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Working Paper

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KOF Working Papers, No. 199

Provided in Cooperation with:
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Suggested Citation: Arvanitis, Spyros; Stucki, Tobias (2008) : Training propensity of start-ups in Switzerland: A study based on data for the start-up cohort 1996 - 97, KOF Working Papers, No. 199, ETH Zurich, KOF Swiss Economic Institute, Zurich, https://doi.org/10.3929/ethz-a-005582300

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https://hdl.handle.net/10419/50369

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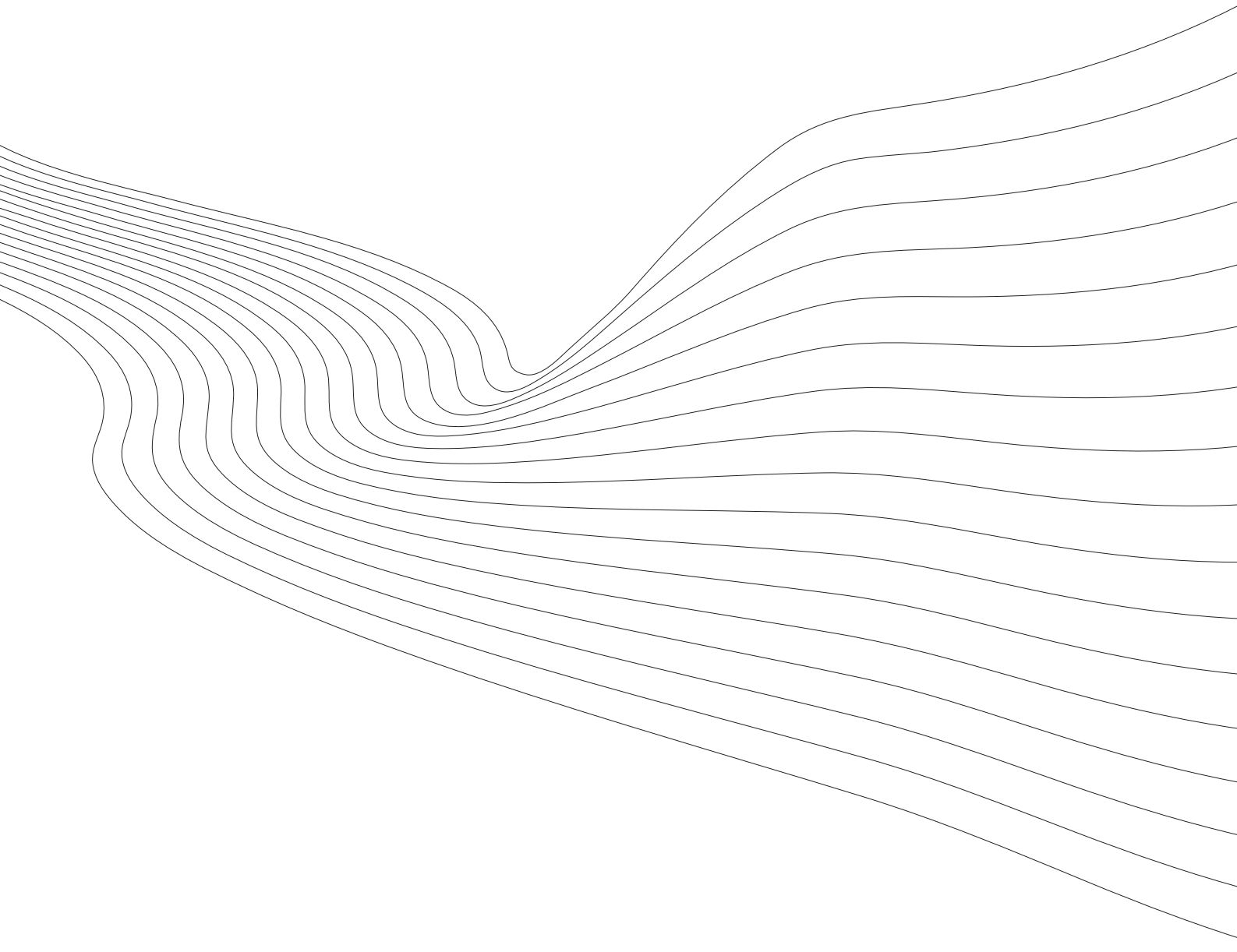

No. 199
May 2008

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Training Propensity of Start-ups in Switzerland - A Study Based on Data for the Start-up Cohort 1996-97*

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Key words: start-ups; training; innovation; firm age

JEL classification: J24; O30

* This study was funded by the Swiss Federal Office for Professional Education and Technology (OPET) through its Leading House on the Economics of Education, Firm Behaviour and Training Policies. The views expressed herein are those of the authors and do not necessarily reflect the views of the OPET or the Leading House. Any remaining errors are the responsibility of the authors. The authors gratefully acknowledge the useful comments and suggestions of Uschi Backes-Gellner, Stefan Wolter and the members of the Advisory Board of the Leading House at the meeting of 24th June 2008.

Abstract

This study is based on data of a cohort of Swiss firms that were founded in 1996/97. In the year 2000 data were collected by means of a postal survey among those firms, which still existed by that time. In 2003 and 2006 two further surveys were conducted among the participants of the respective last study. In this study we analyzed, firstly, the determinants of the propensity to train apprentices of new firms and how they change with increasing firm age. Secondly, we investigated how a firm's training propensity correlated with its labour productivity. To this end, we specified an equation for training propensity and an equation for labour productivity, which included as an additional production factor the endogenized propensity to train apprentices.

1. Introduction

Many economists think that new firms are an important source of new business practices and new technology. Such innovative behaviour is closely related to a high rate of human capital formation. The dual system of vocational education is an important pillar of the Swiss education system and an important source of human capital for the Swiss economy. Thus, it is also relevant to know how new firms behave with respect to the specific type of human formation that is based on vocational education. Are newly-founded firms interested in investing in the training of apprentices and, if so, is this training propensity increasing or decreasing with firm age? So far, the training behaviour of new firms is not much analyzed.[1]

In this study we analyze, firstly, the determinants of training propensity and how they change with increasing firm age for a cohort of Swiss firms that were founded in 1996/97. Secondly, we investigate how a firm's training propensity correlates with its labour productivity.

The data used in this study come from the cohort of Swiss enterprises, which were founded between 1996 and 1997. This was the first cohort of start-ups that was registered by the Swiss Federal Statistical Office. This cohort contained only "green-field" start-ups without mergers, manager-takeovers, etc.

Our model of training propensity distinguishes five main groups of determinants: (a) variables measuring the endowment of a new firm with human capital (skill mix of the employees as measured by formal education, further training, shortage of high-qualified personnel); (b) variables measuring the level of innovative and technological activities: development and introduction of new products, modification of existing products, R&D activities; intensity of use of internet and intranet; (c) variables measuring the level and / or change of the level of total firm activity: growth of sales; growth of employment; expected future development of demand; break-even point of profits; (d) variables measuring competitive pressure: intensity of price and non-price competition; export propensity; and (e) variables measuring some characteristics of the firm founders (age, gender); firm size was a separate additional determining factor. Finally, controls for industry affiliation and region were also included in the model.

New elements of the analysis are: (a) the use of the data for a cohort of new firms that were observed during a period of ten years; (b) the wide spectrum of determinants that could be taken into account in the model specification, and (c) the investigation of possible effects of the training propensity on labour productivity of newly-founded firms.

The paper is organized as follows. Section 2 discusses the conceptual framework of the study. In section 3 the data are presented. Section 4 contains a description of the main facts with

[1] Recently, a series of studies on the determinants of the propensity of Swiss firms to train apprentices were conducted: see, e.g., Wolter and Schweri (2002), Mühlemann et al. (2005), and Mühlemann and Wolter (2006), and Wolter and Mühlemann (2006). But none of these studies is dealing with newly-founded firms.

respect to the training propensity of new firms in our sample. In section 5 and in section 6 we present the specification of the training propensity equation and the labour productivity equation respectively. The results of the econometric estimations are presented in section 7. Section 8 contains a comparison with results of similar studies. Finally, section 9 concludes with a summary of the main results.

2. Incentives and disincentives related to the decision to train apprentices

Starting point of our conceptual framework is the human capital approach introduced by Becker (1964) according to which the acquisition of vocational education can be considered as an investment in human capital that enables the capital owner to achieve a higher individual performance in the future, e.g. higher productivity. Both employees and employers can have incentives for such investment, if the difference of the *expected benefits* (e.g., productivity gains for the enterprises, labour income increases for the employees) and the *expected costs* (e.g., training costs) is positive. We concentrate here on firms' incentives and motives to invest in human capital by offering training, especially training for apprenticeships.[2] Vocational training contains general skills that satisfy the firms' requirements at industry, sector or even country, but also a portion of firm-specific skills that are not transferable to other firms (or are transferable at a high cost). According to the original human capital approach, employers have an interest to pay only for an investment in firm-specific skills but not for general skills that have to be financed either by the employees or the state. However, in practice we can observe that firms bear a significant fraction of the costs of training, even if this training contains general skills. The investment hypothesis has been further elaborated and refined by Acemoglu and Pischke (1998, 1999). According to this new approach, it can be more profitable for a firm to use skilled employees that have been trained by the firm than unskilled employees, even if the training is not firm-specific. The main reason for this conclusion is the existence of labour markets imperfections due to asymmetric information with respect to the productivity of external employees, search costs, labour market institution such as unions and minimum wages, etc.[3] Put in a more abstract way, the main argument should be that the expected benefits and costs of training for a firm are primarily determined by all factors that influence the future demand for skilled labour.[4]

We hypothesize that a series of factors that could influence *positively* the expected demand for skilled labour would be also important for a firm's decision to train apprentices. In

[2] We refrain here from discussing other motives of training (production motive; reputation motive) that are not taken into consideration in the empirical part of the study (see, e.g., Niederalt 2004 and Mohrenweiser and Backes-Gellner 2006 for a discussion of the literature dealing with the relevance of different motives).

[3] In a recent paper Kessler and Lülfesmann (2006) show that when general and specific skills are complementary to each other employers may be willing to sponsor general training even in competitive labour markets.

[4] This indirect approach differs from that used in an important branch of empirical literature that investigates the direct the net cost and gains of training apprentices, see, e.g., Schweri et al. (2003) for Switzerland and Beicht et al. (2004) for Germany.

accordance with literature, we identify a series of such factors that we comprise in four groups (see, e.g., Franz et al. 2000 and Niederalt 2004 for a similar approach): human resources; innovation and technology; firm activity level; and market conditions.

Human resources. A firm's demand for apprentices depends among other things on the demand for employees with different levels of vocational education. The relationship between the demand for apprentices and the demand for other categories could be substitutive or complementary. We expect a complementary relationship between apprentices and middle-educated employees (upper secondary education level; 'Berufslehre') and a substitutive relationship between apprentices and low-educated employees (vocational education without a formal degree; no vocational education). It is more difficult to disentangle the relationship of apprentices to high-qualified employees (tertiary-level education). Given that middle-educated and high-educated are mostly positively correlated, we expect a positive relationship of apprentices to high-qualified employees.

Innovation and technology. There is long-term empirical evidence that both the number and the employment share of high-skilled (or high-educated) workers have grown over time in many OECD countries. While many factors have contributed to this increase most authors think that this effect is attributable primarily to skill-based technical change. One of the most popular explanations which have been offered by the economic literature is based on the so-called „skill-biased technological change" hypothesis, according to which the reason for the up-skilling of labour force is the non-neutrality of technological change, which favours the use of skilled labour more than the use of other labour inputs. Due to the complementarity of skills (education) and technology, an acceleration of the rate of technological change would cause an increase of the demand for skilled labour.[5] The reason for the most recent acceleration of technological change is assumed to be the diffusion of Information and Communication Technologies (ICT) which seem to have given new impetus to the substitution process of low-skilled by high-skilled employees (see Bresnahan et al. 2002). Empirical evidence for Switzerland shows that technological changes (e.g., the use of ICT) shift skill requirements in favour of high-qualified (tertiary-level education) employees and appear to be neutral with respect to middle-educated employees (upper secondary education level; 'Berufslehre'), which is the most numerous category of employees in the Swiss economy (see Arvanitis 2005). The demand for apprentices is closely related to the demand for middle-educated employees, therefore the expected effect of innovation and technology on the training propensity of Swiss firms is not a priori clear.

Firm activity level. The demand for any category of employees is dependent on the expected level of firm activity as measured, e.g., by the expected product demand or by sales. The extent of this dependence is related to the relative importance of a certain category of

[5]For recent surveys of the theoretical and empirical literature on skill-biased technical change see Sanders and ter Weel (2000) and Acemoglu (2002).

employees in a firm's skill mix. In general, we expect positive effects of the variables measuring firm activity.

Market conditions. In a recent paper Gersbach and Schmutzler (2006) postulate and derive theoretically two hypotheses about the market conditions under which industry-specific training is likely to occur: (a) concentration is high or competitive intensity is low, and (b) product differentiation is sufficiently strong. We consider the intensity of price competition (as measured in this study; see table 5) as a proxy for 'competitive intensity' in the above theoretical context and the intensity of non-price competition (as measured in this study; see table 5) as a proxy for 'product differentiation'. Thus, according to hypothesis (a) intense price competition would exercise a *negative* influence on training propensity. On the contrary, according to hypothesis (b) intensive non-price competition would have a *positive* effect on training propensity.

Competitive pressure could enhance a firm's performance both in terms of productivity and product quality as well as its innovativeness and the pace of technological change ("free competition effect"; see, e.g., Geroski 1995). Contrary to this positive competition effect, the older literature assumed that intensive competition could hamper innovation activity ("Schumpeterian effect"). In the game-theoretic literature the impact of market structure (as a proxy for product market competition) upon the schedule of innovation is shown to depend critically on the difference of profit rates preceding and following the innovation (see, e.g., Reinganum 1981). This dependence being quite complicated, most studies do not come to theoretical unambiguous results with respect to the effects of market concentration on innovation. Recently, Aghion et al. (2005) developed a model that predicts an inverted-U relationship between product market competition and innovation. The authors found strong evidence for this model using U.K. panel data. There is also some evidence for Switzerland for a positive correlation between the intensity of non-price competition and innovation (see Arvanitis and von Arx 2004).

Given the ambiguity of the effect of market concentration on innovation and via innovation on the demand for qualified personnel as well as hypothesis (a) of Gersbach and Schmutzler, we would expect an *insignificant* (or even a *negative*) effect of intense price competition on the training propensity. On the other hand, we expect that intensive non-price competition would *positively* influence not only innovation but also directly the propensity to train apprentices according to hypothesis (b) of Gersbach and Schmutzler.

What about expected costs? Costs (e.g., training costs, recruitment costs, and learning by doing of newly-hired employees) depend mostly on the requirements of technology used, the labour market situation, and the existing institutional framework with respect to training of apprentices. We expect a large portion of these costs to be industry-specific, sector-specific or even region-specific. For example, in the Swiss apprenticeship system duration of training, formal requirements for trainers, performance requirements for apprentices, and (partly)

apprentices' wages are determined either by the state and/or the employers' associations at industry or sector level.

Further, we expect that the propensity to train apprentices would increase with increasing firm size. Larger firms have more resources than small ones, thus a larger potential for investing in education and vocational training. Moreover, if economies of scale exist, e.g., with respect to the facilities of vocational education, larger firms would have a comparative advantage vis-à-vis smaller ones, e.g., regarding training costs.

We are especially interested for the training propensity in the context of *newly-founded* firms. A general characteristic of an average young firm that distinguishes it from the average established firm is the considerably smaller size of the young enterprise. Thus, young firms would be expected to have generally a lower training propensity than established firms. This also means that young firms that grow older would show a higher training propensity than at the founding time or at an earlier phase of their development. In case of young firms some *individual characteristics of the firm founders*, a factor that does not play any role more in established firms, could also be relevant for the propensity to train apprentices; e.g., the professional experience and the vocational education of the founders could have a positive or negative influence on training propensity, dependent on the affinity of these persons to this type of vocational education.

3. Description of the Data

3.1 Construction of the data set

The data used in this study come from the cohort of Swiss enterprises, which were founded between 1996 and 1997. This is the first cohort of start-ups that was registered by the Swiss Federal Statistical Office. This cohort contains only "green-field" start-ups without mergers, manager-takeovers, etc. In the year 2000 data were collected by means of a postal survey among those firms that still existed by that time. In 2003 and 2006 two further surveys were conducted among the participants of the 2000 and 2003 survey respectively that still existed in 2003 and 2006 respectively and were willing to fill up the questionnaire. The data sets for 2000, 2003 and 2006 contained 1604, 940 and 620 observations respectively. Answers were received from 48.8% (2000), 58.6% (2003) and 66% (2006) of the firms respectively that were contacted.

Firms with up to one employee (measured in full-time equivalents including working firm owners) were excluded because of their size as potential firms, where apprentices are trained. Therefore, we used for each survey only the data of firms with a size of more than one employee. This restriction reduced the number of observations in our data sets to 937 (2000), 595 (2003) and 405 (2006) firms respectively (see table A.1 in the Appendix). A comparison

of the composition of the original data by industry and region with that of the data used in this study showed only small differences.

The questionnaire covered questions about basic firm characteristics, firm performance and activity level, resource endowment, innovative activities, and the market environment. In the year 2000 also information about the conditions of the firm foundation was collected, while in 2003 and 2006 questions about information and communications technologies (ICT) were included.

To substitute for missing values in the variables due to item non-response, we used the multiple imputations technique by Rubin (1987). The estimations were based on the mean of five imputed values for every missing value of a certain variable (see Donzé (2001) for a detailed report on the procedure used). For some variables such imputations were not possible, therefore not all data could be used in the econometric estimations.

3.2 Characteristics and development of the start-ups 1996/1997-2006

Most of the start-ups in the data set are firms in the service sector (see table A.1 in the Appendix). In each point of time they represent about 80% of the observations. About 12% belong to the construction sector, the rest 8% to the manufacturing sector. These shares remained almost constant during the period 2000-2006. In the service sector the sub-sector of modern (knowledge-intensive) services (e.g., banking and insurance, business services) has a larger share than the sub-sector of traditional services (e.g., trade, hotels and catering); the share of modern services increased considerably between 2000 and 2006. In the manufacturing sector there are more low-tech than high-tech start-ups.

The observed start-ups are for the most part small firms. In each survey more than 70% of the enterprises had employed less than five employees (measured in full-time equivalents). The average firm size has only slightly increased from one period to the next one.

In the year 2000 about 32% of the firms had 100% or more employees than they had in the beginning (table A.2). In the subsequent periods 2000-03 and 2003-06 about 22% and 12% of firms respectively could keep this pace of growth. In 2006, ten years since their foundation, only about 10% of the firms employed more than ten employees.

4. Start-ups 1996/1997-2006 and training propensity

Table 1 contains some information on the percentage of enterprises having apprentices and the average employment share of apprentices (training intensity referring to the firms with apprentices). In the year 2000 only 11% of the 937 firms that were considered in our estimates

had at least one apprentice. The share of firms that employed apprentices increased to 15% until 2003 and to 17% until 2006.

The average employment share of apprentices was almost constant in during the observation period and amounted to about 24%. But the informative value of the average employment share of apprentices is limited. In small firms as most of the start-ups are changes in the number of employees can make a big impact on the share of apprentices. The share is quite volatile and difficult to interpret. Therefore, we abstain from further analysis of the share of firms having apprentices.

The data in table 1 is classified by industry and sector. Further, services and manufacturing are grouped into sub-sectors. In all three surveys the percentage of enterprises having apprentices was at the highest in the construction sector (22.6% in 2000; 28.6% in 2003; 31.3% in 2006). The corresponding figures in the manufacturing industries were considerably lower (8.2% in 2000; 12.8% in 2003; 27.3% in 2006)[6] and in the traditional services (12.8% in 2000; 18.2% in 2003; 16.0% in 2006). In the modern services only a few firms provided vocational training (6.9% in 2000; 9.1% in 2003; 12.4% in 2006). The propensity to do vocational training seems to be strongly sector-specific. In particular, the results for the service sector that represent the largest part of our observations show that the most dynamic sub-sector of the economy, the knowledge-based services, contribute only weakly to the training of apprentices. On the whole, new firms in less innovative industries tend to have more apprentices than new firms in innovative industries.

As expected, we find that the share of apprentices is generally positively correlated with the firm size (table 2). A more detailed analysis of the quantitative relationship between training propensity and firm size showed that the propensity increases with firm size but at a decreasing rate. This is a hint that there are no scale effects with respect to training propensity, at least for the limited range of firm size of new firms in our sample.

A comparison with data for similar size classes of the total firm population (see Müller and Schweri 2006, p. 39) shows significant differences between start-ups and established firms For all size classes in cross-section 2000 a smaller portion of start-ups offered apprenticeships than established firms in1998. The differences decrease to some extent if we compare start-ups in the cross-section 2003 with established firms in 2001.

The geographical region in which firms are located has little effect on the training propensity (table 3). The percentages of enterprises having apprentices do not vary much among most regions regions. The training propensity in the Lac Léman region tended to be above-average, while it was mostly below-average in Zurich.

[6] The volatility of the shares of firms having apprentices in the high-tech sub-sector are due to the very small numbers of firms behind these shares and should be regarded with caution.

5. Specification of a model of the determinants of training propensity

We used the binary variable 'a firm has apprentices yes/no' (TRP) as dependent variable. As already mentioned, the informative value of the average employment share of apprentices is limited. A further problem is that due to the small share of firms having apprentices the number of observations for the analysis of training intensity would become too low for econometric estimations. Therefore, we refrained from using training intensity as a further dependent variable.

In section 2 we discussed potential determinants of apprentice training that could be classified in five groups. In this section we specify the variables in every of these groups (see table 4 for details).[7]

Human resources. We used four dummy variables for the following four categories of employees with different education level: employees with university education yes/no (QUAL_4); employees with other tertiary-level education (including graduates of universities of applied sciences) (QUAL_3); employees with upper secondary education ('Berufslehre') (QUAL_2); and employees (with vocational education without a formal degree; no vocational education) (QUAL_1). We used these variables as proxies for the expected demand for the respective employee categories. We expect a positive effect for the high-educated and the middle-qualified employees (upper secondary education-level) and a negative effect for the low-qualified employees. In addition, we also use a dummy variable for the shortage of high-qualified personnel (SHORT). We assume that if there is a shortage of high-qualified employees, this would have a positive effect on the propensity to train apprentices. Further, for two points of time there is additional information on firm-funded further training available (dummy variable FTRAIN). Our hypothesis is that firms that are willing to invest in further training of their employees would be also inclined to train apprentices.

Innovation and technology. We used the following three indicators to measure innovation: the input indicator 'R&D activities yes/no' (R&D); and two output indicators for product innovation: 'development and introduction of *new* products yes/no' (NP) and 'development and introduction of *modified* existing products' (MP). Further, for two points of time (2003, 2006) there is additional information on the use of ICT: 'intensive use of *internet* yes/no' (dummy variable INTER) and 'intensive use of *intranet* yes/no' (dummy variable INTA), thus having measures for the degree of ICT-based inter-connection inside the firm as well as with the firm environment. As already stated in section 2, the expected effect of innovation and technology on the training propensity of Swiss firms is not a priori clear.

[7] For similar specifications of the propensity to train apprentices in studies based on German or Austrian firm data, see, e.g., Neubäumer and Bellmann (1999); Franz et al. (2000); Stöger and Winter-Ebmer (2001); Beckmann (2002); and Niederalt (2004).

Firm activity level. We used three variables to cover firm activity level: a variable for the expected demand development (DEMAND); a variable for sales increase (SALES) and a variable for employment increase (EMPL); and a variable indicating if the firm has reached its break-even point with respect to profits (BREAK). All four variables are dummies. We expect a positive effect of these variables.

Market conditions. The competition pressure is measured directly by the two variables 'intensity of price competition' (PCOMP) and 'intensity of non-price competition' (NPCOMP). A third variable, 'exports yes/no' (EXPORT), measures the competition effect indirectly. As already mentioned, we expect a positive effect for NPCOMP and a negative effect for PCOMP. Export competition could be driven either by price or non-price competition or both of them. Thus, the effect of the variable EXPORT is not a priori clear.

Founder characteristics. For the first period 1996/1997-2000 several individual characteristics of the founders are available. We used two of them in our specification: gender (variable GENDER) and average age (variable AGE) as a proxy of professional experience. We do not have a priori expectations for GENDER; we expect a positive effect for AGE.[8]

Control variables. Firm size is measured by four dummy variables reflecting the small range of size in our sample of new firms (SIZE_1 to SIZE_4). A further important control variable is the sector affiliation (three dummy variables for manufacturing, modern services and traditional services; IND_1 to IND_3).

A formal expression of the training propensity equation is as follows:[9]

$$TRP = \alpha_0 + \alpha_1\ QUAL\_4 + \alpha_2\ QUAL\_3 + \alpha_3\ QUAL\_2 + \alpha_4\ QUAL\_1 + \alpha_5\ FTRAIN + \alpha_6\ SHORT + \alpha_7\ NP + \alpha_8\ MP + \alpha_9\ R\&D + \alpha_{10}\ INTER + \alpha_{11}\ INTRA + \alpha_{12}\ BREAK + \alpha_{13}\ SALES + \alpha_{14}\ DEMAND + \alpha_{15}\ EMPL + \alpha_{16}\ PCOMP + \alpha_{17}\ NPCOMP + \alpha_{18}\ EXPORT + \alpha_{19}\ AGE + \alpha_{20}\ GENDER + control\ variables + u \qquad (1)$$

6. Specification of a model of labour productivity

For the models of productivity we used the natural logarithm of sales per employee (number of employees measured in full-time equivalents; variable LQ/L) as dependent variable.

The following factors were considered as independent variables in the productivity model (see table 4): a variable for physical capital CAP), which for all three periods takes the value of the start-up capital;[10] a variable for human capital (dummy variable for employees with tertiary-

[8] We do not use the founders' education level as a further personal characteristic because this variable is strongly correlated or even identical with (one of) the variables for the employees' educational level due to the smallness of the new firms in our sample.

[9] The variables FTRAIN, INTER and INTRA are only for the cross-sections 2003 and 2006 available.

[10] Data on physical capital are not available for the two last periods. We found it better to use the start-up capital as a control for physical capital than not controlling at all for capital.

level education; QUAL); a variable for R&D ('R&D activities yes/no'; R&D); a variable reflecting serious financial difficulties (FIN); and the propensity of training (TPR), Further, the productivity equation includes controls for firm size (dummy variables SIZE_1 to SIZE_4), sector affiliation (dummy variables IND_1 to IND_3) and geographical region (dummy variables REG_1 to REG_6).

We expect a positive effect of the three variables CAP, QUAL and R&D and a negative effect of FIN on productivity. We have no a priori expectations with respect to the effect of the training propensity variable. A formal expression of the propensity equation is as follows:

$$LQ/L = \beta_0 + \beta_1 LCAP + \beta_2 FIN + \beta_3 R\&D + \beta_4 QUAL + \beta_5 TRP + control\ variables + u \quad (2)$$

7. Results of the econometric estimations

7.1 Testing for selection bias

Between two subsequent surveys some firms disappeared from the market, some other did not want to participate to our survey. If the probability to get an answer depends upon the propensity to train, a selection bias may arise.

In table 5 we present information on the training propensity of all firms that participated to the 2000 (2003) survey versus the training propensity of those firms that were still existing and willing to participate to the subsequent survey 2003 (2006). In the former case (period 2000-2003) the respondents of both surveys showed a training propensity of 11.9% versus a propensity of 10.0% of the respondents only of the earlier survey; in the latter case (period 2003-2006) the corresponding figures are 14.0% versus 16.9%. The differences between these figures are small and they are not systematic. In the period 2000-2003 the respondents of both surveys showed a higher propensity that the respondents of only the earlier survey; in the period 2003-2006 it was the other way around. These preliminary results can be interpreted as a hint that there is no significant bias with respect to training propensity.

Further, we estimated a Heckman selection model (see Heckman 1976) for 2003 and 2006 to test for a possible bias (see table 6). Due to technical difficulties (no convergence of the estimates) we could estimate the selection model only for the period 2000-2003. The selectivity equation is based on the data of the respective previous period. According to Wooldridge (2002) the selection equation (variable ANSWER in table 6) should contain the same explanatory variables as the training propensity equation plus an additional variable that allows the model identification.[11] This additional variable was the variable EQUITYFIN. We

[11] We had to drop the variables FTRAIN, INTER, and INTRA from the propensity equation because data for these variables were not available for the year 2000.

expected that financial difficulties could be an important factor for explaining why a firm did not exist anymore or did not participate to the next survey.

According to the results in table 6 we could not detect a selection bias for 2003. The LR test on the correlation of the residuals of the selection equation and the training propensity equation is not statistically significant.

7.2 Estimates of the training propensity equation

We estimated separate probit models with the binary dependent variable TRP for each of the three cross-sections 2000, 2003 and 2006 (see table 7). Each cross-section reflects a further stage in the development of the start-ups. Thus, differences of the results over these three points of time would represent differences of behaviour with respect to training propensity in different development stages, provided that measurement errors are not the reason for these differences.

7.2.1 Cross-section 2000

Three to four years after the firms' foundation, the training propensity appeared to depend on several factors (column 1 to column 4 in table 7).[12]

Human resources. The firms' skill mix plays an important role for the training propensity in the first years after foundation. We found a statistically significant positive correlation of training propensity with the dummy variable for the one category of high-qualified employees (variable QUAL_3) and a statistically significant negative correlation with the dummy for the low-qualified employees (variable QUAL_1). The coefficients of the other two variables for academics (variable QUAL_4) and middle-educated employees (variable QUAL_2) are not statistically significant.[13] We expected a positive effect also for the variable QUAL_2 that could not be detected in the estimates. According to our survey most of the founders had a tertiary-level education (university education: 42.1%; other tertiary-level education: 20.2%) and only 37.7% were middle-educated persons ('Berufslehre'); see Arvanitis and Marmet 2001, p. 96). Given the crucial role of the founders also with respect to human resources, it is thus understandable that our result reflects the higher share of high-qualified persons among firm founders. This is an important result that shows that high-educated founders, presumably also middle-educated, are inclined to offer apprentice training. [14] On the contrary, firms with a high share of low-educated employees appear to be less interested in apprentice training. Moreover, the significantly positive coefficient of the variable SHORT demonstrates that

[12] For the cross-section 2000 no data for the variables FTRAIN, INTER and INTRA were available, thus these three variables are not included in the equation for this cross-section.

[13] Due to multicollinearity we had to conduct separate estimates with the different variables for human resources (columns 1 to 3 in table 7).

[14] A comparison with the results for a sample of established firms shows that in general there is a strong positive correlation between the training propensity and the share of middle-educated employees (see Arvanitis 2008).

firms are stronger inclined to offer apprentice training when they anticipate a shortage of qualified personnel. The shift from a firm without employees of the category 'other than university tertiary-level education' to a firm with employees of this category is correlated with an increase of 5.2% of the likelihood of offering apprentices (see marginal effects in column 4 corresponding to the estimates in column 1 in table 7). This is the strongest effect for this cross-section (without control variables).

Innovation and technology. Conducting R&D (innovation input) seems to be unrelated to the training propensity. It makes a big difference for training propensity whether new firms are introducing new products or just modified existing ones. For the former case we find a negative correlation, for the latter case a positive correlation with training propensity. A possible explanation for the negative effect of new products could be that new firms that concentrate in product innovation in the first years after foundation depend heavily on high-qualified personnel, thus have little scope for apprentice training. On the contrary, improvement of existing products is more compatible with apprentices training. A shift from a firm without modified products to a firm with such products is correlated to an increase of the probability of apprentice training of 4.6%, which is the second-strongest effect for this cross-section (see column 4 in table 7).

Firm activity level. Rather unexpected, all four variables related to firm activity (BREAK; SALES; DEMAND; EMPL) are statistically insignificant. Given the volatility of macroeconomic conditions in the reference period 1996/97-2006, this result could be interpreted as a hint that the training propensity is a kind of structural characteristic of a firm, thus independent of demand conditions.

Market conditions. Neither the intensity of price competition (PCOMP) nor the intensity of non-price competition (NPCOMP) appears to have an effect on the training propensity. Exporting firms among new firms are less inclined than non-exporting ones to train apprentices. In accordance with the theoretical expectations the negative effect result could be interpreted as a hint that export competition is primarily price competition. But this conclusion would be in contradiction with the well-known fact, that the export advantages of Swiss firms are mostly not price advantages but rather advantages based on better quality and other parameters of non-price competition.

This effect could be also explained by the concentration of scarce management resources of small new firms in expanding activities in foreign markets, thus paying less attention to time-consuming training matters, especially with respect to apprentices. Thus export activities seem to distract the management attention from training activities, at least in the first years after the firm foundation.

Founder characteristics. Rather unexpected, we find a statistically significant negative coefficient of the variable for the average age of the firm founders (AGE).[15] Younger founders seem to be stronger inclined to training than older ones. An explanation for this effect could be that not the level of professional experience but the educational level of the founders is relevant with respect to training propensity. Younger founder are in general better educated than older ones (see Arvanitis and Marmet 2001). On the other hand, gender (GENDER) has no significant effect on the probability to train apprentices.

7.2.2 Cross-section 2003

We find no significant effects of the four variables for *human resources* used in cross-section 2000. However, the coefficient of the variable for further firm-initiated training (FTRAIN) is significantly positive (this is also the case for the next cross-section 2006). This is another important result that shows that investment in human capital is positively correlated with the propensity to train apprentices. The corresponding marginal effect is 5.4%, the strongest effect (together with the effect of the variable BREAK) for this cross-section.

We find no significant effects for the *innovation* variables NP, MP and R&D. No effect is discernible also for the technology variable INTRA for intranet use. However, the coefficient of the variable for internet (INTER) is significantly negative. This effect becomes statistically insignificant in the cross-section 2006. It seems that to some extent technologically up-graded start-ups are less inclined to offer apprentices than firms with a lower technological level.

Two of the three variables referring to the *level of firm activity* (DEMAND and EMPL) show no effect on the training propensity. For this cross-section, the variable for having attained the profit break-even point BREAK is negatively correlated with training propensity (marginal effect of 5.4%). A possible explanation for this effect could be that in a trough year of the business cycle (as the year 2003 war) the profits would strongly diverge among firms.

No effect is found also for all four variables for the *market conditions*. The negative effect of the variable AGE is found also for this cross-section.

On the whole, six to seven years after the firm foundation the model variables appear to explain considerably less of training behaviour than in the previous cross-section.

7.2.3 Cross-section 2006

The positive effect of further training (variable FTRAIN) and the negative effects of exports (variable EXPORT) and of founders' age (variable AGE) were found also for this cross-section nine to ten years after the firm foundation. All other variables were statistically

[15] We have data about the individual characteristics of the founders only for the year 2000. We used the same data also for the years 2003 and 2006. Thus, we could not take into account possible exits and entries of firm owners, which on the whole were rather low (in 2006, 11.8% of the firms reported an entry of a new owner; 19.5% of the firms reported an exit of a founder; see Marmet 2006).

insignificant. On the whole, the model variables explain even less of training behaviour than in the cross-section 2003.

7.2.4 Firm size and sector effects

After having controlled for a large number of possible determinants, firm size dummy variables still explain a considerable portion of regression variance. Their coefficients are always positive but training propensity does not increase monotonously with increasing firm size. For all three cross-section, first, when a firm employs 3 to 4 employees instead of up to two employees (SIZE_1), the likelihood of offering apprenticeships increases on average by 8.0 (2000), 18.4% (2003), and 25.9% (2006) respectively (columns 4, 8 and 12 in table 7). Secondly, the probability to offer vocational training in firms with more than twenty employees (SIZE_4) is on average 44.9% (2000), 56.4% (2003), and 67.7% (2006) respectively, thus significantly higher than in firms with up to two employees, but only in 2000 higher than that for the other three firm size classes. For the other two thresholds (SIZE_2 and SIZE_3) the results differ from cross-section to cross-section.

For all three cross-sections the coefficient of the dummy variable for the modern services (IND_2) is significantly negative, indicating that in the sub-sector of the economy with the highest growth rate the training propensity is significantly lower than in all other sectors. The absolute value of the corresponding marginal effect has increased between 2000 and 2006 from 6.1% to 8.7%.

7.3 Panel estimates of the training propensity equation

In a further step, we estimated the training propensity equation for a sample containing only the 286 start-ups that could survive until 2006 and had more than 1 employee in all three periods.[16] We estimated a pooled probit model with time dummies and a random probit model. The results are presented in table 8. There are only few differences as compared with the results of separate estimates for each cross-section in table 7. A new finding is that for the firms that operated during the whole long period 1996/97 to 2006 the increase of firm employment (variable EMPL) increased also the demand for apprentices. All other effects were found also in the estimates for the cross-sections: positive effect for employees with tertiary-level education (without academics); negative effect for profit break-even point; negative effect for exports; negative effect for the age of the firm founders; positive effect for firm size; and negative effect for the knowledge-based service industries.

[16] The surviving firms were more than 286, namely 396, but not all of them had more than 1 employee in the earlier periods.

7.4 Estimates of the labour productivity equation

We estimated OLS models for the dependent variable LQ/L for the years 2000, 2003 and 2006 (see table 9). To take into account the endogenous character of training propensity (TRP) we estimated Full Information Maximum Likelihood models; this model considers the effect of the endogenously chosen binary variable TRP on the endogenous continuous variable LQ/L, conditional on two sets of independent variables.[17] To model TRP, we used the same independent variables as in table 7 (including the variables QUAL_3 and QUAL_4). The variable SHORT that correlates with TRP but not with LQ/L is the identifying variable in the estimates for cross-section 2000; the variable AGE for the estimates for cross-section 2003; and variable FTRAIN for the estimates for cross-section 2006.

We find, as expected, a positive effect for LCAP but only for the cross-section 2000. For the other two cross-sections the coefficients of this variable are insignificant. For R&D we find rather unexpectedly a significantly negative effect only for the cross-section 2000. Start-ups with R&D activities seem to concentrate their efforts to these activities and somewhat neglect other important entrepreneurial activities, e.g. cost optimization. For the year 2003 we find a significant negative effect for the variable FIN. QUAL seems to be of no relevance for the productivity of the young firms in our sample. For 2006, there is a firm size effect, larger firms having a higher productivity than smaller ones. For 2000 we find positive effects for firms in the modern as well as in the traditional service industries.

What we are most interested is the effect of the training propensity (TRP) on productivity. We find a statistically significant negative effect for all three cross-sections. This result is in accordance with the findings for a sample of Swiss established firms (see Arvanitis 2008). Thus, start-ups with an above-average labour productivity show a low propensity to train apprentices. An explanation for this result could be that new firms that have already achieved a high productivity level, presumably by applying more advanced technology and/or having a better organization, assign a significantly lower priority to the task of training apprentices than firms with a low productivity.

8. Comparison with existing empirical literature

There are only few empirical studies that deal direct with apprenticeship training in start-up companies based on samples of new firms. Two recent studies deal directly with the training behaviour of newly-founded firms.

[17] In further estimates not presented here we used alternative estimation methods to test the robustness of the results. We estimated a 2SLS model and also applied a two-step procedure with bootstrap estimations for the standard errors. The results were similar to those presented here.

Baldwin (2000) in a study for Canadian start-ups that were founded in the period 1983-1986 and survived to1993 found that firms that train their employees are more likely to grow, given other things such as innovation and technological capabilities.

The study of Demgenski and Icks (2002) is based on data on start-up companies in business services in Germany that was collected in 2001. The sample used contains not only "green-field" start-ups, but newly-founded firms in general that were not older than 11 years in 2001. The authors conducted regression analysis for explaining the firms' training propensity. They found a positive effect with respect to expected higher skill-requirements, but a negative effect of the share of employees with tertiary-level education. No effect could be found for the expected development of employment and for advanced vocational training. As in most studies, there was a positive effect of firm size. With respect to founder characteristics, the qualification level of a company's manager does not seem to be of relevance for the probability to train apprentices. A further finding of the study is that venture start-ups show a higher training propensity than company takeovers. Finally, no effect could be found for firm age.

Sassmannshausen and Reinert (2006) also conducted an analysis of the probability to train in young firms. The data was limited to the three German cities Wuppertal, Remscheid and Solingen (all located in the federal state of Nordrhein-Westfalen). Based on bivariate correlation analysis the authors found a positive effect of firm size but no significant effect of the gender of the entrepreneur, the age of the enterprise and the type of start-up ("green-field" foundation or not). Moreover, they showed that past firm performance is more relevant for the decision to train apprentices than expected performance.

A second category of empirical studies deals indirectly only with the training behaviour of new firms that usually are part of a sample of established firms.

In a study based on a panel of Swiss firms in the period 1995- 2004 Arvanitis (2008) found that firm age correlates positively with the propensity to train apprentices, which is quite compatible with the results of the present study.

Further, Neubäumer and Bellmann (1999) found in a study based on data for German firms – contrary to their expectations – no significant difference with respect to the propensity of training apprentices between start-ups and established firms. Also in Niederalt (2004) was the coefficient of the dummy variable for start-ups in the estimates for the training propensity of German firms insignificant.

Finally, in a study based on data for Austrian firms Stöger and Winter-Ebner (2001) investigated the determinants of training propensity and training intensity three points of time (1983, 1990, and 1998). They found a positive effect for firm age and also for firm size both with respect to training propensity and training intensity. They included in their training equations also variables related to the age and gender structure of the employees.

We could not find any studies that investigate the relationship between training propensity and labour productivity of start-ups. Thus, we can compare only with the few existing similar studies for established firms.[18]

In the already above-mentioned study for Swiss firms Arvanitis (2008) found that a strong negative effect of the propensity of training apprentices on labour productivity. This finding is quite compatible with our finding in the present study.

Fougère and Schwerdt (2002) investigated the contribution of the number of apprentices to output value in a production function framework based on data for German and French firms in 1992/93. They estimated the production functions separately for three firm size classes (less than 20 employees; between 20 and 200 employees; more than 200 employees). Moreover, they estimated quartile regressions for every firm size class. They could not find a statistically significant contribution of the number of apprentices for 'small' and for 'large' firms for both countries when using the entire sample. For the 'medium-sized' firms they found a negative effect for the German firms (as we also found for the Swiss firms) and an insignificant effect for the French firms. The regressions based on French data for the 1st, 2nd and 3rd quartile respectively showed positive effects, for the 4th quartile an insignificant effect. The respective regressions for the German firms showed a negative effect for the 1st quartile, a positive effect for the 4th quartile and insignificant effects for the 2nd and 3rd quartile respectively. On the whole, the contributions of apprentices to productivity are rather weak for both countries.

Finally, Zwick (2007) in a paper with German firm data studied the influence of the share of apprentice in German firms on the firm profits per employee and found partly a negative effect. In a new study, Mohrenweiser and Zwick (2008) showed that the negative effect of the share of apprentices on firms' profits can be found only in manufacturing occupations but not in trade, commercial, craft and construction occupations, for which this effect is positive.

On the whole, a close comparison with other studies is not possible due to differences either in the composition of the data with respect to industry affiliation or in model specification.

9. Conclusions

In this study we analyzed, firstly, the determinants of training propensity and how they change with increasing firm age for a cohort of Swiss firms that were founded in 1996/97. Secondly, we investigated how a firm's training propensity correlated with its labour productivity.

The main results of our estimations are as follows:

[18] For productivity effects of firm-sponsored training in general (not specifically apprentice training) see, e.g., Dearden et al. (2006).

(a) *Human capital endowment*. The skill mix of the employment shows an effect only in the first years after the firm foundation (until 2000): the share of the employees with tertiary level education (without academics) is positively, the share of low-qualified personnel negatively correlated with the training propensity. For the other two periods, the qualification mix shows no effect. On the other hand, firms that offer further education for their employees are stronger inclined to offer apprentices than firms without further education activities. This is an interesting result showing that a high propensity to offer apprenticeships is embedded in the overall tendency of a firm to improve its human capital.

(b) *Innovation and technology*. For the starting period (until 2000) the relation of training propensity to the introduction of *new* products is negative, the relation to the introduction of *further modified* products positive. Having R&D activities (or not) is of no relevance for the training propensity. For the two other periods we could not find any effect of the innovation variables. In sum, there is no close relation between innovative activities and the training propensity, with the exception of the starting period, in which efforts to develop and introduce new products seem to distract the attention of firm management from training activities. On the other hand, for the same period modifications of existing products correlate positively with training activities.

A further result is that the intensity of use of internet as indicator of the technological level is negatively correlated with the training propensity (statistically significant is this result only for 2003), thus implying that technologically up-grated start-ups are less inclined to offer apprenticeships than firms with a lower technological level.

(c) *Firm activity level*. It is a rather astonishing result that the training propensity is not significantly related to employment growth, sales growth, expected future development of demand or the break point of profits. Given the volatility of macroeconomic conditions in the reference period 2000-2006, this result could be interpreted as a hint that the training propensity is a kind of structural characteristic of a firm, thus independent of demand conditions.

(e) *Competitive pressures*. We find no effects for the two variables measuring the intensity of price and non-price competition. The export variable has throughout a negative coefficient but this is statistically significant only for the starting period. Export activities seem to distract the management attention from training activities.

(e) *Founder characteristics*. Gender shows no influence at all, age of the founders throughout a negative one. Thus, older firm founders tend to offer less apprenticeships than younger ones, due presumably to the fact that younger founders are better educated than older ones.

Firm size dummies are positively correlated with the training propensity but the training propensity does *not* increase monotonously with increasing firm size. Modern services, the

most dynamic part of the Swiss economy in the last twenty years, show the lowest training propensity, after controlling for all other things.

Finally, we found a statistically significant negative effect of training propensity on labour productivity for all three cross-sections.

On the whole, our model explains a considerable portion of the variance of the propensity to train apprentices only for the cross-section 2000, i.e. three or four years after a firm's foundation. For the other two cross-sections 2003 and 2006 the model's explanatory power diminishes considerably. Thus, our results could be interpreted as a hint that the training propensity is a kind of structural characteristic of newly-founded firms that is determined by a series of structural factors in the first years after the firm foundation (as in 2000 for the 1996/97 cohort) and appears to be independent of demand conditions.

On the average the training propensity increases with firm age, but it appears that this increase is driven – with the important exception of further education – by structural factors such as firm size and sector affiliation.

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Table 1: Propensity of training and training intensity of start-ups by sector and industry

Year	2000		2003		2006	
Industry / sector	Percentage of enterprises having apprentices	Average employment share of apprentices (reference: enterprises with apprentices)	Percentage of enterprises having apprentices	Average employment share of apprentices (reference: enterprises with apprentices)	Percentage of enterprises having apprentices	Average employment share of apprentices (reference: enterprises with apprentices)
Food	0.0	-	0.0	-	-	-
Textiles, clothing, leather	20.0	40.0	0.0	-	0.0	-
Wood processing, paper, printing	12.0	7.3	0.0	-	30.0	24.3
Chemicals, plastics, glass, stone, and clay	0.0	-	12.5	12.0	33.3	27.0
Metal, metalworking	8.3	33.0	11.1	14.0	25.0	20.0
Machinery, vehicles	0.0	-	33.3	2.0	33.3	10.0
Electrical machinery, electronics, watches	9.1	10.0	28.6	5.5	40.0	5.5
Other manufacturing	9.1	50.0	25.0	40.0	0.0	-
Manufacturing	8.2	18.5	12.8	13.2	27.3	18.7
− High-tech manufacturing	4.2	10.0	25.0	6.3	38.5	15.0
− Low-tech manufacturing	9.8	24.2	6.5	27.0	20.0	23.3
Construction	22.6	20.6	28.6	17.2	31.3	26.4
Wholesale trade	12.9	32.0	17.3	30.1	13.3	35.3
Retail trade	18.1	31.5	24.7	26.1	23.9	32.3
Hotels, catering	5.6	10.0	10.0	5.0	0.0	-
Transport, telecommunications	3.9	33.0	9.5	31.0	25.0	37.5
Banks, insurance	17.7	18.3	12.5	10.0	33.3	1.0
Real estate, leasing, computer services	3.7	13.8	7.0	23.8	13.0	17.2
Other business services	7.0	20.8	10.0	27.4	11.7	21.2
Educational services	0.0	-	0.0	-	0.0	-
Health care	16.7	33.3	28.6	13.8	18.2	14.0
Personal services	18.5	37.4	18.2	50.0	0.0	-
Culture/sport/entertainment	16.7	31.0	0.0	-	0.0	-
Services	9.9	27.2	13.4	26.5	13.9	24.6
− Modern services	6.9	19.3	9.1	27.3	12.4	19.5
− Traditional services	12.8	31.5	18.2	26.0	16.0	30.3
Total	11.1	25.4	15.0	23.7	17.0	24.2
N	937	104	595	89	405	69

Note: High-tech manufacturing: chemicals; plastics; machinery; electrical machinery; electronics and instruments; vehicles; low-tech manufacturing: all other manufacturing industries; modern services: banking and insurance; computer services; other business services; traditional services: all other service industries.

Table 2: Propensity of training and training intensity of start-ups by firm size

Year	2000		2003		2006	
Firm size	Percentage of enterprises having apprentices	Average employment share of apprentices (reference: enterprises with apprentices)	Percentage of enterprises having apprentices	Average employment share of apprentices (reference: enterprises with apprentices)	Percentage of enterprises having apprentices	Average employment share of apprentices (reference: enterprises with apprentices)
1 - 2 employees	5.2	36.0	4.7	33.6	2.3	42.5
2 - 4 employees	12.7	30.5	17.5	28.7	21.8	27.4
4 - 10 employees	20.9	18.4	29.5	20.4	29.5	26.3
10 - 20 employees	14.3	11.6	27.6	11.3	44.8	14.5
more than 20 employees	38.9	9.1	28.6	6.5	41.7	9.4
Total	11.1	25.4	15.0	23.7	17.0	24.2
N	937	104	595	89	405	69

Table 3: Propensity of training and training intensity of start-ups by geographical region

Year	2000		2003		2006	
Region	Percentage of enterprises having apprentices	Average employment share of apprentices (reference: enterprises with apprentices)	Percentage of enterprises having apprentices	Average employment share of apprentices (reference: enterprises with apprentices)	Percentage of enterprises having apprentices	Average employment share of apprentices (reference: enterprises with apprentices)
Lac Léman region	15.7	21.2	26.6	24.4	18.8	15.2
Espace midland	12.3	22.3	17.9	22.5	21.7	25.5
North-western Switzerland	10.2	33.6	13.2	29.3	17.7	26.2
Zurich	9.5	25.9	9.5	26.1	9.2	25.8
Eastern Switzerland	9.3	19.7	14.5	20.9	19.2	29.2
Central Switzerland	11.3	31.1	11.4	20.9	18.4	18.7
Ticino	12.0	29.0	18.2	20.5	20.0	21.0
Total	11.1	25.4	15.0	23.7	17.0	24.2
N	937	104	595	89	405	69

Table 4: Definition and measurement of model variables

Variable	Definition/measurement
Dependent variables	
TRP	Having at least one apprentice yes/no (training propensity)
LQ/L	Logarithm of total sales per employee (number of employees measured in full-time equivalents)
ANSWER	Firm sent back the questionnaire yes/no
Independent variables	
QUAL_4	University graduates yes/no
QUAL_3	Employees with other tertiary-level education yes/no
QUAL_2	Employees with a formal degree in vocational education (‘Berufslehre’) yes/no
QUAL_1	Employees with vocational education without formal degree or no formal vocational education yes/no
QUAL	Employees with tertiary-level education
FTRAIN	Firm-initiated further training yes/no
SHORT	Shortage of high-qualified personnel yes/no; the variable is based on the two ordinal variables 'high-qualified personnel is too expensive' and 'high-qualified personnel is too difficult to find'; we calculated the average of the scores for these two variables; then transformed the mean of these two five-level ordinal variables (level1: 'very weak'; level 5: 'very strong') to a binary variable (1: values higher than 3 of the mean variable;0: values 3 and lower than 3)
NP	Development and introduction of *new* products yes/no
MP	Development and introduction of *modified* existing products yes/no
R&D	R&D activities yes/no
INTER	Intensity of use of internet; transformation of a five-level ordinal variable (level 1: 'very weak use'; level 5: 'very strong use') to a binary variable (value 1: levels 4 and 5 of the original five-level variable; value 0: levels 1, 2 and 3 of the original variable)
INTRA	Intensity of use of intranet; original and transformed variables as for INTER
BREAK	Profit break-even point attained yes/no
SALES	Development of sales; dummy variable (1: increase; 0. decrease; no change); 2000: sales in 1999 compared with those in 1998; 2003: sales in 2002 compared with those in 1999; 2006: sales in 2005 compared with those of 2002)
DEMAND	Development of a firm’s specific product demand in the next two years measured by a five-level ordinal variable (level 1: ‘strong decrease’; 5; ‘strong increase’) referring to the (reference year: survey year); transformation of this variable to a binary variable (value 1: levels 4 and 5; value 0: levels 1, 2 and 3 of the original five-level variable)
EMPL	Development of employment; dummy variable (1: increase; 0: decrease; no change of the number of employees (number of employees measured in full-time equivalents; reference periods: 1997-1999; 2000-2002; 2003-2005)
PCOMP	Intensity of price competition; transformation of a five-level ordinal variable (level 1: 'very weak'; level 5: 'very strong') to a binary variable (value 1: levels 4 and 5 of the original five-level variable; value 0: levels 1, 2 and 3 of the original variable
NPCOMP	Intensity of non-price competition; original and transformed variables as for IPC
EXPORT	Exports yes/no
GENDER	Gender of the firm founders: male/female (the most frequently reported gender is regarded as representative for the firm founders; if the number of 'females' equals the number of 'males' we set 'female')
AGE	Average age of the firm founders
LCAP	Natural logarithm of the start-up capital
FIN	Importance of financial obstacles for the firm foundation and/or a firm’s further development; the variable is based on six ordinal variables for various categories of financial obstacles; we transformed the mean of these six five-level ordinal variables (level 1: 'very weak'; level 5: 'very strong') to a binary variable (value 1: average value of more than 3; value 0: average value up to and including 3)
EQUITYFIN	Importance of equity financing; the variable is based on three ordinal variables for various categories of equity financing; transformation of the variables as for FIN.
SIZE_1 to SIZE_4	Dummies for four firm size classes: 3 to 4 employees (SIZE_1); 5 to 10 employees (SIZE_2); 11 to 20 employees (SIZE_3); 21 and more employees (SIZE_4) (reference group: 1 to 2 employees)
IND_1 to IND_4	Dummies for three industries: manufacturing (IND_1); modern services (IND_2); traditional services (IND_3) (reference industry: construction)

REG_1 to REG_6	Dummies for six geographical regions: Lac Léman (REG_1); Espace midland (REG_2); North-western Switzerland (REG_3); Zurich (REG_4); Eastern Switzerland (REG_5); Central Switzerland (REG_6); (reference region: Ticino)

Table 5: Training propensity in 2000 by getting an answer in 2003

	answer 2003	
	Yes	no
apprentices 2000 yes	11.90%	10.0%
N	547	390
	answer 2006	
	Yes	no
apprentices 2003 yes	14.00%	16.90%
N	406	189

Table 6: Testing for selection bias for the training propensity; cross-section 2003; (Heckman selection model)

	Coef.	Std.Err.	z	P>|z|	[95% Conf.	Interval]
TPR						
QUAL_4	-0.161	0.161	-1.00	0.319	-0.477	0.156
QUAL_3	0.175	0.136	1.28	0.201	-0.093	0.442
QUAL_2	0.315	0.191	1.65	0.099	-0.059	0.688
QUAL_1	0.078	0.147	0.53	0.596	-0.210	0.366
SHORT	0.074	0.132	0.56	0.573	-0.185	0.334
NP	-0.127	0.190	-0.67	0.504	-0.499	0.245
MP	0.003	0.132	0.02	0.982	-0.255	0.261
R&D	0.194	0.173	1.12	0.262	-0.145	0.534
BREAK	-0.070	0.150	-0.47	0.641	-0.364	0.224
SALES	-0.013	0.156	-0.09	0.931	-0.319	0.292
DEMAND	-0.004	0.131	-0.03	0.976	-0.261	0.253
EMPL	-0.181	0.157	-1.15	0.249	-0.489	0.127
PCOMP	-0.118	0.128	-0.92	0.356	-0.369	0.133
NPCOMP	0.107	0.131	0.82	0.414	-0.150	0.365
EXPORT	-0.156	0.171	-0.91	0.361	-0.492	0.179
GENDER	0.030	0.161	0.19	0.853	-0.286	0.346
AGE	-0.024	0.009	-2.74	0.006	-0.042	-0.007
SIZE_1	0.700	0.184	3.81	0.000	0.340	1.060
SIZE_2	1.135	0.206	5.51	0.000	0.731	1.538
SIZE_3	0.971	0.311	3.13	0.002	0.362	1.580
SIZE_4	1.253	0.378	3.32	0.001	0.512	1.993
IND_1	-0.471	0.307	-1.53	0.125	-1.072	0.131
IND_2	-0.469	0.232	-2.03	0.043	-0.924	-0.015
IND_3	-0.066	0.210	-0.32	0.753	-0.478	0.345
CONS	-1.077	0.459	-2.35	0.019	-1.977	-0.178
ANSWER						
QUAL_4	0.100	0.110	0.91	0.363	-0.115	0.314
QUAL_3	0.044	0.093	0.48	0.632	-0.137	0.226
QUAL_2	0.212	0.103	2.05	0.040	0.010	0.415
QUAL_1	0.107	0.116	0.92	0.356	-0.120	0.334
SHORT	-0.071	0.092	-0.77	0.441	-0.252	0.110
NP	-0.179	0.113	-1.58	0.114	-0.402	0.043
MP	-0.187	0.089	-2.10	0.036	-0.362	-0.013
R&D	0.162	0.108	1.50	0.133	-0.049	0.373
BREAK	0.485	0.097	4.97	0.000	0.294	0.676
SALES	0.039	0.094	0.41	0.679	-0.145	0.223
DEMAND	0.447	0.102	4.38	0.000	0.247	0.648
EMPL	0.156	0.093	1.67	0.095	-0.027	0.339
PCOMP	-0.043	0.081	-0.53	0.594	-0.203	0.116
NPCOMP	-0.042	0.084	-0.50	0.620	-0.207	0.123
EXPORT	0.090	0.097	0.92	0.356	-0.101	0.280
GENDER	-0.214	0.100	-2.13	0.033	-0.410	-0.018
AGE	0.000	0.005	0.05	0.962	-0.010	0.010
SIZE_1	0.191	0.112	1.70	0.089	-0.029	0.410
SIZE_2	0.069	0.144	0.48	0.629	-0.212	0.351
SIZE_3	-0.138	0.277	-0.50	0.620	-0.681	0.406
SIZE_4	0.357	0.400	0.89	0.373	-0.428	1.141
IND_1	-0.109	0.198	-0.55	0.581	-0.497	0.279
IND_2	-0.014	0.163	-0.09	0.929	-0.334	0.305
IND_3	0.174	0.157	1.11	0.268	-0.134	0.482

EQUITYFIN	0.168	0.093	1.81	0.071	-0.014	0.350
CONS	-0.963	0.299	-3.22	0.001	-1.550	-0.377
N			=	466		
Wald chi2			=	67.57***		
rho			=	1.000		
LR test of rho=0: Prob > chi2			=	0.139		

Notes: See table 4 for the variable definitions; the data for the TPR equation refer to the year 2003, while the data for the ANSWER equation refer to year 2000.

Table 7: Training propensity TRP; probit estimates

Year	2000				2003				2006			
Explanatory variables	TRP probit	TRP probit	TRP probit	TRP probit me (dy/dx)	TRP probit	TRP probit	TRP probit	TRP probit me (dy/dx)	TRP probit	TRP probit	TRP probit	TRP probit me (dy/dx)
QUAL_4	-0.227			-0.029	-0.151			-0.023	-0.107			-0.015
	(0.16)				(0.20)				(0.25)			
QUAL_3	0.397***			0.052	-0.050			-0.008	0.351*			0.048
	(0.14)				(0.16)				(0.20)			
QUAL_2		0.109				0.147				0.265		
		(0.16)				(0.20)				(0.25)		
QUAL_1			-0.582***				0.105				-0.292	
			(0.17)				(0.16)				(0.22)	
SHORT	0.302**	0.291**	0.308**	0.045	0.232	0.223	0.222	0.040	-0.150	-0.161	-0.165	-0.020
	(0.14)	(0.14)	(0.14)		(0.16)	(0.16)	(0.16)		(0.20)	(0.19)	(0.19)	
FTRAIN					0.392*	0.354	0.382*	0.054	0.754**	0.813**	0.800**	0.075
					(0.21)	(0.22)	(0.22)		(0.33)	(0.32)	(0.33)	
NP	-0.333*	-0.396**	-0.461**	-0.038	-0.163	-0.173	-0.155	-0.024	0.406	0.415*	0.377	0.070
	(0.20)	(0.19)	(0.20)		(0.23)	(0.23)	(0.23)		(0.25)	(0.25)	(0.25)	
MP	0.331**	0.352**	0.331**	0.046	0.041	0.039	0.052	0.007	0.172	0.147	0.141	0.025
	(0.14)	(0.15)	(0.15)		(0.16)	(0.16)	(0.16)		(0.19)	(0.19)	(0.19)	
R&D	-0.164	-0.154	-0.181	-0.021	0.164	0.158	0.147	0.029	0.172	0.174	0.156	0.026
	(0.18)	(0.17)	(0.18)		(0.19)	(0.20)	(0.19)		(0.26)	(0.26)	(0.25)	
INTER					-0.500***	-0.517***	-0.512***	-0.080	-0.277	-0.244	-0.239	-0.040
					(0.19)	(0.19)	(0.19)		(0.21)	(0.22)	(0.21)	
INTRA					-0.194	-0.195	-0.191	-0.029	-0.236	-0.252	-0.270	-0.030
					(0.22)	(0.22)	(0.22)		(0.24)	(0.25)	(0.24)	
BREAK	-0.098	-0.081	-0.097	-0.014	-0.298*	-0.293*	-0.296*	-0.054	0.047	0.090	0.070	0.006
	(0.15)	(0.15)	(0.15)		(0.17)	(0.18)	(0.18)		(0.29)	(0.29)	(0.29)	
SALES	-0.140	-0.138	-0.150	-0.020	0.122	0.120	0.129	0.019	-0.251	-0.206	-0.187	-0.036
	(0.15)	(0.15)	(0.15)		(0.18)	(0.18)	(0.18)		(0.19)	(0.19)	(0.18)	
DEMAND	-0.238	-0.218	-0.237	-0.036	0.234	0.229	0.217	0.039	0.042	0.057	0.054	0.006
	(0.16)	(0.16)	(0.16)		(0.15)	(0.15)	(0.15)		(0.19)	(0.18)	(0.18)	

EMPL	0.136	0.163	0.173	0.018	-0.241	-0.266	-0.245	-0.041	0.261	0.216	0.220	0.036
	(0.17)	(0.17)	(0.17)		(0.17)	(0.17)	(0.17)		(0.20)	(0.20)	(0.20)	
PCOMP	0.054	0.066	0.109	0.007	-0.071	-0.064	-0.060	-0.011	0.190	0.236	0.223	0.027
	(0.13)	(0.13)	(0.13)		(0.15)	(0.15)	(0.15)		(0.19)	(0.19)	(0.19)	
NPCOMP	-0.107	-0.110	-0.124	-0.015	0.166	0.175	0.166	0.027	0.300	0.278	0.285	0.042
	(0.14)	(0.14)	(0.14)		(0.16)	(0.15)	(0.16)		(0.20)	(0.20)	(0.20)	
EXPORT	-0.372**	-0.372**	-0.433***	-0.045	-0.284	-0.276	-0.269	-0.042	-0.475*	-0.453*	-0.466*	-0.057
	(0.16)	(0.16)	(0.17)		(0.20)	(0.20)	(0.20)		(0.25)	(0.25)	(0.25)	
GENDER	0.003	0.043	0.047	0.000	0.287	0.283	0.286	0.043	0.163	0.144	0.115	0.022
	(0.15)	(0.15)	(0.15)		(0.18)	(0.18)	(0.18)		(0.23)	(0.23)	(0.22)	
AGE	-0.019**	-0.018**	-0.019**	-0.003	-0.023**	-0.025**	-0.025**	-0.004	-0.038***	-0.040***	-0.039***	-0.005
	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.01)	
SIZE_1	0.511***	0.505***	0.585***	0.080	0.901***	0.894***	0.889***	0.184	1.251***	1.328***	1.366***	0.259
	(0.16)	(0.16)	(0.17)		(0.20)	(0.20)	(0.20)		(0.27)	(0.27)	(0.27)	
SIZE_2	0.790***	0.780***	0.942***	0.152	1.350***	1.321***	1.315***	0.347	1.459***	1.495***	1.593***	0.354
	(0.18)	(0.17)	(0.19)		(0.22)	(0.21)	(0.22)		(0.28)	(0.28)	(0.28)	
SIZE_3	0.538	0.499	0.814**	0.102	1.270***	1.223***	1.194***	0.366	1.922***	1.990***	2.141***	0.576
	(0.35)	(0.34)	(0.35)		(0.34)	(0.33)	(0.34)		(0.36)	(0.34)	(0.34)	
SIZE_4	1.539***	1.525***	1.785***	0.449	1.761***	1.686***	1.642***	0.564	2.162***	2.162***	2.403***	0.677
	(0.41)	(0.39)	(0.41)		(0.48)	(0.47)	(0.47)		(0.51)	(0.50)	(0.51)	
IND_1	-0.329	-0.402	-0.487*	-0.037	-0.417	-0.420	-0.428	-0.053	0.025	0.077	0.050	0.004
	(0.29)	(0.29)	(0.29)		(0.31)	(0.31)	(0.31)		(0.32)	(0.32)	(0.32)	
IND_2	-0.473**	-0.497**	-0.681***	-0.061	-0.510**	-0.535**	-0.539**	-0.079	-0.626**	-0.542*	-0.691**	-0.087
	(0.21)	(0.20)	(0.20)		(0.25)	(0.24)	(0.24)		(0.30)	(0.29)	(0.29)	
IND_3	-0.101	-0.112	-0.195	-0.013	-0.094	-0.109	-0.125	-0.015	-0.289	-0.234	-0.318	-0.038
	(0.19)	(0.19)	(0.19)		(0.23)	(0.23)	(0.23)		(0.28)	(0.28)	(0.28)	
N	797	797	797	797	563	563	563	563	396	396	396	396
Pseudo R2	0.174	0.157	0.179		0.216	0.216	0.215		0.311	0.305	0.307	
Wald chi2	89.44***	79.01***	92.07***		100.37***	99.41***	100.16***		84.97***	83.38***	86.65***	

Notes: see table 4 for the variable definitions; the standard errors are found in brackets under the coefficients; ***, **, * denotes statistical significance at the 1%, 5% and 10% test level, respectively; heteroscedasticity-robust standard errors (White procedure).

Table 8: Training propensity TRP; panel estimates (only firms that are present in all three cross-sections

Explanatory variables	Pooled probit	Random effect probit
QUAL_4	-0.179	-0.173
	(0.15)	(0.40)
QUAL_3	0.450***	1.045***
	(0.13)	(0.33)
SHORT	-0.0145	0.0279
	(0.13)	(0.26)
NP	-0.0624	-0.260
	(0.16)	(0.39)
MP	0.144	0.144
	(0.13)	(0.25)
R&D	0.144	0.551
	(0.15)	(0.35)
BREAK	-0.254*	-0.369
	(0.15)	(0.30)
SALES	-0.117	-0.385
	(0.14)	(0.25)
DEMAND	-0.153	-0.164
	(0.14)	(0.23)
EMPL	0.243*	0.484*
	(0.14)	(0.27)
PCOMP	0.0337	0.119
	(0.12)	(0.24)
NPCOMP	0.111	0.117
	(0.13)	(0.28)
EXPORT	-0.323**	-0.598*
	(0.15)	(0.36)
GENDER	0.103	0.179
	(0.14)	(0.45)
AGE	-0.0218***	-0.0571**
	(0.0077)	(0.026)
SIZE_1	0.979***	2.162***
	(0.18)	(0.55)
SIZE_2	1.320***	2.757***
	(0.19)	(0.60)
SIZE_3	1.544***	4.246***
	(0.25)	(0.82)
SIZE_4	1.665***	3.460***
	(0.32)	(0.95)
IND_1	-0.327	-0.689
	(0.24)	(0.78)
IND_2	-0.780***	-2.068***
	(0.19)	(0.67)
IND_3	-0.323*	-0.942
	(0.18)	(0.60)
Y2003	-0.0811	
	(0.17)	
Y2006	0.152	
	(0.17)	
N	857	857
Pseudo R2	0.222	
Wald chi2	137.54***	40.93***

Rho		0.824
LR test of rho=0		109.48***

Notes: see table 4 for the variable definitions; the standard errors are found in brackets under the coefficients; ***, **, * denotes statistical significance at the 1%, 5% and 10% test level, respectively; heteroscedasticity-robust standard errors (White procedure).

Table 9: Productivity LQ/L; instrumented TRP; OLS estimates

Year	2000	2003	2006
Explanatory variables			
LCAP	0.040**	0.032	-0.002
	(0.02)	(0.02)	(0.02)
FIN	-0.031	-0.211**	-0.121
	(0.09)	(0.09)	(0.08)
QUAL	0.077	-0.040	0.010
	(0.08)	(0.11)	(0.09)
R&D	-0.181**	-0.061	0.038
	(0.07)	(0.09)	(0.09)
SIZE_1	0.135*	0.169	0.137
	(0.08)	(0.11)	(0.10)
SIZE_2	0.074	0.234**	0.393***
	(0.10)	(0.10)	(0.12)
SIZE_3	0.074	0.264	0.464***
	(0.14)	(0.23)	(0.18)
SIZE_4	0.423**	0.443*	0.981*
	(0.19)	(0.25)	(0.51)
IND_1	0.078	0.246	0.248*
	(0.10)	(0.19)	(0.15)
IND_2	0.182*	0.012	-0.154
	(0.10)	(0.12)	(0.11)
IND_3	0.414***	0.125	0.105
	(0.10)	(0.10)	(0.14)
TRP	-0.818***	-0.416*	-0.922***
	(0.20)	(0.24)	(0.18)
N	740	563	396
Wald chi2	67.01***	38.78***	59.37***
Rho	0.359	0.161	0.651
Wald test of rho=0: Prob > chi2	0.001	0.2304	0.000

Notes: see table 4 for the variable definitions; this model also includes controls for geographical region; the standard errors are found in brackets under the coefficients; ***, **, * denotes statistical significance at the 1%, 5% and 10% test level, respectively; heteroscedasticity-robust standard errors (White procedure).

APPENDIX:

Table A.1: Composition of data set used by industry, firm size (firm size > 1 employee), and region

Year	2000		2003		2006	
Industry / sector	N	Percentage of firms	N	Percentage of firms	N	Percentage of firms
Food	5	0.5	2	0.3	0	0.0
Textiles, clothing, leather	5	0.5	3	0.5	3	0.7
Wood processing, paper, printing	25	2.7	11	1.8	10	2.5
Chemicals, plastics, glass, stone, and clay	12	1.3	8	1.3	6	1.5
Metal, metalworking	12	1.3	9	1.5	4	1.0
Machinery, vehicles	4	0.4	3	0.5	3	0.7
Electrical machinery, electronics, watches	11	1.2	7	1.2	5	1.2
Other manufacturing	11	1.2	4	0.7	2	0.5
Manufacturing	85	9.1	47	7.9	33	8.1
− High-tech manufacturing	24	2.6	16	2.7	13	3.2
− Low-tech manufacturing	61	6.5	31	5.2	20	4.9
Construction	102	10.9	63	10.6	48	11.9
Wholesale trade	85	9.1	52	8.7	30	7.4
Retail trade	127	13.6	81	13.6	46	11.4
Hotels, catering	18	1.9	10	1.7	4	1.0
Transport, telecommunications	26	2.8	21	3.5	8	2.0
Banks, insurance	17	1.8	8	1.3	3	0.7
Real estate, leasing, computer services	108	11.5	57	9.6	46	11.4
Other business services	301	32.1	221	37.1	162	40.0
Educational services	11	1.2	7	1.2	5	1.2
Health care	18	1.9	14	2.4	11	2.7
Other services	27	2.9	11	1.8	8	2.0
Culture/sport/entertainment	12	1.3	3	0.5	1	0.2
Services	750	80.0	485	81.5	324	80.0
− Modern services	376	40.1	254	42.7	193	47.7
− Traditional services	374	39.9	231	38.8	131	32.3
Firm Size (number of employees)						
1 – 2 employees	445	47.5	257	43.2	176	43.5
2 – 4 employees	276	29.5	183	30.8	110	27.2
4 – 10 employees	163	17.4	112	18.8	78	19.3
10 – 20 employees	35	3.7	29	4.9	29	7.2
more than 20 employees	18	1.9	14	2.4	12	3.0
Region						
Lac Léman region	102	10.9	64	10.8	32	7.9
Espace midland	187	20.0	134	22.5	97	24.0
North-western Switzerland	137	14.6	76	12.8	62	15.3
Zurich	222	23.7	137	23.0	98	24.2
Eastern Switzerland	140	14.9	83	13.9	52	12.8
Central Switzerland	124	13.2	79	13.3	49	12.1
Ticino	25	2.7	22	3.7	15	3.7
N	937	100	595	100	405	100

Table A.2: Employment growth of start-ups 1996/97-2006

Period	1996/97 - 2000		2000 - 2003		2003 - 2006	
Employment growth	N	Percentage of firms	N	Percentage of firms	N	Percentage of firms
More than -50%	11	1.2	13	2.2	10	2.5
-20% - 50%	89	9.5	53	9.0	52	12.8
- 5% - -20%	37	3.9	30	5.1	41	10.1
-5% - 5%	117	12.5	135	22.9	95	23.5
+5% - +20%	39	4.2	41	7.0	34	8.4
+20% - +50%	167	17.8	106	18.0	77	19.0
+50% - +100%	178	19.0	89	15.1	48	11.9
+100% and more	299	31.9	122	20.7	48	11.9
N	937	100	589	100	405	100
average increase	108.39%		57.13%		32.56%	

Table A.3: Descriptive statistics

	2000		2003		2006	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
TPR	0.111	0.314	0.150	0.357	0.170	0.376
TRL	11.994	0.886	12.097	0.928	12.008	0.772
QUAL_4	0.277	0.448	0.282	0.451	0.296	0.457
QUAL_3	0.552	0.498	0.607	0.489	0.575	0.495
QUAL_2	0.708	0.455	0.745	0.436	0.741	0.439
QUAL_1	0.255	0.436	0.274	0.446	0.222	0.416
SHORT	0.306	0.461	0.296	0.457	0.316	0.466
FTRAIN			0.815	0.389	0.832	0.374
NP	0.159	0.366	0.129	0.336	0.133	0.340
MP	0.442	0.497	0.403	0.491	0.402	0.491
R&D	0.244	0.430	0.188	0.391	0.173	0.379
INTER			0.483	0.500	0.576	0.495
INTRA			0.166	0.372	0.217	0.413
BREAK	0.733	0.443	0.778	0.416	0.847	0.361
SALES	0.754	0.431	0.693	0.461	0.572	0.495
DEMAND	0.800	0.401	0.375	0.484	0.528	0.500
EMPL	0.732	0.443	0.625	0.485	0.531	0.500
PCOMP	0.436	0.496	0.504	0.500	0.489	0.500
NPCOMP	0.557	0.497	0.541	0.499	0.528	0.500
EXPORT	0.287	0.453	0.250	0.434	0.259	0.439
GENDER	0.721	0.449	0.723	0.448	0.711	0.454
AGE	39.113	8.307	39.121	8.259	38.637	8.178

Table A.4a: Correlation matrix for the cross-section 2000

	QUAL_4	QUAL_3	QUAL_2	QUAL_1	SHORT	NP	MP	R&D	BREAK	SALES	DEMAND	EMPL	PCOMP	NPCOMP	EXPORT	GENDER
QUAL_3	-0.01	1.00														
QUAL_2	-0.22	-0.27	1.00													
QUAL_1	-0.14	-0.06	0.05	1.00												
SHORT	0.04	0.00	0.00	0.06	1.00											
NP	0.10	-0.04	-0.02	-0.05	0.05	1.00										
MP	0.14	0.09	-0.07	-0.03	0.03	0.02	1.00									
R&D	0.19	0.06	-0.17	-0.10	0.13	0.22	0.33	1.00								
BREAK	0.00	0.04	-0.01	-0.06	-0.06	-0.05	0.01	0.00	1.00							
SALES	0.04	0.03	0.01	-0.02	0.02	0.02	0.06	0.01	0.08	1.00						
DEMAND	0.07	0.02	-0.04	-0.02	0.03	0.11	0.11	0.10	0.00	0.18	1.00					
EMPL	0.06	0.03	0.06	0.07	0.11	0.04	0.09	0.03	0.02	0.07	0.10	1.00				
PCOMP	-0.08	0.02	0.06	0.05	0.00	0.03	-0.02	-0.03	-0.02	0.00	-0.02	-0.01	1.00			
NPCOMP	0.09	0.04	-0.05	-0.09	0.07	0.08	0.17	0.14	0.04	0.06	0.11	0.06	0.02	1.00		
EXPORT	0.19	0.09	-0.16	-0.10	0.07	0.05	0.19	0.26	0.06	0.05	0.09	0.02	-0.03	0.09	1.00	
GENDER	0.07	0.09	-0.06	0.00	0.03	0.05	0.02	0.08	0.05	0.00	0.02	0.04	-0.03	0.03	0.07	1.00
AGE	0.01	0.05	-0.01	-0.04	-0.12	-0.05	0.02	0.00	0.08	-0.05	-0.03	-0.01	-0.04	0.00	0.07	0.02

Table A.4b: Correlation matrix for the cross-section 2003

	QUAL_4	QUAL_3	QUAL_2	QUAL_1	SHORT	FTRAIN	NP	MP	R&D	INTER	INTRA	BREAK	SALES	DEMAND	EMPL	PCOMP	NPCOMP	EXPORT	GENDER
QUAL_3	-0.02	1.00																	
QUAL_2	-0.24	-0.20	1.00																
QUAL_1	-0.06	-0.04	0.07	1.00															
SHORT	0.03	0.03	0.04	0.01	1.00														
FTRAIN	0.06	0.17	0.10	-0.06	0.06	1.00													
NP	0.11	0.00	-0.01	-0.06	0.12	0.14	1.00												
MP	0.02	0.06	0.01	-0.06	0.06	0.17	0.11	1.00											
R&D	0.14	0.06	-0.09	-0.04	0.02	0.10	0.22	0.24	1.00										
INTER	0.21	0.06	-0.10	-0.12	0.06	0.13	0.06	0.13	0.10	1.00									
INTRA	0.14	0.07	-0.03	-0.06	0.09	0.08	0.12	0.10	0.13	0.34	1.00								
BREAK	0.01	-0.01	0.01	-0.04	0.02	0.09	0.10	-0.04	-0.04	0.03	-0.01	1.00							
SALES	-0.01	-0.01	0.13	0.02	0.05	0.07	0.09	0.05	0.07	0.08	0.01	0.15	1.00						
DEMAND	0.06	0.06	-0.01	0.04	0.05	0.07	0.08	0.12	0.14	0.14	0.02	0.07	0.05	1.00					
EMPL	0.04	0.00	0.17	0.08	0.08	0.08	0.06	0.03	0.01	0.10	0.03	0.08	0.20	0.02	1.00				
PCOMP	-0.03	-0.02	0.03	0.00	0.09	0.06	0.06	0.04	0.05	-0.02	0.00	-0.09	-0.03	-0.03	0.07	1.00			
NPCOMP	0.10	0.02	-0.06	-0.04	0.05	0.15	0.07	0.10	0.09	0.11	0.09	0.01	0.07	0.13	0.07	0.01	1.00		
EXPORT	0.16	0.12	-0.15	-0.16	0.01	0.05	0.05	0.24	0.22	0.18	0.11	0.00	0.00	0.10	-0.02	0.05	0.10	1.00	
GENDER	0.08	0.08	-0.03	-0.04	0.00	-0.10	0.04	-0.01	0.05	0.02	-0.04	0.05	0.12	-0.02	0.07	-0.05	-0.05	0.05	1.00
AGE	0.07	0.07	-0.02	-0.03	-0.10	0.02	-0.05	-0.02	-0.07	-0.11	0.01	0.06	-0.09	-0.05	-0.09	-0.05	-0.02	0.08	0.00

Table A.4c: Correlation matrix for the cross-section 2006

	QUAL_4	QUAL_3	QUAL_2	QUAL_1	SHORT	FTRAIN	NP	MP	R&D	INTER	INTRA	BREAK	SALES	DEMAND	EMPL	PCOMP	NPCOMP	EXPORT	GENDER
QUAL_3	-0.06	1.00																	
QUAL_2	-0.25	-0.19	1.00																
QUAL_1	-0.07	0.02	0.05	1.00															
SHORT	0.07	0.06	0.02	0.03	1.00														
FTRAIN	0.05	0.17	0.05	-0.07	-0.03	1.00													
NP	0.08	-0.01	-0.03	-0.06	-0.01	0.02	1.00												
MP	0.06	-0.01	-0.06	0.02	-0.01	0.12	0.04	1.00											
R&D	0.22	0.03	-0.13	0.03	0.05	0.07	0.22	0.27	1.00										
INTER	0.23	0.11	-0.07	-0.11	0.13	0.09	0.12	0.20	0.14	1.00									
INTRA	0.16	0.11	-0.10	-0.05	0.05	0.12	0.12	0.17	0.16	0.39	1.00								
BREAK	0.01	0.05	0.01	-0.05	-0.06	0.09	-0.04	-0.02	-0.10	0.01	0.07	1.00							
SALES	0.03	0.07	-0.02	0.13	0.08	0.02	0.05	0.03	0.02	0.03	0.02	0.03	1.00						
DEMAND	0.08	0.00	-0.03	0.04	0.14	0.02	-0.03	0.04	0.14	0.06	0.01	0.00	0.05	1.00					
EMPL	0.13	0.04	0.03	0.09	0.03	0.13	0.11	0.16	0.08	0.06	0.04	0.08	0.31	0.08	1.00				
PCOMP	0.04	0.05	-0.06	0.11	0.09	-0.05	-0.02	-0.07	-0.01	-0.05	0.11	-0.09	-0.01	-0.08	-0.05	1.00			
NPCOMP	0.06	0.03	0.00	-0.02	0.07	0.15	0.05	0.17	0.07	0.10	0.17	0.11	0.04	0.15	0.05	-0.02	1.00		
EXPORT	0.17	0.03	-0.13	0.02	0.03	0.10	0.16	0.20	0.33	0.13	0.08	-0.01	0.00	0.11	0.14	-0.03	0.13	1.00	
GENDER	0.01	0.03	0.01	0.01	0.08	0.02	0.04	-0.01	0.05	0.01	-0.02	0.04	0.08	-0.03	0.10	-0.03	-0.06	0.07	1.00
AGE	0.00	0.00	-0.03	-0.02	-0.06	0.01	0.05	-0.01	-0.12	-0.02	-0.10	-0.04	0.04	-0.08	-0.06	-0.07	-0.06	0.09	-0.07