5.57 % increase in the probability of training apprentices (or an elasticity of 0.569), which is quite substantial. Firm size has an additional impact; given the number of skilled workers, small firms are still less likely to train apprentices. The reason for this behavior could be that small firms face a higher uncertainty about the quality of an apprentice and his quit behavior (small firms are usually the last in the chain when school-leavers apply for apprenticeships). At the same time, they are very often too small and too specialized to provide all the required training lessons and contents at reasonable costs. In addition, a firm with problems in recruiting workers on the external labor market has a 9.2 percentage point higher probability of training apprentices. Furthermore, firms in the construction sector have a 7.5 percentage point higher training probability, and firms in public administration are 10 percentage points more likely to train apprentices.

The only important difference to the studies cited above is that the effect of language regions in Switzerland disappears once we control for the structure of the education system. It is precisely the more developed upper secondary school system in the French part of Switzerland that is in competition with the dual education system. Due to the fact that a larger proportion of more able pupils at the age of 15–16 continues a school-based education, the expected training costs of an apprentice are higher in the French part and thus the average training probability is lower.

6 Concluding remarks

The results described in this paper provide insights indicating that regional aspects of the labor market and the education system influence the training decision of firms. The factors singled out in the analysis have several consequences for policy making.

The negative effect of a high density of firms (in the same industry) on the likelihood of training apprentices underlines the importance of training regulations. Firms need to be able to train apprentices in a cost-efficient manner if the labor markets are competitive. Otherwise, firms will not engage in training, because the probability of recouping the training expenses after the training period would be too low.

The variables related to the supply of potential apprentices have several implications. Firstly, the quality of the school system directly impacts the cost-benefit ratio of an apprenticeship program. Therefore, measures which improve the competencies of school-leavers will affect the apprenticeship training system positively. Secondly, the importance of a large number of potential applicants for the training decision of firms indicates that the current problems that a fraction of school-leavers experience when trying to find an apprenticeship will not automatically be solved due to future demographic changes. The predicted reduction in the number of school-leavers will result in a lower number of applicants for an apprenticeship per firm. Hence, the probability of a good match between the firm and the ap-

[19] The dependent variable "high layoffs" is defined as a binary variable with the value 1 if more than 50 % of apprentices are not kept on in a firm.

[20] The following results are marginal effects or elasticities from Model 4 in Table 3, which is our preferred specification. For reasons of space, these figures are not reported in a separate table.

prentice will be lower, and thereby the likelihood of a firm providing apprenticeships will be reduced. Finally, the public investments in full-time schooling options at upper secondary level are – intentionally or not – a threat to the dual apprenticeship training system. The more attractive and accessible full-time schooling programs are, the more difficult it will be for firms to find apprentices with sufficiently high competencies. Therefore, even schooling programs that were initially created to solve cyclical imbalances on the apprenticeship market can cause the destruction of apprenticeship posts in the long run.

References

Acemoglu, Daron/Pischke, Joern-Steffen (1999): The Structure of Wages and Investment in General Training. Journal of Political Economy 107 (3), 539–72.

Acemoglu, Daron/Pischke, Joern-Steffen (1998): Why Do Firms Train? Theory and Evidence. Quarterly Journal of Economics 113 (1), 79–119.

Becker, Gary S. (1964): Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education. New York; London: Columbia University Press.

Beicht, Ursula/Walden, Günter /Herget, Hermann (2004): Kosten und Nutzen der betrieblichen Berufsausbildung in Deutschland. Berichte zur beruflichen Bildung. Heft 264. Bonn: Bundesinstitut für Berufsbildung.

Bierhoff, Helvia/Prais, S. J. (1997): From school to productive work: Britain and Switzerland compared. Cambridge University Press.

Bonnal, Liliane/Mendes, Sylvie/Sofer, Catherine (2002): School-to-Work Transition: Apprenticeship versus Vocational School in France. International Journal of Manpower 23, 426–42.

Brunello, Giorgio/de Paola, Maria (2004): Training and Density of Economic Activity: Evidence from Italy. IZA Discussion Paper No. 1173.

Brunello, Giorgio/Gambarotto, Francesca (2004): Agglomeration Effects on Employer-Provided Training: Evidence from the UK. IZA Discussion Paper No. 1055.

Cameron, A. C./Trivedi, Pravid K. (2006): Microeconometrics. Methods and Applications. Cambridge University Press.

Euwals, Rob/Winkelmann, Rainer (2002): Mobility after Apprenticeship – Evidence from Register Data. Applied Economics Quarterly 48 (3–4), 256–78.

Franz, Wolfgang/Zimmermann, Volker (2002): The transition from apprenticeship training to work. International Journal of Manpower 23 (5), 411–25.

Harhoff, Dietmar/Kane, Thomas J. (1997): Is the German Apprenticeship System a Panacea for the U.S. Labor Market? Journal of Population Economics 10 (2), 171–96.

Leuven, Edwin (2005): The Economics of Private Sector Training: A Survey of the Literature. Journal of Economic Surveys 19 (1), 91–111.

Muehlemann, Samuel/Schweri, Juerg/Winkelmann, Rainer/Wolter, Stefan C. (2007): An Empirical Analysis of the Decision to Train Apprentices. LABOUR: Review of Labour Economics and Industrial Relations 21 (3), 419–441.

Müller, Barbara/Schweri, Jürg (2006): Die Entwicklung der betrieblichen Ausbildungsbereitschaft: eine Längsschnittuntersuchung zur dualen Berufsbildung in der Schweiz. Zollikofen: Schweizerisches Institut für Berufspädagogik.

Niederalt, Michael (2005): Bestimmungsgründe des betrieblichen Ausbildungsverhaltens in Deutschland. Discussion Paper No. 36, University of Erlangen-Nürnberg.

OECD (2000): From Initial Education to Working Life. Making Transitions Work.

OECD (2002): Reading for Change: Performance and Engagement across Countries. Results from PISA 2000.

OECD (2004): Learning for Tomorrow's World: First Results from PISA 2003.

Schweri, Juerg/Muehlemann, Samuel/Pescio, Yasmina/Walter, Belinda/Wolter, Stefan C./Zuercher, Lukas (2003): Kosten und Nutzen der Lehrlingsausbildung aus der Sicht Schweizer Betriebe, Volume 2 der Beiträge zur Bildungsökonomie. Chur, Zuerich: Ruegger Verlag.

Stevens, Margaret (1994): A Theoretical Model of On-the-Job Training with Imperfect Competition. Oxford Economic Papers 46 (4), 537–62.

Winkelmann, Rainer (1996): Employment Prospects and Skill Acquisition of Apprenticeship-Trained Workers in Germany. Industrial and Labor Relations Review 49 (4), 658–72.

Wolter, Stefan C./Muehlemann, Samuel/Schweri, Juerg (2006): Why Some Firms Train Apprentices and Many Others Do Not. German Economic Review 7 (3), 249–264.

Wolter, Stefan C./Schweri, Juerg (2002): The Cost and Benefit of Apprenticeship Training: The Swiss Case. Applied Economics Quarterly 48 (3–4), 347–67.