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## What determines the innovation capability of firm founders?

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# KOF Working Papers

What Determines the Innovation Capability of Firm Founders?

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# **What Determines the Innovation Capability of Firm Founders?**

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## **Abstract**

Innovative start-ups, not start-ups in general, seem to be important drivers of economic growth. However, little is known about how such firms look like. As activities of start-ups are strongly related to firm founders, we investigate this question focusing on the innovation capability of firm founders. We find that the combination of different founder characteristics such as university education (at best a combination of technical and commercial education), prior experience in R&D, and strong motivation to realize own innovative ideas increases innovative activities of start-ups by more than 40%.

## 1. Introduction

Most start-ups have more in common with self-employment than with the creation of high growth companies (Shane 2009, p. 142). Thus, it is especially for policy makers important to be able to identify firms with a high probability of growth perspectives. Starting point of our analysis is the idea that an important characteristic of such high-growth firms is their innovation performance. Innovative start-ups are considered to be important drivers of innovation in existing industries (Schumpeter 1934, Aghion et al. 2006) and create new industries (Acs & Audretsch 1990). Despite this expected positive impact on economic growth, little is known about the factors that determine the innovation performance of start-ups.

The innovative activity of start-ups might strongly depend on the characteristics of the firm founders, e.g. education, experience and age. The founders determine a firm's strategies and coordinate the resources to implement them (Bergmann Lichtenstein & Brush 2001, Barringer et al. 2004). Further, as start-ups are mostly small firms, the capabilities of the founders themselves serve as important resources to create competitive advantage (Hadjimanolis 2000). Founders do not only decide whether to innovate or not, but are directly involved in the innovation process of the start-ups. Knowing the innovation capability of firm founders would make it much easier to identify the innovative start-ups, especially as most of these characteristics are easy to observe and remain constant over time.

While there is empirical evidence for such a link between management characteristics and innovation activities for established firms (e.g., Romijin & Albaladejo 2002, Barker & Mueller 2002, Hadjimanolis 2000, Chen et al. 2008), to our knowledge only two studies deal with the relationship between founder characteristics and innovation using data of newly-founded firms (see section 6). In this paper we investigate the influence of founder characteristics on the innovative activity of start-ups based on Swiss data for the start-up cohort 1996/97. We find that the founders' education level, the level of their experience in R&D and the availability of

innovation-relevant ideas coming from the founder persons are the main characteristics that enhance innovation activities of start-ups. In combination these three factors can increase the probability of innovative activities by more than 40%.

Compared to other research our study has primarily three new elements. First, our empirical basis is a sample of start-ups that is representative of all firms founded in 1996/97 in Switzerland as recorded by a census of the Swiss Federal Statistical Office for this period. Further, we dispose of data for three cross-sections, so that we can follow the development of the start-ups over a period of almost ten years. A second interesting feature of our data is the wide spectrum of variables, especially with respect to founder characteristics, that could be taken into account in the model specification. Third, we investigate not only the factors explaining the existence of innovative activities in start-ups but also the effects of changes of the composition of the founding teams on innovation and factors determining the persistence of innovative activities.

The remainder of the paper is organized as follows: Section 2 presents the conceptual background of the empirical analysis and derives our main hypotheses. Section 3 describes the database. Section 4 discusses the methodology of our analysis. Section 5 presents the estimation results. Section 6 contains a comparison with results of similar studies. Section 7 concludes our paper.

## **2. Conceptual background and hypotheses**

Our conceptual framework builds upon the resource-based approach of firm, according to which a direct link is assumed between a firm's competitive advantage and the individual resources of the employees, especially managing persons (see Barney 1991). Thus, the performance of start-ups should be strongly related to their innovation capability as reflected by the individual resources and capabilities of the founding persons (see, e.g., Hadjimanolis 2000, Capaldo et al. 2003 and Romijin & Albaladejo 2002 for a similar approach). As most start-ups are small firms, firm founders are directly involved in the operational process of the firms. Founders also make

strategic decisions such as the choice to innovate or not. Knowledge and skills of entrepreneurs are thus important resources of the start-ups and should also impact innovative activity. In this paper we analyze the relationship between innovative activity of start-ups and founder characteristics, embedded in an extensive model of determinants of innovation.

In view of the complexity of the innovation process characterized by several stages from basic research to the penetration of the market with new products, an approach relying on a single measure of innovation may leave out important relationships and produce results that are not robust (see e.g. Kleinknecht et al. 2002; Rogers 1998). In this study we use two innovation measures covering the input as well as the output side of the innovation process. In our model, innovation output is measured by the introduction of new or modified products (IP). The existence of R&D activities (R&D) indicates innovation input. Following the theoretical literature and in accordance with empirical studies, our model includes three categories of independent variables: founder characteristics, firm characteristics and characteristics of a firm's environment.

## **2.1 Founder characteristics**

As we primarily focus on the impact of the founder characteristics on the innovative activity, we include an extensive set of variables which may impact the innovation capability of the firm founders. First of all the education *level* of the founders should be an important factor for innovation. Through formal education, people acquire skills which help to recognize opportunities in the surrounding environment (Shane 2000). Further, a higher level of education may increase the ability to absorb new ideas, thus the ability to identify innovative opportunities (Barker & Mueller 2002, p.787).

(H1) We thus expect that firms with founders with a high level of education would show a higher propensity to innovation than firms with founders without high education.

Not only the level of education, but also the *type* of education of the founders may impact innovation. Commercial education primarily enhances accounting and marketing capabilities. In



contrast, people with a technical education background may have a more complete understanding of technology and innovation (Hambrick & Mason 1984, p.201; Barker & Mueller 2002, p.787).

(H2) These arguments suggest that firms with founding teams with pronounced technical know-how would tend to have more innovative activities than firms with founders with primarily commercial education.

Beside formal education, prior *industry experience* also affects considerably the ability to detect (innovative) opportunities (Shane 2000). As new firms have no track record, such experience is of special importance. In order to be able to identify opportunities for new products and services, it is important for a firm founder to be familiar with customer needs and market developments.

(H3) We thus expect that founding teams with prior industry experience would tend to initiate more innovative activities than founding teams without or little prior industry experience.

Starting a new business requires specific management know-how, for example with respect to finances or organization of production or marketing. Prior experience as self-employed reduces costs to manage “basic” tasks, thus allowing firm founders to concentrate on other tasks such as innovation activities.

(H4) Founding teams with self-employment experience have more innovative activities than firms without self-employment experience.

Innovative activities imply a certain level of innovation-specific know-how. This type of knowledge is needed to assess the potential of competing research streams, to develop R&D strategies or to organize and coordinate research projects (see Lynskey 2004, p. 175).

(H5) Founding teams with R&D experience have more innovative activities than firms without self employment experience.

Beside specific innovation know-how in technical terms, innovative activities often build upon concrete ideas about possible innovative projects based on experience made in earlier occupations of the founders either in research or in business. The realization of such innovation-relevant ideas is often an important motivation for starting new business. Thus, the decision

whether a firm has innovative activities should thus also depend on the availability of such *innovation-relevant ideas*.

(H6) In firms which were founded to implement concrete ideas from the founder's former occupation, innovation-relevant ideas seem to be available. Therefore, we would expect that these firms have more innovation activities.

Investment in innovation is a long-term investment and pay-offs are uncertain at the time of investment. Innovative activities would thus be related to the risk behaviour of the founding team. An important proxy for this behaviour is the *age* of firm founders. As older firm founders have a shorter investment horizon and more inclined to secure primarily their retirement income, they would tend to be more risk-averse than younger founders (see Hambrick & Mason 1984, p. 198). Risk-taking is also influenced by *gender*. Women typically are more likely to be risk-averse (see, e.g., Jianakopulos & Bernasek 1998; Eckel & Grossman 2002).

(H7) The higher the average age of the founding team, the lower would be the level of innovative activities of the firm.

(H8) Start-ups, in which all founding persons are male, would show a higher propensity to innovation than start-ups with only female founding persons.

## **2.2 Firm characteristics**

As most start-ups are small firms, it is difficult to separate the effect of the founding team and the effect of the other employees of the start-ups. Thus, we refrain from including in addition to the variables describing the founder characteristics also variables measuring the human resources of the other employees. We control for such resources by inserting a variable for *firm size*. Larger firms are expected to have more resources for innovation projects than smaller ones. Given the small number of employees other than founders in start-ups, the firm size may also capture the effect of the size of the founding teams. We expect that the size of the founding team is positively correlated with the propensity to innovation (see Cohen & Levinthal 1990). Firm size should thus positively impact innovation activities.

Competing on international market requires competitive advantages. The *export* orientation of a firm would thus be positively correlated with its innovative activity (see Roper & Love 2002). Since diversified firms have more opportunities to use new knowledge, *product diversification* would enhance innovative activities of these firms (see Katila 2002, p.1002).<sup>1</sup>

### 2.3 Market conditions

We expect that positive *demand expectations* would positively stimulate present innovation activities (see Horbach 2007).

Internal resources of start-ups are limited. External networks can provide additional knowledge and expertise (Malerba & Torrisi 1992, Shan et al. 1994). *Cooperation* with other firms or institutes, especially cooperation in R&D, would increase the amount of available knowledge and thus positively impact innovative activities.

Markets with intensive *competition* require greater flexibility and would in general force firms to become more innovative (Katila & Shane 2005). However, as experience and resources of start-ups in general are limited, intensive *price* competition may discourage innovation, intensive *non-price* competition encourage it. Finally, to capture industry specific effects, we further include dummies controlling for *industry affiliation*.<sup>2</sup>

## 3. Description of the Data

The sample we use in this study is based on the cohort of Swiss enterprises that were founded between 1996 and 1997 and recorded by the Swiss Federal Statistical Office. This cohort contained 7112 “green-field” start-ups (i.e. mergers and manager-takeovers were not included)

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<sup>1</sup> Diversification would make it more difficult for the management to monitor the firm’s R&D activities. In large firms, this may lead to decreasing commitment to innovation activities, but this is of limited relevance for the small start-ups in our sample.

<sup>2</sup> As start-ups are often financially constrained, innovation activities may be stimulated by public financial support. In our sample, however, less than 5 percent of the firms received public subsidies and for only 1 percent of the firms this financial support was of high importance.

that were founded in this period and were active (i.e. conducted business activities at least twenty hours a week).<sup>3</sup>

3288 (46.2%) of these start-ups were still in business in 2000.<sup>4</sup> Among the firms that still existed by that time, data were collected by means of a postal survey. 49.4% (1625) of the firms answered the questionnaire. 1339 (82.4%) of these firms survived the next three years. In 2003 a follow-up survey was conducted among these firms. Answers were received from 70.6% (945) of the firms. In 2006, nine to ten years after the firm's foundation, 857 (90.7%) of the participants of the 2003 survey still existed. 73.5% (630) of them were willing to fill out a third questionnaire. For some firms we thus have data at different points in time. For firms which dropped out of the sample we know whether the firm still existed at time of drop out and also whether the firm survived the following period up to 2006. In sum, the data set covers 3200 observations. Because of item non-response only 2393 observations could be used for econometric estimations.

The questionnaire covered questions about basic firm characteristics, firm performance and activity level, resource endowment, innovative activities and the market environment.<sup>5</sup> In 2000, the questionnaire included detailed questions about the founder characteristics (e.g., gender, age, education, experience) at time of firm foundation. As we have this information for up to three representative firm founders and less than 4% of the firms in our sample have more than three founders, we are able to describe in detail the characteristics of the whole founding team.

#### **4. Econometric framework**

To capture different aspects of innovative activity we estimate our model using a proxy for innovation input as well as a proxy for innovation output. R&D is a binary variable measuring

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<sup>3</sup> The firms were recorded by the Swiss Federal Statistical Office independently whether they were enrolled in the Swiss Commercial Register or not.

<sup>4</sup> The current status of the firms was checked to a large part by phone.

<sup>5</sup> The questionnaire is available in German, French and Italian at <http://www.kof.ethz.ch/surveys/structural/panel>.

whether a firm had R&D activities. IP is a binary variable measuring whether a firm introduced new or modified products.

To explain innovative activities we include all variables presented in section 3 (for a detailed definition of the variables and descriptive statistics see Table 1 and Table 2, respectively). Models comprise for both innovation variables the same independent variables. To take into account the binary character of the dependent variables we estimate probit models.

#### **4.1 Sample attrition**

Between two subsequent surveys some firms disappeared from the market and some other did not want to participate to our survey anymore. The question is whether the remaining samples are still representative. When determinants of selection are correlated with innovative activities attrition is selective, and traditional econometrical techniques will lead to biased and inconsistent estimates. Following Wooldridge (2002, p. 581) we test for selective attrition between two cross-sections by inserting a selection indicator as an additional explanatory variable in our model, running the regression and testing the statistical significance of the coefficient of the selection indicator. As a selection indicator we use the dummy variable INSAMPLE that takes the value one if a firm is still in our sample in the following cross-section and zero if not. We have no such indicator for cross-section 2006, so we can apply this test only for the cross-sections 2000 and 2003. Test results indicate that selective attrition is of minor importance; the coefficient of the selection variable is only in one of six models statistically significant (at the 5% test-level) (see Table A.1 in the appendix). Thus, pooling the data of the different cross-sections without correcting for selective attrition seems to be an adequate procedure.

#### **4.2 Heterogeneity**

Likelihood-ratio tests show that the pooled probit model is not the appropriate estimation method (see the lower part of Table 3). We could not estimate fixed-effects models because we have no variation over time within a firm for the variables describing the founder characteristics.

Random-effects regression is thus the preferred method in order to take into consideration firm heterogeneity.

### **4.3 Endogeneity**

A further potential problem is the possible endogeneity of some of the right-hand variables that would imply inconsistent estimates. Since the data dealing with the founder characteristics refer to the point of time of the firm foundation and remain constant over time, our main results should not be affected by endogeneity.

Furthermore the results are also not driven by multicollinearity (see the correlation matrix in Table A.2 in the appendix).

## **5. Results**

### **5.1 Factors influencing the innovation performance of start-ups**

The results of the random-effects estimates are reported in Table 3. Column (1) and (3) show the estimated coefficients and the corresponding standard errors. Column (2) and (4) show average marginal effects.

Primarily, we are interested in the influence on innovative activities exerted by the variables describing the founder characteristics. As expected, the education level of the firm founders does affect innovation activities of the start-ups. Firms with a majority of founders that have a university degree (LEVEL\_UNI) have significantly more innovative activities. A shift from a founding team that predominantly comprises of persons that do not have (academic) university education to a team, in which most members have such education, is correlated with an increase of 11.6% and 9% of the likelihood that the firm introduce innovative products and conduct R&D activities respectively. Interestingly, we can observe such an effect only for university education. The impact of the variable for tertiary-level education other than academic university education (LEVEL\_O\_TERTIARY), such as a degree from universities of applied science, is not statistically significant. Thus, hypothesis H1 is confirmed, at least for university education.

The estimates in Table 3 corroborate only partly hypothesis H2, namely with respect to R&D activities. For start-ups with a founding team with pronounced technical know-how (TYPE\_TECHNICAL) a significantly positive correlation to R&D propensity is found, while for new firms with founders with primarily commercial know-how (TYPE\_COMMERCIAL) the estimates show a negative correlation to R&D propensity. We could not find significant effects of these two variables for the output variable IP. The founders' technical background might enhance R&D activities but is apparently not a necessary precondition for innovation output. Moreover, our results demonstrate that a mix of both qualification types (TYPE\_MIX) is required for having R&D activities as well as for being able to introduce innovative products.

Hypothesis H3 is not confirmed as the results for the variable EXP\_IND demonstrate. The effect of industry experience innovation output IP is statistically insignificant, while the impact on R&D activities is significantly negative. A reason for this negative effect may be that teams with industry experience are less inclined to conduct R&D than founders with research background. In our sample less than 3 percent of the firms have at the same time industry experience and R&D experience. However, as industry experience helps people to find market niches, it is not surprising that firms with industry experience show, despite less R&D activities, not significantly less innovation output.

The impact of self-employment experience (EXP\_SELF) is statistically insignificant. In estimates of the model separately for each cross-section, we find that in the first period 1996/97-2000 founding teams with self-employment experience have significantly more innovative activities (innovation input as well as innovation output) than other teams. In a first period self-employment experience helps to limit costs of administrative tasks and more time is available for innovative activities. With increasing firm age other teams also make such experience, wherefore the advantage disappears. Thus, hypothesis H4 is only partially confirmed.

The strongest effect on innovative activities as measured by the respective marginal effect is found for the variable that measures R&D experience (EXP\_RAD). The availability of such

innovation specific know-how increases the probability of innovation input and output by 20.2% and 19.2%, respectively. The impact of concrete innovation-relevant ideas from prior occupations (INNO\_IDEA) is also positive and statistically significant. Firms that were founded in order to realize concrete ideas for innovations from the founder's former occupation (either in research or in business) have on average an 8.3% and 10.3% higher probability of innovation input and output respectively than firms without such ideas. Therefore, the hypotheses H5 and H6 are clearly confirmed by our estimates.

Finally, we find no effect for the average age (LAGE) of the founders and the expected positive impact of gender only for R&D activities. Start-ups have significantly more R&D activities when all team members are male (MALE\_TEAM), compared with a team of women. As a consequence, hypothesis H7 is rejected and hypothesis H8 is only partly confirmed.

The results for the other variables are in line with the expectations. Exporting firms (EXPORT), firms with product diversification (DIVERSIFICATION), firms with cooperation (COOPERATION) and firms that expect a positive development of the firm-specific product demand (DEMAND\_FUTURE) tend to a higher innovation propensity than firms without such characteristics. While intensive non-price competition (NPCOMP) stimulates innovation output, no effect is found for the intensity of price competition (PCOMP). Not unsurprisingly, sector affiliation primarily affects R&D activities. Firms in the manufacturing sector have significantly more R&D activities than firms in other sectors. Further, there is more R&D activity in the service sector than in the construction sector. Contrary to expectation, firm size (LSIZE) does not affect innovative activities. As the observed start-ups are for the most part small firms, little variance in firm size may be the reason for this result.

On the whole, estimation results show that innovative activities of start-ups are strongly related to the characteristics of the firm founders. Innovation capability of the founders is primarily determined by the education level (LEVEL\_UNI), R&D experience (EXP\_RAD) and the availability of concrete innovation relevant ideas from earlier occupations (INNO\_IDEA). The



strong impact of the founder characteristics becomes even clearer, when we analyse the effect of combinations of these three variables within a firm (see Table 4). In combination these factors increase the probability of innovation output by more than 40% and the probability of doing R&D by more than 35%.

## **5.2 Influence of changes in the composition of founding teams**

Over time, changes in the composition of the founding teams that are at the same time also management teams of the firms are possible. The firms reported the characteristics of the founding team at the time of firm foundation, so it is possible that some of these factors may change later. As nearly 80% of the firms report no change in their management teams, this problem should be of small importance. We expect therefore that excluding firms with such changes would not affect much our estimates. This is partially the case, as the results in Table 5 show. These changes do not affect the results of the innovation output model, but they make a difference for the R&D model: the variable for other tertiary level education (LEVEL\_O\_TERTIARY) now is positively correlated with R&D activities (the effect of LEVEL\_O\_TERTIARY is however significantly smaller than the effect of LEVEL\_UNI) and we also find a significant positive effect of self-employment experience (EXP\_SELF). On the other hand, the impact of commercial know-how (TYPE\_COMMERCIAL) and that of gender (MALE\_TEAM) on R&D become insignificant.

## **5.3 Persistently innovative start-ups**

So far we have considered all firms that have had innovation activities in some point of time. However, it would be interesting to know whether founder characteristics also affect the *persistence* of innovation over time. In order to investigate such differences, we estimate a multinomial logit model including only firms which answered all three questionnaires and choose the base category so that we can analyze whether the effects of founder characteristics differ for firms that have in each cross-section (persistently) innovative activities from firms with

discontinuous innovative activities.<sup>6</sup> The results show that founder characteristics are *not* the factors determining the persistence of innovation in start-ups (see Table 6). Only R&D experience (EXP\_RAD) was significantly larger in firms that have had in each cross-section R&D activities than in firms with discontinuous R&D activities. Founders' characteristics seem to determine whether a firm gets engaged in innovative activities but not the persistence of such innovative activities over time.

Firm size (LSIZE) appears to be a further factor positively correlated with innovation persistence, also the intensity of competition in a firm's main product market, as measured by the existence of exporting activities (EXPORT), the intensity of non-price competition (NPCOMP), and finally the existence of cooperation with other firms/institutes (COOPERATION).

## **6. Comparison with existing empirical literature**

We could find only two empirical studies that deal with the innovation capability of firm founders in start-ups. The first one is the study of Lynskey (2004) that analyzes the impact of the CEO characteristics based on Japanese firm-level data that were collected in 1999 and referred to technology-based firms that were founded 10 years or less before the survey, i.e. at the earliest in 1989. Innovative activity is measured by the number of patent applications and the number of new products. Several managerial variables are included in the estimated models. They also include a variable that captures effects of the education level of the CEO, a dummy that measures whether the CEO has previous R&D experience and a variable that denotes the age of the CEO. Moreover, they test the impact of management experience and whether the CEO is engaged in a research network. An additional variable denotes whether the CEO is also the founder of the firm, so that possible differences between these two functions can be captured. However, only a few of these variables show statistically significant effects on innovation activity. While in the

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<sup>6</sup> See the note in Table 6 for the construction of the dependent variables for the multinomial logit model. Because we have not enough observations for each of the three categories to test the gender effect in detail as in the previous models, we include just a single variable measuring the dominant gender of the founding team (GENDER) in the estimates in Table 6.

new product regression no variable significantly correlates, R&D experience and a research network positively affect the number of patent applications of the start-ups. In contrast with our results, managerial characteristics show no explanatory power in their models. An explanation could be that the firms in their sample are much larger than our firms. While the average age of the firms is quite similar, average sales of their firms are above 1.5 million USD compared with 0.1 million USD in our sample. We would expect that the CEO is less directly involved in the innovation process in such large firms than in smaller firms. Accordingly, the impact on innovative activities should be more limited. Further, the CEO is probably only one person of a founding team that as a whole may have a stronger impact on innovation activities of the start-ups.

In a second study Koch & Strotmann (2008) analyze the impact of founder characteristics on the innovation performance of German start-ups in the knowledge-intensive business sector. They distinguish two categories of innovation performance, incremental innovation and radical innovation. As independent variables they include variables describing the characteristics of one firm founder such as age and sex. Further, they use information on this founder's last occupation before the foundation (university, private economy or self-employed) as a proxy for the professional background of the founder. Beside a dummy for team foundations, they also have information on whether a concrete idea from the founder's former occupation was decisive for the foundation, what is similar to the variable INNO\_IDEA in our study. As Lynskey (2004), Koch & Strotmann (2008) find only a few significant effects. Male founders tend to have more radical innovations than female founders and firms of founders that were self-employed before foundation have fewer innovations (incremental and radical) than firms of founders that worked in the private economy. All other variables that describe the founder characteristics do not significantly affect the innovation performance. Concerning firm size, the firms in their sample are quite similar to the firms in our sample. While their firms on average have 4.5 employees, the firms in our sample have on average 1.6 employees. Further, it is questionable whether the

information on one founder's last occupation adequately describes the professional background of the founders. This information is only available for one founder per firm (about 60% of the firms were team foundations) and is also not available for previous occupations of the founders. A dummy variable that measures whether the background of the founders is diversified can only partially solve this problem.

## **7. Conclusions**

Following pattern emerges from our estimates: the ability of start-ups to conduct R&D *and* introduce innovative products depends on founders having a university education (at best mixed technical and commercial), prior experience in R&D, and – especially important – strong motivation to realize own innovative ideas. In combination to these founder characteristics export orientation, the existence of a diversified product portfolio and cooperation with other firms/institutions appear to be firm characteristics that enhance innovation performance. Changes of the composition of the founding team have no discernible influence on this pattern for the innovation output variable; but some differences do exist for the innovation input model. Founders' characteristics seem to determine whether a firm gets engaged in innovative activities but not the persistence of such innovative activities over time (with the exception of experience in R&D).

Especially for policy makers it is important to identify firms with a high probability of enhancing economic growth. As innovation performance is a crucial precondition for the growth of such firms, it is important to know which factors determine whether a young firm has innovative activities or not. Costs of identification decrease, when these factors are easily observable and remain constant over time. As we find in this paper, information about firm founders has these characteristics.

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Table 1: Definition and measurement of model variables

Variable	Definition/ measurement
Dependent variables	
R&D	R&D activities yes/no (in previous period)
IP	Development and introduction of new/modified existing products yes/no (in previous period)
Independent variables	
LEVEL_UNI, LEVEL_O_TERTIARY	Dummies describing the dominant education level of the firm founders (most founders have a university degree (LEVEL_UNI); most founders have another tertiary-level education (LEVEL_O_TERTIARY); reference group: most founders do not have a tertiary-level education)
TYPE_TECHNICAL, TYPE_COMMERCIAL, TYPE_MIX	Dummies describing the type of strength of the founding team (team has pronounced technical but not management know-how (TYPE_TECHNICAL); team has pronounced management but not technical know-how (TYPE_COMMERCIAL); team has pronounced technical as well as management know-how (TYPE_MIX); reference group: team has not pronounced technical and management know-how; transformation of two five-level ordinal variables (level 1: 'very weak'; level 5: 'very strong') to binary variables (value 1: levels 4 and 5 of the original five-level variable; value 0: levels 1, 2 and 3 of the original variable))
EXP_IND	At least one of the founders has industry experience yes/no
EXP_SELF	At least one of the founders has experience with self employment yes/no
EXP_RAD	At least one of the founders has R&D experience yes/no
INNO_IDEA	Firm was founded to implement concrete ideas from the founders former occupation yes/no (transformation of a five-level ordinal variable (level 1: 'very low importance'; level 5: 'very high importance') 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))
LAGE	Average age of the firm founders; natural logarithm
GENDER	Gender of the firm founders: male/female (value 1: 'male'; value 0: 'female'; the most frequently reported gender is regarded as representative for the firm founders; when the number of 'females' equals the number of 'males' we set 'female')
MALE_TEAM, MIXED_TEAM	Dummies describing the gender mix of the founding team (all team members are male (MALE_TEAM); there are males and females in the founding team (MIXED_TEAM); reference group: all team members are female)
LSIZE	Number of employees; natural logarithm
EXPORT	Firm exports goods and/or services yes/no
DIVERSIFICATION	Firm is present in more than one product and/or service sector yes/no
DEMAND_FUTURE	Development of a firm's specific product demand in the next two years (transformation of a five-level ordinal variable (level 1: 'strong decrease'; 5: 'strong increase') referring to the (reference year: survey year); to a binary variable (value 1: levels 4 and 5; value 0: levels 1, 2 and 3 of the original five-level variable))
COOPERATION	Firm cooperates with other firms/institutes yes/no (dummy variable measures whether or not a firm cooperates in acquisition, production, distribution or R&D)
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 PCOMP)
MANUFACT, MOD_SERV, TRAD_SERV	Dummies for three industries (manufacturing (MANUFACT); modern services (MOD_SERV); traditional services (TRAD_SERV); reference industry: construction)
Y2003, Y2006	Time dummies for the years 2003 and 2006, respectively (reference year: 2000)
INSAMPLE_03	Firm is still in the sample in cross-section 2003 yes/no
INSAMPLE_06	Firm is still in the sample in cross-section 2006 yes/no

Table 2: Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
IP	0.478	0.500	0	1
R&D	0.212	0.409	0	1
LEVEL_UNI	0.232	0.422	0	1
LEVEL_O_TERTIARY	0.468	0.499	0	1
TYPE_TECHNICAL	0.211	0.408	0	1
TYPE_COMMERCIAL	0.264	0.441	0	1
TYPE_MIX	0.267	0.443	0	1
EXP_IND	0.437	0.496	0	1
EXP_SELF	0.101	0.301	0	1
EXP_RAD	0.118	0.322	0	1
INNO_IDEA	0.564	0.496	0	1
LAGE	3.649	0.234	2.890	4.174
MALE_TEAM	0.672	0.470	0	1
MIXED_TEAM	0.232	0.422	0	1
LSIZE	0.485	0.734	-1.273	4.558
EXPORT	0.247	0.432	0	1
DIVERSIFICATION	0.496	0.500	0	1
DEMAND_FUTURE	0.585	0.493	0	1
COOPERATION	0.393	0.488	0	1
PCOMP	0.461	0.499	0	1
NPCOMP	0.533	0.499	0	1
MANUFACT	0.077	0.267	0	1
MOD_SERV	0.467	0.499	0	1
TRAD_SERV	0.365	0.482	0	1
Y2003	0.295	0.456	0	1
Y2006	0.201	0.401	0	1



Table 3: Estimates of innovative activity; random-effects probit

Dependent variable	IP		R&D		Expected sign
	dy/dx		dy/dx		
Founder characteristics					
LEVEL_UNI	0.353*** (0.114)	0.116*** (0.037)	0.737*** (0.197)	0.090*** (0.023)	+
LEVEL_O_TERTIARY	0.081 (0.092)	0.026 (0.030)	0.235 (0.168)	0.029 (0.020)	+
TYPE_TECHNICAL	0.135 (0.119)	0.044 (0.039)	0.640*** (0.204)	0.078*** (0.024)	+
TYPE_COMMERCIAL	0.094 (0.109)	0.031 (0.036)	-0.361* (0.201)	-0.044* (0.025)	-
TYPE_MIX	0.229** (0.111)	0.075** (0.036)	0.312* (0.189)	0.038* (0.023)	?
EXP_IND	0.004 (0.082)	0.001 (0.027)	-0.301** (0.144)	-0.037** (0.017)	+
EXP_SELF	0.079 (0.132)	0.026 (0.044)	0.348 (0.221)	0.043 (0.027)	+
EXP_RAD	0.585*** (0.135)	0.192*** (0.044)	1.653*** (0.217)	0.202*** (0.020)	+
INNO_IDEA	0.314*** (0.081)	0.103*** (0.026)	0.679*** (0.146)	0.083*** (0.017)	+
LAGE	-0.151 (0.169)	-0.050 (0.055)	-0.099 (0.287)	-0.012 (0.035)	-
MALE_TEAM	0.064 (0.135)	0.021 (0.044)	0.525** (0.264)	0.064** (0.032)	+
MIXED_TEAM	0.123 (0.150)	0.040 (0.049)	0.235 (0.286)	0.029 (0.035)	?
Firm characteristics					
LSIZE	0.074 (0.052)	0.024 (0.017)	0.019 (0.083)	0.002 (0.010)	+
EXPORT	0.484*** (0.087)	0.159*** (0.028)	0.589*** (0.130)	0.072*** (0.016)	+
DIVERSIFICATION	0.400*** (0.079)	0.131*** (0.025)	0.238* (0.134)	0.029* (0.016)	+
Market conditions					
DEMAND_FUTURE	0.284*** (0.075)	0.093*** (0.024)	0.362*** (0.122)	0.044*** (0.015)	+
COOPERATION	0.411*** (0.073)	0.135*** (0.023)	0.957*** (0.120)	0.117*** (0.015)	+
PCOMP	-0.067 (0.069)	-0.022 (0.023)	-0.131 (0.110)	-0.016 (0.013)	?
NPCOMP	0.266*** (0.069)	0.087*** (0.022)	0.093 (0.111)	0.011 (0.014)	?
MANUFACT	0.343* (0.191)	0.113* (0.062)	1.866*** (0.409)	0.228*** (0.049)	
MOD_SERV	0.151 (0.151)	0.050 (0.050)	1.196*** (0.358)	0.146*** (0.043)	
TRAD_SERV	0.284* (0.149)	0.093* (0.049)	1.159*** (0.359)	0.142*** (0.043)	
Y2003	-0.016 (0.080)	-0.005 (0.026)	-0.137 (0.121)	-0.017 (0.015)	
Y2006	-0.056 (0.087)	-0.019 (0.029)	-0.509*** (0.143)	-0.062*** (0.017)	
CONSTANT	-1.056* (0.639)		-4.486*** (1.174)		
N	2393		2393		
Groups	1204		1204		
Wald chi <sup>2</sup>	237.82***		179.76***		
Rho	0.356		0.629		
LR test of rho=0	70.08***		117.45***		

Notes: see Table 1 for the variable definitions; to estimate marginal effects, we fixed the group specific intercept at 0, but otherwise averaged the marginal effects over the other explanatory variables; standard errors are in brackets under the coefficients; \*\*\*, \*\*, \* denotes statistical significance at the 1%, 5% and 10% test level, respectively.

Table 4: Combination of founder characteristics; random-effects probit

Dependent variable	IP		R&D	
		dy/dx		dy/dx
u1_r0_i0	0.436** (0.170)	0.143** (0.055)	0.531* (0.299)	0.063* (0.036)
u0_r1_i0	0.342 (0.262)	0.112 (0.085)	1.257*** (0.400)	0.150*** (0.047)
u0_r0_i1	0.299*** (0.095)	0.098*** (0.031)	0.414** (0.176)	0.049** (0.021)
u0_r1_i1	1.258*** (0.212)	0.412*** (0.066)	2.579*** (0.337)	0.307*** (0.032)
u1_r0_i1	0.692*** (0.149)	0.227*** (0.047)	1.416*** (0.257)	0.169*** (0.029)
u1_r1_i0	1.067*** (0.359)	0.349*** (0.116)	1.534*** (0.489)	0.183*** (0.057)
u1_r1_i1	0.843*** (0.256)	0.276*** (0.082)	2.856*** (0.433)	0.340*** (0.044)
LEVEL_O_TERTIARY	0.069 (0.092)	0.023 (0.030)	0.228 (0.168)	0.027 (0.020)
TYPE_TECHNICAL	0.142 (0.119)	0.047 (0.039)	0.662*** (0.204)	0.079*** (0.024)
TYPE_COMMERCIAL	0.097 (0.109)	0.032 (0.036)	-0.321 (0.200)	-0.038 (0.024)
TYPE_MIX	0.217* (0.111)	0.071* (0.036)	0.354* (0.190)	0.042* (0.022)
EXP_IND	0.010 (0.082)	0.003 (0.027)	-0.298** (0.143)	-0.035** (0.017)
EXP_SELF	0.071 (0.132)	0.023 (0.043)	0.322 (0.220)	0.038 (0.026)
LAGE	-0.143 (0.169)	-0.047 (0.055)	-0.153 (0.286)	-0.018 (0.034)
MALE_TEAM	0.056 (0.134)	0.018 (0.044)	0.548** (0.265)	0.065** (0.032)
MIXED_TEAM	0.119 (0.149)	0.039 (0.049)	0.273 (0.286)	0.032 (0.034)
LSIZE	0.074 (0.052)	0.024 (0.017)	0.013 (0.083)	0.002 (0.010)
EXPORT	0.484*** (0.087)	0.159*** (0.028)	0.601*** (0.130)	0.072*** (0.016)
DIVERSIFICATION	0.408*** (0.079)	0.134*** (0.025)	0.237* (0.134)	0.028* (0.016)
DEMAND_FUTURE	0.281*** (0.075)	0.092*** (0.024)	0.351*** (0.122)	0.042*** (0.014)
COOPERATION	0.412*** (0.073)	0.135*** (0.023)	0.946*** (0.119)	0.113*** (0.015)
PCOMP	-0.071 (0.069)	-0.023 (0.022)	-0.137 (0.110)	-0.016 (0.013)
NPCOMP	0.266*** (0.069)	0.087*** (0.022)	0.095 (0.111)	0.011 (0.013)
MANUFACT	0.307 (0.190)	0.101 (0.062)	1.767*** (0.402)	0.210*** (0.047)
MOD_SERV	0.136 (0.151)	0.044 (0.049)	1.154*** (0.352)	0.137*** (0.042)
TRAD_SERV	0.267* (0.148)	0.087* (0.048)	1.096*** (0.352)	0.130*** (0.042)
Y2003	-0.016 (0.080)	-0.005 (0.026)	-0.144 (0.121)	-0.017 (0.014)
Y2006	-0.057 (0.087)	-0.019 (0.029)	-0.515*** (0.143)	-0.061*** (0.017)
CONSTANT	-1.062* (0.641)		-4.126*** (1.168)	
N	2393		2393	
Groups	1204		1204	
Wald chi <sup>2</sup>	241.97***		180.86***	
Rho	0.352		0.625	
LR test of rho=0	68.18***		115.26***	

*Reading Aid:* u=LEVEL\_UNI, r=EXP\_RAD, i=INNO\_IDEA; Combinations of these three binary variables: u0\_r1\_i1= a firm with LEVEL\_UNI=0, EXP\_RAD=1 and INNO\_IDEA=1; u1\_r0\_i0= a firm with LEVEL\_UNI=1, EXP\_RAD=0 and INNO\_IDEA=0; etc; reference group: u0\_r0\_i0.

*Notes:* see Table 1 for the variable definitions; to estimate marginal effects, we fixed the group specific intercept at 0, but otherwise averaged the marginal effects over the other explanatory variables; standard errors are in brackets under the coefficients; \*\*\*, \*\*, \* denotes statistical significance at the 1%, 5% and 10% test level, respectively.

Table 5: Estimates of innovative activity excluding firms with changes in the composition of the founding team; random-effects probit

Dependent variable	IP		R&D		Expected sign
	dy/dx		dy/dx		
Founder characteristics					
LEVEL_UNI	0.431*** (0.135)	0.136*** (0.042)	0.938*** (0.246)	0.102*** (0.025)	+
LEVEL_O_TERTIARY	0.162 (0.105)	0.051 (0.033)	0.486** (0.205)	0.053** (0.022)	+
TYPE_TECHNICAL	0.164 (0.139)	0.052 (0.044)	0.710*** (0.248)	0.077*** (0.026)	+
TYPE_COMMERCIAL	0.145 (0.126)	0.046 (0.040)	-0.248 (0.238)	-0.027 (0.026)	-
TYPE_MIX	0.212* (0.126)	0.067* (0.040)	0.444** (0.226)	0.048** (0.024)	?
EXP_IND	-0.016 (0.094)	-0.005 (0.030)	-0.374** (0.170)	-0.041** (0.018)	+
EXP_SELF	0.151 (0.165)	0.048 (0.052)	0.557** (0.280)	0.060** (0.030)	+
EXP_RAD	0.684*** (0.166)	0.216*** (0.051)	1.805*** (0.275)	0.195*** (0.022)	+
INNO_IDEA	0.334*** (0.093)	0.106*** (0.029)	0.710*** (0.175)	0.077*** (0.018)	+
LAGE	-0.050 (0.191)	-0.016 (0.060)	-0.036 (0.333)	-0.004 (0.036)	-
MALE_TEAM	0.005 (0.149)	0.002 (0.047)	0.500 (0.305)	0.054 (0.033)	+
MIXED_TEAM	0.055 (0.170)	0.017 (0.054)	0.313 (0.335)	0.034 (0.036)	?
Firm characteristics					
LSIZE	0.105 (0.067)	0.033 (0.021)	0.024 (0.115)	0.003 (0.012)	+
EXPORT	0.489*** (0.103)	0.155*** (0.031)	0.628*** (0.157)	0.068*** (0.017)	+
DIVERSIFICATION	0.520*** (0.092)	0.165*** (0.027)	0.210 (0.159)	0.023 (0.017)	+
Market conditions					
DEMAND_FUTURE	0.293*** (0.088)	0.093*** (0.027)	0.376** (0.148)	0.041** (0.016)	+
COOPERATION	0.452*** (0.084)	0.143*** (0.026)	1.052*** (0.153)	0.114*** (0.016)	+
PCOMP	-0.086 (0.080)	-0.027 (0.025)	-0.028 (0.132)	-0.003 (0.014)	?
NPCOMP	0.301*** (0.080)	0.095*** (0.025)	0.095 (0.135)	0.010 (0.015)	?
MANUFACT	0.314 (0.211)	0.099 (0.066)	2.009*** (0.470)	0.217*** (0.049)	
MOD_SERV	0.082 (0.168)	0.026 (0.053)	1.214*** (0.407)	0.131*** (0.043)	
TRAD_SERV	0.210 (0.163)	0.067 (0.051)	0.949** (0.401)	0.103** (0.043)	
Y2003	-0.030 (0.093)	-0.009 (0.030)	-0.346** (0.151)	-0.037** (0.016)	
Y2006	-0.017 (0.103)	-0.005 (0.033)	-0.708*** (0.185)	-0.077*** (0.020)	
CONSTANT	-1.515** (0.724)		-5.025*** (1.397)		
N	1875	1875	1875	1875	
Groups	1026		1026		
Wald chi <sup>2</sup>	199.84***		117.23***		
Rho	0.377		0.655		
LR test of rho=0	55.17***		78.27***		

Notes: see Table 1 for the variable definitions; to estimate marginal effects, we fixed the group specific intercept at 0, but otherwise averaged the marginal effects over the other explanatory variables; standard errors are in brackets under the coefficients; \*\*\*, \*\*, \* denotes statistical significance at the 1%, 5% and 10% test level, respectively.

Table 6: Estimates of persistence of innovative activity; multinomial logit estimates (base category: firms with discontinuous innovative activities)

Dependent variable	IP		R&D	
	no	persistently	no	persistently
Founder characteristics				
LEVEL_UNI	-0.781** (0.379)	0.332 (0.364)	-0.760** (0.373)	0.121 (0.594)
LEVEL_O_TERTIARY	-0.543* (0.280)	-0.379 (0.320)	-0.237 (0.336)	-0.155 (0.546)
TYPE_TECHNICAL	0.235 (0.349)	0.174 (0.416)	-0.038 (0.394)	1.023 (0.683)
TYPE_COMMERCIAL	0.285 (0.323)	0.458 (0.395)	0.728* (0.392)	0.265 (0.801)
TYPE_MIX	-0.189 (0.365)	0.443 (0.390)	-0.061 (0.372)	0.674 (0.645)
EXP_IND	-0.255 (0.253)	-0.311 (0.296)	0.464 (0.282)	-0.041 (0.497)
EXP_SELF	-0.309 (0.456)	-0.204 (0.518)	0.447 (0.544)	0.782 (0.739)
EXP_RAD	-1.568*** (0.611)	0.249 (0.396)	-1.370*** (0.446)	1.591*** (0.475)
INNO_IDEA	-0.447* (0.249)	0.436 (0.285)	-0.875*** (0.281)	0.497 (0.512)
LAGE	0.637 (0.515)	0.533 (0.568)	0.255 (0.644)	-1.208 (0.823)
GENDER	-0.164 (0.257)	-0.185 (0.287)	-0.000 (0.285)	0.499 (0.530)
Firm characteristics				
LSIZE	0.198 (0.320)	0.876*** (0.327)	-0.617* (0.322)	0.053 (0.495)
EXPORT	0.101 (0.317)	0.835*** (0.272)	-0.664** (0.284)	0.230 (0.408)
DIVERSIFICATION	-0.876*** (0.250)	0.204 (0.269)	-0.391 (0.266)	0.471 (0.428)
Market conditions				
DEMAND_FUTURE	-0.767*** (0.287)	0.556 (0.382)	-0.374 (0.329)	0.638 (0.623)
COOPERATION	-0.442* (0.261)	0.440* (0.263)	-0.910*** (0.272)	0.693 (0.426)
PCOMP	0.178 (0.243)	0.015 (0.271)	0.705*** (0.265)	-0.217 (0.438)
NPCOMP	-0.654*** (0.243)	0.582** (0.278)	-0.077 (0.268)	-0.329 (0.404)
MANUFACT	0.335 (0.581)	1.323* (0.755)	-2.514*** (0.876)	-0.933 (1.204)
MOD_SERV	0.168 (0.404)	1.085* (0.633)	-2.047*** (0.746)	-1.113 (1.149)
TRAD_SERV	-0.276 (0.410)	1.078* (0.626)	-1.331* (0.770)	-0.972 (1.150)
CONSTANT	-0.822 (1.937)	-6.396*** (2.239)	3.919 (2.495)	1.289 (3.370)
N	484		484	
Wald chi <sup>2</sup>	144.10***		163.70***	

Notes: We define the following categorical variables to measure the persistence of innovative activities: no (firm has no innovative activities), discontinuously (firm has in some cross-sections innovative activities) and persistently (firm has in all three cross-sections innovative activities); see Table 1 for the variable definitions; heteroskedasticity-robust standard errors (White procedure) are in brackets under the coefficients; a Hausman test does not reject the null hypothesis that the assumption of independence of irrelevant alternatives (IIA-assumption) is fulfilled in any single case (suest-based Hausman test implemented in Stata); standard errors are in brackets under the coefficients; \*\*\*, \*\*, \* denotes statistical significance at the 1%, 5% and 10% test level, respectively.

**Appendix:**

Table A.1: Test for selective attrition (selection indicator included in innovation models)

Dependent variable Period	IP			R&D		
	1996/97-2000	1996/97-2000	2000-2003	1996/97-2000	1996/97-2000	2000-2003
Founder characteristics						
LEVEL_UNI	0.277** (0.115)	0.275** (0.115)	0.340** (0.150)	0.579*** (0.138)	0.582*** (0.138)	0.392** (0.177)
LEVEL_O_TERTIARY	0.062 (0.093)	0.062 (0.093)	0.127 (0.122)	0.333*** (0.120)	0.337*** (0.119)	-0.059 (0.154)
TYPE_TECHNICAL	0.166 (0.121)	0.167 (0.121)	-0.002 (0.156)	0.445*** (0.142)	0.445*** (0.142)	0.435** (0.182)
TYPE_MANAGEMENT	0.042 (0.111)	0.044 (0.111)	-0.036 (0.143)	-0.181 (0.147)	-0.185 (0.147)	-0.398* (0.216)
TYPE_MIX	0.223** (0.112)	0.220** (0.112)	-0.019 (0.146)	0.280** (0.137)	0.278** (0.138)	0.071 (0.187)
EXP_IND	-0.058 (0.084)	-0.058 (0.084)	0.020 (0.108)	-0.154 (0.103)	-0.150 (0.103)	-0.165 (0.137)
EXP_SELF	0.226* (0.133)	0.224* (0.133)	-0.019 (0.178)	0.322** (0.154)	0.321** (0.153)	0.112 (0.208)
EXP_RAD	0.659*** (0.149)	0.659*** (0.149)	0.475*** (0.173)	1.150*** (0.142)	1.148*** (0.142)	0.994*** (0.177)
INNO_IDEA	0.326*** (0.081)	0.328*** (0.081)	0.121 (0.108)	0.486*** (0.101)	0.491*** (0.100)	0.307** (0.146)
LAGE	-0.049 (0.170)	-0.050 (0.169)	-0.491** (0.224)	0.254 (0.207)	0.258 (0.207)	-0.161 (0.289)
MALE_TEAM	-0.059 (0.145)	-0.059 (0.145)	0.076 (0.181)	0.359* (0.212)	0.360* (0.212)	0.104 (0.252)
MIXED_TEAM	-0.015 (0.161)	-0.011 (0.161)	0.100 (0.200)	0.175 (0.227)	0.176 (0.227)	-0.146 (0.293)
Firm characteristics						
LSIZE	0.150 (0.103)	0.150 (0.103)	0.091 (0.096)	-0.050 (0.118)	-0.049 (0.118)	0.062 (0.117)
EXPORT	0.338*** (0.096)	0.340*** (0.096)	0.484*** (0.125)	0.414*** (0.101)	0.413*** (0.101)	0.185 (0.145)
DIVERSIFICATION	0.447*** (0.079)	0.445*** (0.079)	0.162 (0.102)	0.205** (0.096)	0.207** (0.097)	0.103 (0.131)
Market conditions						
DEMAND_FUTURE	0.369*** (0.093)	0.372*** (0.093)	0.240** (0.107)	0.204* (0.118)	0.206* (0.118)	0.089 (0.134)
COOPERATION	0.388*** (0.082)	0.387*** (0.082)	0.295*** (0.109)	0.717*** (0.097)	0.718*** (0.097)	0.765*** (0.132)
PCOMP	-0.063 (0.080)	-0.062 (0.080)	0.005 (0.101)	-0.160* (0.096)	-0.161* (0.096)	0.005 (0.129)
NPCOMP	0.340*** (0.080)	0.342*** (0.080)	0.179* (0.103)	0.049 (0.098)	0.044 (0.098)	0.260** (0.130)
MANUFACT	-0.010 (0.194)	-0.014 (0.194)	0.698*** (0.266)	1.005*** (0.269)	1.008*** (0.268)	0.770** (0.326)
MOD_SERV	-0.003 (0.152)	-0.004 (0.151)	0.517** (0.210)	0.766*** (0.235)	0.770*** (0.235)	0.348 (0.278)
TRAD_SERV	0.109 (0.150)	0.104 (0.150)	0.606*** (0.207)	0.636*** (0.236)	0.646*** (0.235)	0.347 (0.274)
INSAMPLE_03	-0.009 (0.080)			0.097 (0.098)		
INSAMPLE_06		-0.053 (0.081)	0.047 (0.109)		0.055 (0.096)	-0.323** (0.132)
CONSTANT	-1.311** (0.662)	-1.293* (0.663)	0.212 (0.872)	-4.258*** (0.843)	-4.251*** (0.841)	-1.585 (1.123)
N	1186	1186	702	1186	1186	702
Pseudo R2	0.156	0.156	0.109	0.314	0.313	0.268
Wald chi2	220.53***	220.89***	101.72***	302.77***	300.99***	162.21***

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

Table A.2: Correlation matrix

	LEVEL_ UNI	LEVEL_O_ TERTIARY	TYPE_ TECHNICAL	TYPE_ MANAGEMENT	TYPE_ MIX	EXP_ IND	EXP_ SELF	EXP_ RAD	INNO_ IDEA	LAGE	MALE_ TEAM	MIXED_ TEAM	LSIZE	EXPORT	DIVERSIFICATION	DEMAND_ FUTURE	COOPERATION	PCOMP
LEVEL_O_TERTIARY	-0.515																	
TYPE_TECHNICAL	0.077	0.011																
TYPE_COMMERCIAL	-0.014	0.076	-0.310															
TYPE_MIX	-0.023	0.029	-0.313	-0.362														
EXP_IND	-0.034	0.054	-0.060	0.010	0.146													
EXP_SELF	0.063	-0.025	-0.024	0.030	-0.058	-0.222												
EXP_RAD	0.131	-0.008	0.236	-0.143	0.081	-0.165	-0.092											
INNO_IDEA	0.099	0.000	0.049	0.001	0.141	0.079	-0.025	0.089										
LAGE	0.067	0.037	-0.108	0.144	-0.008	-0.016	0.104	0.054	-0.071									
MALE_TEAM	-0.013	-0.005	0.085	-0.056	-0.004	-0.036	-0.041	0.021	-0.020	-0.019								
MIXED_TEAM	0.042	0.011	-0.015	-0.005	0.020	0.034	0.093	0.021	-0.013	0.030	-0.786							
LSIZE	0.059	-0.032	0.017	-0.059	0.036	0.057	0.039	0.022	0.045	-0.039	-0.005	0.065						
EXPORT	0.161	-0.039	0.045	-0.025	0.072	-0.017	0.024	0.190	0.102	0.082	0.029	0.009	0.069					
DIVERSIFICATION	-0.009	0.022	-0.055	0.007	0.102	-0.013	-0.012	0.016	0.054	-0.026	0.029	0.044	0.074	0.104				
DEMAND_FUTURE	0.040	-0.023	-0.035	0.005	0.050	0.034	-0.028	0.027	0.073	-0.061	0.013	0.022	0.010	0.073	0.093			
COOPERATION	0.084	-0.009	0.086	-0.068	0.046	-0.016	-0.016	0.115	0.105	-0.046	0.041	0.039	0.042	0.177	0.154	0.110		
PCOMP	-0.011	0.014	0.007	0.008	0.051	0.022	-0.065	0.026	0.063	-0.045	-0.039	0.059	0.046	-0.016	0.028	-0.067	0.047	
NPCOMP	0.045	0.009	-0.009	0.020	0.074	0.004	-0.035	0.062	0.072	-0.014	-0.005	0.047	0.043	0.056	0.040	0.125	0.110	0.065