



# Founders' human capital and the growth of new technology-based firms: A competence-based view

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## Abstract

In this paper, we analyze empirically the relation between the growth of new technology-based firms and the human capital of founders, with the aim of teasing out the “wealth” and “capability” effects of human capital. For this purpose, we take advantage of a new data set relating to a sample composed of 506 Italian young firms that operate in high-tech industries in both manufacturing and services. In accordance with competence-based theories, the econometric estimates show that the nature of the education and of the prior work experience of founders exerts a key influence on growth. In fact, founders' years of university education in economic and managerial fields and to a lesser extent in scientific and technical fields positively affect growth while education in other fields does not. Similarly prior work experience in the same industry of the new firm is positively associated with growth while prior work experience in other industries is not. Furthermore, it is the technical work experience of founders as opposed to their commercial work experience that determines growth. The fact that within the founding team there are individuals with prior entrepreneurial experiences also results in superior growth. Lastly, we provide evidence that there are synergistic gains from the combination of the complementary capabilities of founders relating to (i) economic-managerial and scientific-technical education and (ii) technical and commercial industry-specific work experiences. We conclude that the human capital of founders of new technology-based firms is not just a proxy for personal wealth.

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## 1. Introduction

It is generally acknowledged in the economic literature that new firms, especially new technology-based

firms (NTBFs), greatly contribute to the static and dynamic efficiency of the economic system (see for instance, Audretsch, 1995). So, a conspicuous body of empirical studies that will be surveyed in next section (see also Storey, 1994) has analyzed the determinants of their post-entry performances focusing attention on the role played by the human capital characteristics

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of founding teams. The likelihood of survival of new firms and the growth of surviving firms have generally been found to be positively related to the age, education, and work experience of founders. Nonetheless, this evidence is coherent with different arguments proposed by different streams of the theoretical literature in management, economics, and finance.

Studies in financial economics argue that due to capital market imperfections, it is difficult for NTBFs to obtain the external financing they need; in turn lack of adequate funds hinders firms' growth and even threatens survival (Carpenter and Petersen, 2002a,b). Firms that are established by wealthier individuals are less affected by financial constraints as greater personal capital is available to finance firms' operations. Previous studies have shown that there is a positive relation between the human capital and the wealth of individuals (Xu, 1998; Astebro and Bernhardt, 1999). Hence, the positive relation between the post-entry performances of NTBFs and the human capital of their founders may be traced to the "wealth effect" of human capital, simply revealing the presence of binding financial constraints.

Works inspired by the competence-based perspective suggest a different explanation. Hinging on the seminal contributions by Knight (1921) and Schumpeter (1934), this stream of literature argues that firms are bundles of unique, difficult to imitate capabilities.<sup>1</sup> Due to the idiosyncratic, non-contractible nature of entrepreneurial judgment and the high costs necessary to coordinate knowledge dispersed among different individuals (see Hodgson, 1998), the distinctive capabilities of NTBFs are closely related to the knowledge and skills of their founders. In turn, these depend on what founders learned through formal education and prior professional experience. Accordingly, NTBFs established by individuals with greater human capital should outperform other NTBFs because of their unique capabilities. In other words, it is the "capability effect" of founders' human capital that explains its positive impact on the performances of NTBFs.

<sup>1</sup> Distinctive capabilities consist in a firm's ability to select, mobilize, and use tangible and intangible assets to perform tasks in a unique way; they represent what a firm is able to do better than other firms (Winter, 1987; Prahalad and Hamel, 1990; Conner and Prahalad, 1996; Grant, 1996). In this work, we use the terms "competence" and "capability" as synonyms.

Whether it is the "wealth effect" or the "capability effect" that determines the positive association between the growth of NTBFs and the human capital of their founding teams is an important though so far quite underresearched question. In fact, the implications for both entrepreneurs and policy makers widely differ. If the greater financial resources of high human capital individuals are the main determinant of the above mentioned association, the effort of entrepreneurs, and the attention of policy makers should prevalently be drawn to how to fill the so called "funding gap" (Cressy, 2000). Conversely, evidence that founders' unique knowledge and skills greatly contribute to growth indicates that how to fill the "knowledge gap" should be a key priority for entrepreneurs and policy makers.

The objective of this paper is to tease out empirically the "wealth" and "capability" effects of founders' human capital on the growth of NTBFs. For this purpose, we analyze the relation between the growth of NTBFs and the human capital characteristics of their founders through the estimates of several econometric models. As was mentioned above and will be illustrated in next section in greater detail, numerous studies have previously analyzed this issue. We depart from this literature in three respects.

First, we take advantage of a more fine-grained description of the human capital characteristics of founders than the one generally used by econometric studies based on large datasets. Following Becker (1975), a distinction is often made in the literature between the *generic* and *specific* components of human capital. Generic human capital relates to the general knowledge acquired by entrepreneurs through both formal education and professional experience. Specific human capital consists of capabilities that founders can directly apply to the entrepreneurial job in the newly created firm. These include knowledge of the industry in which the new firm operates, that is *industry-specific* human capital obtained by founders through prior work experience in the same industry. They also include knowledge of how to manage a new firm, that is *entrepreneur-specific* human capital; this is developed by founders through "leadership experience" (Brüderl et al., 1992) obtained either through a managerial position in another firm or in prior self-employment episodes. In this paper, we conform to this distinction. In addition, we consider the *nature* of both education (either technical and

scientific or economic and managerial) and work experience (either technical or commercial). We contend that if the “wealth effect” were the only effect at work, founders’ years of education and work experience would have a positive impact on growth, as they proxy greater personal wealth. Nonetheless, the field of education of founders should not play any role. Similarly, whether founders’ prior work experience relates to the sector in which the NTBF operates or to a different sector and to technical or commercial functions should not make any difference. Conversely, if growth turns out to depend on the field of education of founders, the industry of the firm by which they were formerly employed, and the functional domain of their work experience, this will provide evidence supporting the competence-based argument.

Second, we try to detect the existence of *synergistic gains* that arise from the heterogeneity of capabilities within the founding team, as are reflected by founders’ human capital characteristics. With all else equal, if NTBFs established by individuals with heterogeneous education and professional experience exhibit higher growth, this again suggests that the positive relation between founders’ human capital and growth cannot be explained by the “wealth effect” alone. In addition, while it is often claimed in the managerial literature that the heterogeneity of founders’ capabilities matters for growth (see for instance, Cooper and Bruno, 1977; Eisenhardt and Schoonhoven, 1990), the precise nature of the associated synergies has remained largely unexplored.

Third, while we focus on founders’ human capital, we control for other covariates that may influence growth. Among them access to outside equity financing figures prominently. In fact, the likelihood of obtaining outside equity capital possibly depends on the human capital of founders. Moreover, it may depend on other unobserved factors that also affect growth. So, failure to control for the endogeneity bias possibly generated by unobserved heterogeneity across firms may have led to inconsistent estimates in previous studies.

In order to address the above mentioned research questions, we take advantage of a new dataset relating to a sample composed of 506 Italian young firms that operate in high-tech industries in both manufacturing and services. The Research on Entrepreneurship in Advanced Technologies (RITA) database from which sample firms are extracted, provides very detailed

information on the human capital characteristics of each individual founder<sup>2</sup> and other factors that may influence the growth of NTBFs.

The econometric findings confirm the positive impact exerted by founders’ human capital on firms’ growth. More interestingly, they allow to detect both “wealth” and “capability” effects. In other words, in accordance with the competence-based approach the positive relation between founders’ human capital and growth cannot simply be explained by the greater wealth of more qualified individuals.

The paper proceeds as follows. In next section, we briefly synthesize the theoretical and empirical literature relating to the impact of founders’ human capital on firms’ post-entry performances, and we formulate the research hypotheses. Then, we describe the dataset, we illustrate the specification of the econometric models and the dependent and explanatory variables, and we present the results of the econometric estimates. In the subsequent section, a discussion of the main findings and of directions for future research concludes the paper.

## 2. Theory and hypotheses

### 2.1. Founders’ human capital and firms’ post-entry performances: stylized facts

The argument that firms established by individuals with greater human capital outperform other firms is hardly new in the literature. In fact, several previous studies have analyzed the relation between founders’ human capital and the likelihood of survival of new firms and the growth of surviving firms, even though a smaller number has focused on NTBFs.

As was mentioned in the introductory section, a distinction is often made in the literature between *generic* and *specific* human capital. In empirical works, the generic human capital of the founders of a new firm is proxied by education attainments, such as graduation and achievement of a Ph.D. degree or years of schooling, and by the years of work experience before establishing the new firm, or more simply

<sup>2</sup> Founders are defined as all individuals who provided equity capital to and took a managerial position in the new-borne firm. See Colombo et al. (2004) for an identical definition.

by entrepreneurs' age. As to specific human capital, previous studies consider whether founders have business experience in the same sector of the new firm as a proxy of industry-specific human capital, and have prior self-employment or managerial experiences as proxies of entrepreneur-specific human capital.

Let us first consider education. While this variable is generally found to be positively related to the likelihood of survival of new firms (see Bates, 1990; Brüderl et al., 1992; Gimeno et al., 1997), results concerning growth are less robust. In a survey of empirical studies on the determinants of small firms' growth, Storey (1994) highlights that only 8 studies out of the 17 surveyed find a strong positive effect of entrepreneurs' education. Cooper et al. (1994) in a longitudinal study of a large sample of US new ventures, show that high growth firms are more frequently created by more educated individuals. Similar results are obtained by Westhead and Cowling (1995) for UK NTBFs. Brüderl and Preisdörfer (2000) find that in a univariate analysis, growth of newly established Bavarian firms is positively related to years of schooling of firms' main founder; however, the coefficient of this variable though positive, is not significant in more comprehensive multivariate regressions. Quite surprisingly, the nature of the education received by founders has almost been neglected in the empirical literature. An exception is work by Almus and Nerlinger (1999) on newly established West German firms. They provide evidence that firms started by individuals who have a technical degree enjoy greater growth rates; this holds true in high-, medium-, and low-tech industries. On the contrary, business education has a significantly positive impact only for low-tech firms.

As to years of prior work experience of founders, Brüderl et al. (1992) find a U-shaped relationship between this variable and the mortality rate of Bavarian firms, while Brüderl and Preisdörfer (2000) show that it has no statistically significant impact on growth. Almus et al. (1999) highlight that the fact that entrepreneurs have no professional experience at start-up time has a negative, though statistically insignificant influence on growth of East German innovative firms, while it does negatively affect growth of non-innovative firms.

Findings relating to founders' industry-specific human capital are more robust. Brüderl et al. (1992) document that the failure rate of Bavarian new firms

is significantly lower if founders have business experience in the same sector of the new firm. In addition, in a univariate analysis this variable is shown to have a significantly greater value for fast growing firms than for other firms; nevertheless, such relation is not replicated in a multivariate logit analysis (see Brüderl and Preisdörfer, 2000). Cooper et al. (1994) find that industry-specific know-how contributed to both survival and growth of their sample firms. Siegel et al. (1993) show that in a sample of around 1600 Pennsylvania start-ups, the fact that the entrepreneurial team had prior experience in the same industry of the new firm was the only discriminating factor between high-growth and low-growth firms. Similarly, Gimeno et al. (1997) highlight a strong positive association between the post-entry performances of new firms and an index capturing similarity of customers, suppliers, and products/services between the new firm and the organization by which entrepreneurs were formerly employed. A positive impact on growth of similarity between the business of the new firm and the one of the incubating organization is also found by Chandler and Jansen (1992). Cooper and Bruno (1977) consider young high-tech firms that in the 1970s were located in the San Francisco Peninsula. They show that high-growth firms were more likely than discontinued ones to have been founded by individuals who came from incubating organizations that operated in the same industry of the new firm. Similarly, Feeser and Willard (1990) while comparing 39 high-growth computer producers with a matching set of low-growth firms, show that the former firms are more likely than the latter to have products, markets, and technologies closely related to those of their founders' incubating organization.

As was the case for education, only a few studies consider the effects on firms' growth of the functional nature of the work experience of founders. Stuart and Abetti (1990) while analyzing 52 new technical ventures located in the New York/New England area, consider the years of both technical and commercial experience; they find that these variables have no statistically significant impact on a composite "growth and performance" index. Similar results are obtained by Westhead and Cowling (1995). However, both studies consider generic professional experience rather than industry-specific one.

Let us now turn attention to entrepreneur-specific human capital. Several studies have investigated

whether firms whose founders have prior self-employment or managerial experiences perform better than other firms, but have provided mixed results. Bates (1990) and Brüderl et al. (1992), respectively, find no evidence that individuals' prior managerial and self-employment experiences have any impact on new firms' failure rates. In Brüderl and Preisdörfer (2000) study, these variables exhibit significantly higher values in the "fast growing firms" group than in the group that includes the remaining firms; in multivariate logit models the former variable has a positive, statistically significant coefficient, while the latter is positive but insignificant. Gimeno et al. (1997) show that while prior managerial and entrepreneurial experiences positively influence new firms' economic performances, they have no significant impact on survival. Chandler and Jansen (1992) highlight that the number of businesses previously initiated by founders and the years they previously spent as owner–manager do not affect new firms' growth; on the contrary, the years of general managerial experience in another firm are positively correlated with self-perceived management competence, which in turn is a predictor of firms' growth. As regards more specifically NTBFs, Stuart and Abetti (1990) find a strong positive correlation between firms' performances and the entrepreneurial and managerial experiences of founders. However, such results are not replicated by other studies (see for instance, Westhead and Cowling, 1995. For a survey of earlier findings see again Storey, 1994).

Lastly, some previous empirical works draw attention to the heterogeneity of the founding team. This is usually proxied by the number of founders. Yet the evidence relating to the effect on growth of this variable is weak. While some studies highlight a positive effect (Cooper and Bruno, 1977; Eisenhardt and Schoonhoven, 1990. See also the studies mentioned by Storey, 1994), others fail to detect any significant relation (see for instance, Westhead and Cowling, 1995; Almus et al., 1999; Almus and Nerlinger, 1999; Brüderl and Preisdörfer, 2000). Only a few studies developed more direct indicators of founders' heterogeneity. Roue and Maidique (1986) consider the degree of team completeness, defined as the number of essential functions in a new company that are filled by founders at start-up time; they show that successful companies have more complete founding teams. Eisenhardt and Schoonhoven (1990) find that the standard deviation of

the years of industry-specific experience of founders is positively related to firms' growth.

## 2.2. *Theoretical hypotheses*

The empirical literature surveyed in the previous section generally indicates that the human capital of founders positively affects the post-entry performances of NTBFs. Nevertheless, this evidence is compatible with different arguments inspired by different streams of the theoretical literature.

Studies in financial economics suggest that the positive relation between founders' human capital and the post-entry performances of new firms simply reveals the presence of binding financial constraints. On the one hand, previous empirical studies support the view that there is a positive relation between the (generic) human capital of individuals and their wealth. For instance, Astebro and Bernhardt (1999) while examining 986 US start-ups, show that with all else equal, the household income of entrepreneurs is positively related to their educational attainments and years of work experience (see also Xu, 1998). On the other hand, capital market imperfections generally make it difficult for NTBFs to obtain the external financing they need (Carpenter and Petersen, 2002a). As the cost of external financing is considerably greater than the opportunity cost of personal capital, founders of NTBFs preferably resort to this latter type of capital; in other words, there is a "financing hierarchy" (Fazzari et al., 1988).

Previous studies concerned with entrepreneurship have provided evidence consistent with the view that new firms suffer from financial constraints. For instance, both cross-sectoral (Meyer, 1990; Blanchflower and Oswald, 1998) and longitudinal (Evans and Jovanovic, 1989; Evans and Leighton, 1989; Black et al., 1996) studies have shown that the likelihood of being self-employed is higher for individuals with great net worth. Lindh and Ohlsson (1996) using Swedish microdata, have highlighted that this probability increases when individuals receive windfall gains in the form of lottery winnings and inheritances. Holtz-Eakin et al. (1994a) have similarly analyzed reception of an inheritance; their results indicate that the likelihood of establishing a new enterprise and the initial capital committed to the enterprise by the founder significantly increase with the size of the inheritance and that such effect is more pronounced for low

net-worth individuals. In addition, the greater the inherited amount the greater the likelihood of survival and the growth rate of the new venture (Holtz-Eakin et al., 1994b). Astebro and Bernhardt (1999) have shown that the predicted household income of US entrepreneurs positively affects the amount of capital committed to a new venture. Lastly, the analysis of the evolution over time of the size distribution of Portuguese firms performed by Cabral and Mata (2003) indicates the presence of binding financial constraints that prevent new firms from attaining their optimal initial size.<sup>3</sup>

These findings suggest that NTBFs that are established by high human capital individuals can more easily escape financial constraints as these individuals have access to greater personal capital to finance firm's operations. In addition, much of high-tech investments is intangible or firm specific, and thus provides little inside collateral value. Since firms founded by high net worth individuals are in a better position to resort to outside collateral, they will also have easier access to external financing (Bester, 1985, 1987). Therefore, these firms will enjoy higher growth. It follows that it is the "wealth effect" of founders' human capital that explains its positive impact on growth.

Works in economics and management inspired by the competence-based approach propose a different argument. According to this literature, the distinctive capabilities of NTBFs are closely related to the knowledge and skills of their founders.<sup>4</sup> In a very uncertain business environment as is typical of high-tech industries, entrepreneurial opportunities exist because individuals have beliefs that are not shared by others about how their knowledge and skills can be combined with other resources so as to create value (Shane and Venkataraman, 2000; Alvarez and Barney, 2002). In this context, due to the idiosyncratic, non-contractible nature of entrepreneurial judgment when an individual identifies a new and hitherto unrecognized business opportunity, the only option available to exploit it is to start a new firm (see Foss, 1993; Hodgson, 1998).

<sup>3</sup> Nonetheless, the view that new firms face tight financial constraints is not unanimously shared in the literature (see for instance Cressy, 1996, 2000).

<sup>4</sup> "For a new, high-technology firm, the primary assets are the knowledge and skills of the founders. Any competitive advantage the new firm achieves is likely to be based upon what the founders can do better than others" (Cooper and Bruno, 1977, p. 21. See also Feeser and Willard, 1990, p. 88).

Individuals with greater human capital are likely to have better entrepreneurial judgment. In particular, individuals with great industry-specific and entrepreneur-specific human capital are in an ideal position to seize neglected business opportunities and to take effective strategic decisions that are crucial for the success of the new firm. On the one hand, what founders know and can do is very much related to what they learned in the organization by which they were formerly employed (Cooper and Bruno, 1977; Cooper, 1985). If the business of the new firm is closely related to the one of the incubating organization, the new firm can exploit the knowledge about technologies, customers' needs, and competitors' strengths and weaknesses and the contacts with potential customers and suppliers that founders developed in their previous occupation (Feeser and Willard, 1990; Shepherd et al., 2000). On the other hand, the exercise of entrepreneurial judgment benefits from learning by doing, as it is a cumulative process of "identification and discovery" (Loasby, 1995). A similar reasoning applies to managerial tasks involved in organizing and controlling the work of employees (i.e., giving directions to subordinates, delegating authority, designing incentives, and monitoring results). Therefore, there is an advantage in already knowing how to set up and manage a firm.

In addition, successful exploitation of a new business opportunity generally requires the integration of complementary context-specific knowledge (e.g., knowledge relating to complementary technological fields; technological, marketing, and managerial knowledge) that is dispersed among different individuals. In principle, a new firm could acquire the required knowledge by hiring these individuals; nevertheless, this knowledge can be more efficiently coordinated and protected if specialists are members of the founding team and so have a stake in firm's future profits.<sup>5</sup> This again means that NTBFs established by individuals with greater specific human

<sup>5</sup> It generally is quite difficult for NTBFs to attract highly skilled salaried individuals. Of course, NTBFs have other options. For instance, as is acknowledged by a growing literature, under certain circumstances alliances allow NTBFs to obtain the necessary complementary knowledge (see among others McGee et al., 1995; Eisenhardt and Schoonhoven, 1996; Stuart et al., 1999; Lee et al., 2001). Nevertheless, high coordination costs, appropriability hazards, and other transaction costs often make their use quite inefficient.

capital should outperform other NTBFs. It also means that with all else equal, creating a functionally balanced founding team composed of individuals with heterogeneous but complementary capabilities, will lead to better post-entry performances (Cooper and Bruno, 1977; Eisenhardt and Schoonhoven, 1990).

To sum up, according to the competence-based view, NTBFs established by individuals with greater human capital should outperform other NTBFs because of their unique capabilities; in other words, it is the “capability effect” of founders’ human capital that explains its positive impact on growth.

In order to disentangle the relative explanatory power of the “wealth effect” and the “capability effect” arguments, attention must be drawn to the *nature* of the human capital of founding teams; in other words, one should consider the specific type of education and work experience of founders.

Let us first consider education. The wealth effect argument posits that as more educated founders have access to greater personal capital, the NTBFs they established suffer to a lesser extent from financial constraints to growth. Nevertheless, the nature of the education received by founders should not play any role. In particular, no difference should be detected between education in technical-scientific and economic-managerial fields. Conversely, if the type of education is found to differently affect firms’ growth, this suggests that founders’ specific capabilities matter. Following the competence-based view, we thus derive the following hypothesis.

**Hypothesis 1.** The years of education of founders in technical-scientific and economic-managerial fields differently influence the growth of NTBFs.

Let us now draw attention to work experience. A reasoning similar to the one relating to education applies. According to the wealth effect argument, NTBFs established by more experienced individuals should exhibit superior growth. However, whether prior professional experience relates to the same sector of the new firm or not should not make any difference. Conversely, according to the competence-based view, it is the industry-specific work experience of founders as opposed to experience in industries other than the one of the new firm that provides the NTBF with a

sustainable competitive advantage.<sup>6</sup> We thus derive the following hypothesis.

**Hypothesis 2.** Founders’ years of prior work experience in the same industry of the new firm are more positively associated with NTBFs’ growth than founders’ years of prior work experience in other industries.

Furthermore, industry-specific experience may relate to different functional activities. In this respect, one may wish to distinguish between technical and commercial experience. The former captures the context-specific knowledge and skills of founders in R&D, process design, engineering and production, while the latter relates to marketing, sale, and customer care activities. Again, the type of functional experience of founders is unlikely to be related to personal wealth. Hence, if it turned out to matter for growth, this again would argue in favor of the competence-based view. We then obtain the following hypothesis.

**Hypothesis 3.** The years of industry-specific work experience of founders in technical and commercial functions differently influence the growth of NTBFs.

Entrepreneur-specific human capital can be proxied by the experience gained by founders in previous managerial positions in other firms and in previous entrepreneurial episodes.<sup>7</sup> According to the “capability effect” argument, there should be a positive relation between these variables and the growth of NTBFs. Conversely, to the extent that they are unrelated to individuals’ wealth,<sup>8</sup> the “wealth effect” argument has no predictions as to their effect on growth. We then derive the following hypotheses.

<sup>6</sup> As was highlighted earlier, the evidence provided by previous empirical studies indicate that industry-specific work experience is more closely related to the growth of new firms than generic experience. Nonetheless, as far as we know, this argument was not previously tested within the same dataset.

<sup>7</sup> Note that we consider “leadership experience” irrespective of the sector on which it is gained as part of the specific component of human capital. In this respect, the first to acknowledge the non-sector specific nature of the entrepreneurial and managerial experience were Marshall and Paley Marshall (1879, p. 51).

<sup>8</sup> In principle, it might be argued that because of higher salaries, managers are wealthier than other individuals. Nonetheless, this claim is not supported by the available empirical evidence (see in particular Astebro and Bernhardt, 1999).

**Hypothesis 4.** NTBFs established by individuals with prior managerial experiences in other firms exhibit higher growth than other NTBFs.

**Hypothesis 5.** NTBFs established by individuals with prior entrepreneurial experiences exhibit higher growth than other NTBFs.

Lastly, the competence-based approach argues that synergistic gains arise from combination of diversified capabilities within the founding team of a NTBF. As was mentioned earlier, in most previous empirical studies heterogeneity of founders' capabilities was proxied by the number of founders. Actually, this is a quite unsatisfactory proxy; it is positively related to the amount of resources available to the new firm at start-up, including financial resources. So, in accordance with the wealth effect argument, the positive effect on growth of team foundation may arise from relaxation of financial constraints. In order to support the competence-based argument we need to investigate whether particular combinations of founders' capabilities as are reflected by their human capital characteristics, favor firms' growth. Accordingly, we expect NTBFs established by teams of individuals with heterogeneous education and professional experience to exhibit superior performances. We therefore obtain the following hypothesis.

**Hypothesis 6.** NTBFs will exhibit higher growth the more heterogeneous the educational background and the prior work experiences of their founders.

### 3. The dataset

In this paper, we consider a sample composed of 506 Italian NTBFs. Sample firms were established in 1980 or later, were independent at founding time and have remained so by 1 January 2004 (i.e., they were not controlled by another business organization even though other organizations may hold minority shareholdings in the new firms) and operate in the following high-tech sectors, in manufacturing and services: computers, electronic components, telecommunication equipment, optical, medical, and electronic instruments, biotechnology, pharmaceuticals, advanced materials, robotics, and process automation equipment, multimedia content, software,

Internet services (e-commerce, ISP, web-related services), and telecommunication services.

The sample of NTBFs was extracted from the RITA (Research on Entrepreneurship in Advanced Technologies) database, developed at Politecnico di Milano. The development of the database went through a series of steps.

First, Italian firms that complied with the above mentioned criteria relating to age and sector of operations were identified. For the construction of the target population a number of sources were used. These included lists provided by national industry associations, on-line and off-line commercial firm directories, and lists of participants in industry trades and expositions. Information provided by the national financial press, specialized magazines, other sectoral studies, and regional Chambers of Commerce was also considered. Altogether, 1974 firms were selected for inclusion in the database. For each firm, a contact person (i.e., one of the owner-managers) was also identified. Unfortunately, data provided by official national statistics do not allow to obtain a reliable description of the universe of Italian NTBFs.<sup>9</sup> Second, a questionnaire was sent to the contact person of the target firms either by fax or by e-mail. The first section of the questionnaire provides detailed information on the human capital characteristics of firms' founders. The second section comprises further questions concerning the characteristics of the firms including their post-entry performances. Lastly, answers to the questionnaire were checked for internal coherence by educated personnel and were compared with published data (basically data provided by firms' annual reports and financial accounts) if they were available. In several cases, phone or face-to-face follow-up interviews were made with firms' owner-managers. This final step was crucial in order to obtain missing data and ensure that data were reliable.<sup>10</sup>

<sup>9</sup> The main problem is that in Italy most individuals who are defined as "self-employed" by official statistics actually are salaried workers with atypical employment contracts. Unfortunately, on the basis of official data such individuals cannot be distinguished from entrepreneurs who created a new firm.

<sup>10</sup> Note that for only three firms, the set of owner-managers at survey date did not include at least one of the founders of the firm. For these firms information relating to the human capital characteristics of the founders was checked through interviews with firms' personnel so as to be sure that it did not relate to current owner-managers.

Table 1  
Distribution of sample firms by industry and geographic area

	Number of observation	(%)
<b>Industry</b>		
Internet and TLC services	180	35.6
Software	152	30.0
ICT manufacturing	111	21.9
Biotechnology & Pharmaceuticals	21	4.1
Automation & Robotics	42	8.4
Total	506	100.0
<b>Area</b>		
North-west	240	47.4
North-east	114	22.5
Centre	79	15.6
South	73	14.5
Total	506	100.0

The sample used in the present work consists of all RITA firms for which we were able to create a complete data set (see Section 4.2). The only exception concerns data on previous entrepreneurial experiences of firms' founders that were available only for a subsample of 440 firms. The distribution of the sample across industries and geographic areas is illustrated in Table 1.  $\chi^2$ -Tests show that there are no statistically significant differences between the distributions of the sample firms across industries and regions and the corresponding distribution of the population of 1974 RITA firms from which the sample was obtained ( $\chi^2(4) = 3.39$  and  $\chi^2(3) = 4.87$ , respectively).

The sample is quite large and as will be shown in Section 4.2, it exhibits considerable heterogeneity as to the relevant explanatory variables. In addition, the information relating to the human capital of founders is more fine-grained than in previous datasets of similar size. In particular, we differ from previous studies that relied on the estimates of econometric models in that we know the precise nature (in addition to the number of years) of both the education and work experience of founders. Therefore, the dataset used in this work provides a reasonably adequate test bed of the theoretical hypotheses illustrated in Section 2.2. Of course, there is no presumption here to have a random sample. First, in this domain representativeness is a slippery notion as new ventures may be defined in different ways (see for instance, Birley, 1984; Aldrich et al., 1989; Gimeno et al., 1997). Second, as was mentioned above, absent

reliable official statistics, it is very difficult to identify unambiguously the universe of Italian NTBFs. Therefore, one cannot check ex-post whether the sample used in this work is representative of the universe or not. Third, the sample suffers from a survivorship bias: only firms having survived up to the survey date could be included in the sample. In principle, attrition may generate a sample selection bias that is difficult to control. As was illustrated in Section 2, it is widely documented in the empirical literature that failure rates of new firms decrease with the human capital of founders. Therefore, the impact of human capital variables on firms' growth might actually be greater than the one highlighted by our empirical analysis; in other words, the estimated coefficients of the human capital variables might be downward biased due to sample selection.<sup>11</sup>

#### 4. The econometric model

##### 4.1. The specification of the econometric model

We investigate the determinants of NTBFs' growth through econometric estimates of a series of models relating firms' size at survey date measured in logarithm ( $y_{ij}$ ) to variables including the human capital of founders, firms' age, and other control variables ( $x_{ij}$ ):

$$y_{ij} = \beta'_j x_{ij} + \varepsilon_{ij}, \quad i = 1, \dots, 506; j = t, n \quad (1)$$

where the  $\beta_j$  are unknown parameters,  $\varepsilon_{ij}$  the zero mean error terms, and  $\sigma_{\varepsilon_j}$  are their standard deviations. The subscript  $j$  is equal to  $t$  or  $n$  according to the value taken by a so called "treatment" variable ( $T_i$ ), that is equal to 1 if a NTBF resorted to external private equity financing (i.e., private equity financing that is not provided by founders, members of their family and friends) during its life ( $j = t$ ) and 0 otherwise ( $j = n$ ). Estimating separate equations for  $j = t$  and  $j = n$  would lead to inconsistent estimates of both sets of parameters (see Greene, 2003 p. 788). Inserting  $T_i$  as a regressor into Eq. (1), that would then become:

$$y_i = \beta' x_i + \delta T_i + \varepsilon_i, \quad (2)$$

<sup>11</sup> However, note that in principle an opposite bias may also exist: founders with a high level of human capital may have better opportunities and income chances in employee jobs. Thus, they may have a stronger tendency to leave self-employment and stop their new firm. We are grateful to an anonymous referee for raising this point.

might originate endogeneity problems since  $T_i$  is very likely correlated with the error term. In fact, unobserved factors may influence both firms' scale at survey date and the probability of having received external private equity financing. Moreover, we cannot distinguish whether external financing has influenced firm's size or it was firm's size that affected the probability of obtaining this source of financing. Therefore, in order to take into account the possible non-exogenous nature of the variable  $T_i$ , we resort to a two-step procedure (see Heckman, 1990; Vella and Verbeek, 1999; Greene, 2003). More precisely, following Vella and Verbeek (1999) we estimate Eq. (2) via both instrumental variables (IV) and the control function (CF) approach. In both cases, first a selection equation is specified as:

$$T_i = \gamma' z_i + u_i, \quad (3)$$

such that

$$T_i = 1 \quad \text{if } u_i > -\gamma' z_i, \quad T_i = 0 \text{ otherwise,}$$

where  $z_i$  is the set of explanatory variables of NTBFs' access to external private equity financing and  $u_i$  are independent and normally distributed error terms. If Eq. (2) is estimated without correcting for the endogeneity of having received private equity financing modelled by Eq. (3), then the error terms  $\varepsilon_i$  and  $u_i$  will be correlated resulting in biased estimates of the  $\beta$  parameters. So, we estimate (3) parametrically through a probit model. Then, according to the IV approach, we compute the predicted probabilities of  $T_i$ , denoted by  $\hat{T}_i$ , and insert them in Eq. (2) in place of  $T_i$ . These fitted values for  $T_i$  will be correlated with  $y_i$  but not with  $\varepsilon_i$ , allowing us to correctly estimate by OLS Eq. (2), which is now transformed as:

$$y_i = \beta' x_i + \delta \hat{T}_i + \varepsilon_i. \quad (4)$$

An alternative estimator that produces consistent estimates of Eq. (2) is based on the CF method proposed by Heckman (1978, 1979). Let us consider the conditional expectation of  $y_i$  given  $T_i$  and  $z_i$ :

$$E(y_i | T_i, z_i) = \beta' x_i + \delta T_i + E(\eta_i | T_i, z_i), \quad (5)$$

where the latter term is:

$$E(\eta_i | T_i, z_i) = T_i E(\varepsilon_i | T_i = 1, z_i) + (1 - T_i) E(\varepsilon_i | T_i = 0, z_i). \quad (6)$$

Under the joint normality assumption, the two conditional expectations on the right-hand side of expression (6) can be written as:

$$E(\varepsilon_{ij} | T_i, z_i) = \sigma_{\varepsilon j} \lambda_i(\gamma' z_i), \quad (7)$$

where:

$$\lambda_i(\gamma' z_i) = T_i \frac{\phi(-\gamma' z_i)}{1 - \Phi(-\gamma' z_i)} + (1 - T_i) \frac{-\phi(\gamma' z_i)}{\Phi(-\gamma' z_i)}. \quad (8)$$

$\phi(\cdot)$  and  $\Phi(\cdot)$  represent the probability density and cumulative density functions of the standard normal distribution, respectively.  $\lambda_i(\gamma' z_i)$  is the generalized residual (see Gourieroux et al., 1987) of the probit model and can be estimated from Eq. (3). Then, the estimated value of (8), interacted with  $T_i$ , is included in Eq. (2) that can now be estimated by OLS. The corrected version of Eq. (2) is:

$$y_i = \beta' x_i + \delta T_i + \theta_1 T_i \hat{\lambda}_i(\gamma' z_i) + \theta_0 (1 - T_i) \hat{\lambda}_i(\gamma' z_i) + \xi_i. \quad (9)$$

Alternatively, we can constrain  $\sigma_{\varepsilon i}$  to equal  $\sigma_{\varepsilon n}$  and add  $\hat{\lambda}_i(\cdot)$  as a single regressor, obtaining the restricted CF estimator:

$$y_i = \beta' x_i + \delta T_i + \theta \hat{\lambda}_i(\gamma' z_i) + \xi_i. \quad (10)$$

Vella and Verbeek (1999) show that the CF approach is more robust and efficient to specification errors than the IV one; nonetheless this latter is independent of the normality assumption contrarily to the CF method. They also find that results from the restricted and unrestricted CF approaches are very similar in settings as the present one, where treatment's costs do not enter into the selection equation (see on this point also Phillips, 2003). Finally, note that the significance of coefficients  $\theta_0$  and  $\theta_1$  in Eq. (9) and  $\theta$  in Eq. (10) can be regarded as a test of the endogeneity of external private equity financing.

#### 4.2. Dependent and independent variables

The dependent variable of the econometric models is the logarithm of the number of employees of firms at survey date. Since firm's age (*Age*) is added to the set of control variables, the dependent variable is an indicator of the average yearly absolute employment growth

Table 2  
Definition of explanatory variables

Variable	Description
<i>Education</i>	Average number of years of education of founders
<i>Ecoeduc</i>	Average number of years of economic and/or managerial education of founders at graduate and post-graduate level
<i>Techeduc</i>	Average number of years of scientific and/or technical education of founders at graduate and post-graduate level
<i>Workexp</i>	Average number of years of work experience of founders before firm's foundation
<i>Specworkexp</i>	Average number of years of work experience of founders in the same sector of the startup before firm's foundation
<i>Techworkexp</i>	Average number of years of technical work experience of founders in the same sector of the start-up before firm's foundation
<i>Comworkexp</i>	Average number of years of commercial work experience of founders in the same sector of the start-up before firm's foundation
<i>Otherworkexp</i>	Average number of years of work experience of founders in other sectors than the one of the start-up before firm's foundation
<i>DManager</i>	One for firms with one or more founders with a prior management position in a company with more than 100 employees
<i>DEntrepreneur</i>	One for firms with one or more founders with a previous self-employment experience
<i>Age</i>	Number of years since firm's foundation
<i>NFounders</i>	Number of founders
<i>Locdevelop</i>	Value of the index measuring regional infrastructures in 1989 (mean value among Italian regions = 100; source: Centro Studi Confindustria, 1991)
<i>DPprivate equity</i>	One for firms that resorted to outside equity financing from venture capitalists, financial service firms, and other firms
<i>Innovative</i>	One for firms where all founders declared that the wish to exploit an innovative technology was the main motive for the creation of the firm
<i>PESector<sup>a</sup></i>	Ratio of the share accounted for by the sector of the new firm out the total number of high-tech firms that obtained private equity financing over the period 1997–2003 (source: AIFI) to the share accounted for by the same sector out of the total number of Italian NTBFs in 2003 (source: RITA database)
<i>PEArea<sup>a</sup></i>	Ratio of the share accounted for by the geographical area in which the new firm is located out the total number of high-tech firms that obtained private equity financing over the period 1997–2003 (source: AIFI) to the share accounted for by the same geographical area out of the total number of Italian NTBFs in 2003 (source: RITA database)

<sup>a</sup> *PESector* and *PEArea* are defined as follows. First, we considered the total number of high-tech firms that obtained private equity financing over the period 1997–2003 (source: AIFI). Let  $PES_j$  and  $PEA_k$  indicate the shares accounted for by sector  $j$  and geographical area  $k$  out of this number. Let  $S_j$  and  $A_k$  be the estimated shares accounted for by sector  $j$  and geographical area  $k$  out of the total number of Italian NTBFs in 2003 (source: RITA database). Then:  $PESector_j = PES_j/S_j$  and  $PEArea_k = PEA_k/A_k$ .

in the period in which a firm is observed (for a similar approach see for instance, Westhead and Cowling, 1995).<sup>12</sup> The explanatory variables can be subdivided in four groups (see Table 2).

The first group encompasses indicators that have been used by most previous studies to describe the human capital characteristics of entrepreneurs and are included purely for comparison purposes. *Education* and *Workexp* measure the mean number of years of education and work experience of founders. We expect these variables to have a positive effect on growth. Nonetheless, they do not allow to discriminate between the “wealth” and “capability” effects.

For the purpose of the present study, the second group of variables plays a crucial role. They reflect the *nature* of the human capital of founding teams. First, we consider the education attainments of founders; in particular, as concerns graduate and post-graduate education, we distinguish between economic and managerial studies (*Ecoeduc*) and technical and scientific studies (*Techeduc*).<sup>13</sup> Second, we distinguish between

<sup>12</sup> We also used the logarithm of the sales of firms as an alternative measure of growth in the observation period. Data on sales were available for a smaller sample composed of 499 firms. As regards the coefficients of human capital variables, the results are close to the ones presented in Section 5; they are available from the authors upon request.

<sup>13</sup> More precisely, *Ecoeduc* measures years spent for the attainment of degrees in economics, management, and political sciences, while *Techeduc* reflects years spent for obtaining degrees in engineering, chemistry, physics, geology, mathematics, biology, medicine, pharmaceuticals, and computer science. In order to properly judge the effective level of competencies of founders, we consider the minimum length of time necessary to attain a certain degree. In order to attain an Italian graduate degree in economics, management, political sciences, and most scientific degrees 4 years of studies are requested, while 5 years is the minimum time for a degree in engineering and chemistry. Master and Ph.D. programmes require one and three additional years, respectively, independently of the specific field.

founders' years of work experience in the same sector of the new firm (*Specworkexp*) and years of work experience in other sectors (*Otherworkexp*). Third, we also decompose industry-specific experience in *Techworkexp* and *Comworkexp*. The former variable measures the mean number of years of work experience of founders in the R&D, design, engineering and production departments of firms that operate in the same sector of the NTBF under consideration; the latter one is the corresponding measure relating to marketing, sale and customer care functions.

According to the wealth effect argument, variables capturing the nature of the education and professional experience of founders should not differently affect the growth of NTBFs; so if they do, this will argue in favor of competence-based arguments. In particular, as far as different educational attainments reflect different capabilities within the founding team, we expect the coefficients of *Techeduc* and *Ecoeduc* to differ (**Hypothesis 1**), even though we have no expectations as to which one will be more closely associated with growth. In addition, the competence-based literature contends that if the business of the incubating organization is similar to the one of the new firm, the capabilities learned by founders in the organization by which they were formerly employed are crucial for firm's success. Following **Hypothesis 2**, we then predict a greater positive coefficient for *Specworkexp* as opposed to *Otherworkexp*. Lastly, **Hypothesis 3** claims that the industry-specific work experience of founders will differently affect growth according to its functional nature. So, we expect the coefficients of *Techworkexp* and *Comworkexp* to differ, even though once again we have no predictions as to which one will have a greater effect on growth.

In this category, we also consider two measures of the entrepreneur-specific human capital of founders. *DManager* is a dummy variable, which equals 1 if within the founding team there are one or more individuals who had a managerial position in a medium or large company (i.e., number of employees greater than 100)<sup>14</sup> prior to the establishment of the new

firm. *DEntrepreneur* equals 1 if one or more founders had prior self-employment experience. Managerial and entrepreneurial skills benefit from learning by doing; so in accordance with **Hypotheses 4 and 5** we expect both these variables to have positive coefficients in the econometric estimates.

In this paper, we are also interested in the synergistic gains that may arise from combination of heterogeneous and complementary capabilities within the founding team of NTBFs (**Hypothesis 6**). For this purpose, we consider a third group of variables that includes interactive terms between (a) the years of technical-scientific and economic-managerial education of founders (*Techeduc* × *Ecoeduc*), (b) the years of industry-specific work experience of founders in technical and commercial functions (*Techworkexp* × *Comworkexp*), (c) the years of technical-scientific and economic-managerial education, and of industry-specific work experience both in technical and commercial functions (*Techeduc* × *Techworkexp*, *Ecoeduc* × *Techworkexp*, *Techeduc* × *Comworkexp*, *Ecoeduc* × *Comworkexp*), (d) the dummy *DManager* and the years of technical-scientific and economic-managerial education (*DManager* × *Techeduc* and *DManager* × *Ecoeduc*), and (e) the dummy *DManager* and the years of technical and commercial industry-specific experience (*DManager* × *Techworkexp* and *DManager* × *Comworkexp*). According to the "wealth effect" argument, these variables should not have any impact on growth. Conversely, the competence-based view contends that NTBFs with founding teams composed of individuals with complementary educational background and professional experience will exhibit higher growth. Hence, we expect the coefficients of (some of) the interactive terms to be positive (**Hypothesis 6**). This would suggest that the marginal effect on firms' growth of a given human capital characteristic of founders (e.g., industry-specific technical experience) is more positive if within the founding team it is combined with a greater level of another (complementary) human capital characteristic (e.g., industry-specific commercial experience).

The last group includes control variables. *NFounders* is the number of founders of NTBFs. Given the level and nature of the human capital of founding teams, the larger the number of founders the greater the tangible and intangible resources at

<sup>14</sup> In small family-owned Italian companies decision authority is often centralised in the owner-manager's hands (see Colombo and Delmastro, 1999), while salaried managers are assigned execution tasks. So, entrepreneurial learning associated with such managerial positions generally is fairly limited.

their disposal, including financial resources. So, we predict a positive impact of this variable on growth.<sup>15</sup> *Locdevelop* reflects the level of economic development in 1989 of the county where firms are located (source: Centro Studi Confindustria, 1991). It is calculated as the average of the following indexes: per capita value added, share of manufacturing out of total value added, employment index, per capita bank deposits, automobile-population ratio, and consumption of electric power per head. The Italian benchmark value is 100. Since the average value for sample firms is 115, this shows that high-tech start-ups are usually located in more developed regions. Location in a developed area is likely to positively influence growth, as it enables NTBFs to benefit from positive externalities that may arise from external assets with public good nature (e.g., transport system, telecommunication infrastructure, efficient market for support services). *DPrivate equity* is a dummy variable indicating whether firms obtained external private equity financing (i.e., equity financing that is not provided by founders, members of their family, and friends). With all else equal, if they do, financial constraints that may otherwise hinder growth will be relaxed. So, we predict a positive coefficient for this variable. As was explained in the previous section, whether NTBFs resort to this source of financing depends on several observed and unobserved factors. In the selection equation that models the likelihood of obtaining external private equity financing we introduced several independent variables. These include the human capital characteristics of founders, their number, a variable that reflects the importance of innovative motivations for the creation of the firm (*Innomotive*),<sup>16</sup> and firms' age. They also include proxies of the propensity of the private equity industry to invest in the sector (*PESector*) and the geographical area (*PEArea*)

Table 3  
Descriptive statistics of the variables of the econometric models

Variable	Mean	S.D.	Minimum	Maximum
<i>Size</i>	18.961	43.197	1.000	634.000
<i>Eduction</i>	15.147	2.673	8.000	22.500
<i>Ecoeduc</i>	0.316	0.899	0.000	5.000
<i>Techeduc</i>	1.833	2.235	0.000	8.000
<i>Workexp</i>	11.344	7.729	0.000	49.000
<i>Specworkexp</i>	3.976	6.125	0.000	35.500
<i>Techworkexp</i>	2.677	5.023	0.000	30.000
<i>Comworkexp</i>	1.001	3.263	0.000	23.000
<i>Otherworkexp</i>	7.350	8.014	0.000	49.000
<i>DManager</i>	0.093	0.291	0.000	1.000
<i>DEntrepreneur<sup>a</sup></i>	0.404	0.491	0.000	1.000
<i>Age</i>	8.947	5.911	0.000	23.000
<i>NFounders</i>	2.753	1.801	1.000	21.000
<i>Locdevelop</i>	115.764	27.400	43.700	174.700
<i>DPrivate equity</i>	0.115	0.319	0.000	1.000
<i>Innomotive</i>	0.372	0.484	0.000	1.000
<i>PESector</i>	1.984	3.255	0.000	28.314
<i>PEArea</i>	1.111	1.253	0.000	5.892

<sup>a</sup> Data available for a subset of 440 firms.

in which the new firm operates.<sup>17</sup> Lastly, industry dummies were introduced into the econometric models in order to control for industry-specific factors that may influence the growth of NTBFs. In Table 3, we illustrate descriptive statistics of explanatory variables, where for the sake of synthesis, we omit industry dummies.<sup>18</sup>

## 5. Empirical results

In Table 4, we illustrate the results of IV and restricted CF estimates of the growth equation aimed at controlling for the endogeneity bias possibly associated

<sup>15</sup> As was said earlier, in previous work the number of founders has often been considered as a proxy (actually, a quite unsatisfactory one) of the heterogeneity of founders' competencies. In this paper, we have a more direct measure of such effect. So, we just add the number of founders as a control.

<sup>16</sup> The questionnaire provides information as to the main motive of each individual founder for firm's creation. *Innomotive* is a dummy variable that indicates whether all the members of the founding team declared that the wish to exploit an innovative technology was the main motive for the creation of the firm.

<sup>17</sup> *PESector* and *PEArea* are defined as follows. First, we considered the total number of Italian high-tech firms that obtained private equity financing over the period 1997–2003 (source: AIFI). Let  $PES_j$  and  $PEA_k$  indicate the shares accounted for by sector  $j$  and geographical area  $k$  out of this number. Let  $S_j$  and  $A_k$  be the estimated shares of sector  $j$  and geographical area  $k$  out of the total number of Italian NTBFs in 2003 (source: RITA database). Then,  $PESector_j = PES_j/S_j$  and  $PEArea_k = PEA_k/A_k$ .

<sup>18</sup> Correlation across explanatory variables is generally low, suggesting the absence of any relevant problem of multicollinearity. The correlation matrix of explanatory variables is available from the authors upon request.

Table 4  
The determinants of firms' growth

	Probit A (DPrivate equity)	Model 1		Model 2		Model 3		Probit B (DPrivate equity)	Model 4	
		IV	Res. CF	IV	Res. CF	IV	Res. CF		IV	Res. CF
		Log size		Log size	Log size					
<i>a</i> <sub>0</sub> , Constant	−2.229 (0.323)	−0.101 (0.409)	−0.078 (0.399)	0.051 (0.270)	0.122 (0.257)	0.059 (0.268)	0.117 (0.255)	−2.318 (0.352)***	0.060 (0.283)	0.125 (0.273)
<i>a</i> <sub>1</sub> , Education	–	0.018 (0.018)	0.021 (0.018)	–	–	–	–	–	–	–
<i>a</i> <sub>2</sub> , Ecoeduc	0.266 (0.077)***	–	–	0.225 (0.069)***	0.231 (0.066)***	0.191 (0.069)***	0.206 (0.065)***	0.308 (0.091)***	0.146 (0.074)**	0.170 (0.072)**
<i>a</i> <sub>3</sub> , Techeduc	0.074 (0.035)**	–	–	0.044 (0.022)*	0.044 (0.021)**	0.035 (0.022)	0.037 (0.021)*	0.058 (0.039)	0.031 (0.022)	0.033 (0.022)
<i>a</i> <sub>4</sub> , Workexp	–	0.010 (0.005)*	0.010 (0.005)*	–	–	–	–	–	–	–
<i>a</i> <sub>5</sub> , Specworkexp	–	–	–	0.021 (0.007)***	0.020 (0.007)***	–	–	–	–	–
<i>a</i> <sub>6</sub> , Techworkexp	−0.003 (0.018)	–	–	–	–	0.025 (0.009)***	0.025 (0.008)***	0.014 (0.022)	0.021 (0.009)**	0.020 (0.009)**
<i>a</i> <sub>7</sub> , Comworkexp	0.037 (0.021)*	–	–	–	–	−0.009 (0.013)	−0.008 (0.014)	0.042 (0.023)*	−0.019 (0.015)	−0.017 (0.016)
<i>a</i> <sub>8</sub> , Otherworkexp	0.005 (0.011)	–	–	0.010 (0.005)*	0.010 (0.005)*	0.008 (0.005)	0.008 (0.005)	0.003 (0.012)	0.003 (0.006)	0.003 (0.006)
<i>a</i> <sub>9</sub> , DManager	0.709 (0.234)***	–	–	−0.030 (0.174)	−0.032 (0.164)	−0.056 (0.176)	−0.043 (0.160)	0.788 (0.251)***	0.112 (0.171)	0.149 (0.160)
<i>a</i> <sub>10</sub> , DEntrepreneur	–	–	–	–	–	–	–	0.301 (0.189)	0.241 (0.105)**	0.253 (0.102)**
<i>a</i> <sub>11</sub> , Age	0.014 (0.013)	0.079 (0.007)***	0.079 (0.007)***	0.083 (0.007)***	0.082 (0.007)***	0.084 (0.008)***	0.084 (0.007)**	0.012 (0.015)	0.083 (0.008)***	0.083 (0.007)***
<i>a</i> <sub>12</sub> , NFounders	−0.033 (0.050)	0.089 (0.030)***	0.087 (0.030)***	0.088 (0.030)***	0.087 (0.030)***	0.090 (0.030)***	0.088 (0.030)**	−0.021 (0.051)	0.090 (0.032)***	0.088 (0.031)***
<i>a</i> <sub>13</sub> , Locdevelop	–	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	–	0.002 (0.001)	0.002 (0.001)
<i>a</i> <sub>14</sub> , DPrivate equity	–	–	1.779 (0.425)***	–	0.975 (0.568)*	–	1.312 (0.587)**	–	–	1.094 (0.561)**
<i>a</i> <sub>15</sub> , DPrivate equity (predicted)	–	1.900 (0.430)***	–	0.981 (0.583)*	–	1.431 (0.615)**	–	–	1.308 (0.582)**	–
<i>a</i> <sub>16</sub> , Lambda	–	–	−0.490 (0.237)**	–	−0.071 (0.304)	–	−0.243 (0.315)	–	–	−0.129 (0.303)
<i>a</i> <sub>17</sub> , Innomotive	0.538 0.164)***	–	–	–	–	–	–	0.608 (0.175)***	–	–
<i>a</i> <sub>18</sub> , PESector	0.050 (0.021)**	–	–	–	–	–	–	0.058 (0.023)**	–	–
<i>a</i> <sub>19</sub> , PEArea	0.134 (0.054)**	–	–	–	–	–	–	0.110 (0.058)*	–	–
Industry-specific effects=0	–	1.70 (4)	1.91 (4)	1.72 (4)	1.95 (4)*	1.80 (4)	2.03 (4)*	–	1.25 (4)	1.45 (4)
McFadden	0.175	0.227	0.271	0.242	0.288	0.244	0.290	0.197	0.236	0.282
R <sup>2</sup> – Adjusted R <sup>2</sup>										

All two-tailed tests. Huber-White standard errors in parentheses. Number of observations is 506, except for Probit B and Model 4 where number of observations is 440. For the sake of synthesis, we omit to report estimated coefficients of industry dummies.

\*  $p < 0.10$ .

\*\*  $p < 0.05$ .

\*\*\*  $p < 0.01$ .

with the *DPrivate equity* variable.<sup>19</sup> For comparison purposes, we report in Appendix A in Table A1, the results of OLS estimates with no control for endogeneity. The coefficient of the  $\lambda$  correction term in the CF estimates is significant at conventional confidence levels only in Model 1; accordingly with the exception of Model 1, the values of the estimated coefficients in Table 4 are quite close to those reported in Table A1. Nonetheless, the IV and CF estimates help teasing out the direct and indirect (i.e., via the *DPrivate equity* variable) effects of the human capital variables on firms' growth. Note also that quite surprisingly, the coefficients of the *Lambda* correction term are negative indicating that the correlation between the error terms of the growth and selection equations if there is any, is negative. This possibly suggests that unobserved factors that positively influence growth might make it less likely for a firm to resort to external private equity financing.<sup>20</sup>

In column 1, we report the results of the probit estimates of the selection equation. The likelihood of a firm resorting to outside private equity financing is found to increase with the education attainments of founders; the coefficients of both *Ecoeduc* and *Techeduc* are positive and significant at 99% and 95%, respectively. Conversely and again quite surprisingly, founders' prior work experience seems not to play important role, with the exception of managerial experience, captured by *DManager*, which has a positive coefficient significant at 99%. Motivations of founders for the creation of the new firm as reflected by *Innomotive* also have a positive effect significant at 99%. In addition, we found that the likelihood of obtaining outside private equity financing is greater for firms that operate in industries

and are located in geographical areas with high intensity of private equity investments. Conversely, the age of firms at survey date and the number of founders have negligible effects.

Let us now consider the growth equation. In Model 1, in addition to controls, we consider the years of education and of work experience of firms' founders; this makes it easier to compare our findings with those of previous studies. After controlling for the endogeneity of *DPrivate equity*, *Workexp* has positive weakly significant coefficients; the coefficients of *Education* though positive are insignificant. Note that in Table A1 the coefficients of both variables are significant at conventional confidence levels. This suggests that failure to control for the endogeneity of the financial structure of firms in previous works may have upward biased estimates of the effects of these variables on firms' growth. As to control variables, *NFounders* has a positive effect on growth, significant at 99%, while the impact of *Locdevelop* though positive is insignificant. *DPrivate equity* has a large positive coefficient, significant at 99%. The coefficient of this variable can be interpreted as the "experimental average treatment effect" (Heckman, 1990); in other words, it captures the average effect on firms' growth of a random assignment of the "external private equity treatment", even though firms are not randomly assigned this treatment. The values of the coefficients in Table 4 are much larger than the corresponding ones in Table A1, where controls for the endogeneity of *DPrivate equity* are absent. This again suggests that after controlling for observable firm characteristics, firms that are selected in the private equity category would otherwise exhibit lower growth than other firms; recourse to outside private equity financing allow these firms to relax financial constraints, leading to superior growth performances. Lastly, industry dummies are generally not significant, suggesting the absence of any relevant industry-specific fixed effects on firms' growth (*F*-tests on the joint significance of industry parameters are found to reject the null hypothesis at 90% only for Model 2 Res. CF and Model 3 Res. CF).

In Model 2, we replace *Education* with the years of graduate technical-scientific and economic-managerial education of founders, measured by *Techeduc* and *Ecoeduc*, respectively. We also split founders' professional experience according to whether it relates to the same industry of the new firm (*Specworkexp*) or

<sup>19</sup> We also run unrestricted CF estimates. The null hypothesis of equality of the two coefficients of the selectivity correction terms was never rejected. So, we constrained  $\sigma_{\varepsilon_T}$  and  $\sigma_{\varepsilon_N}$  to be equal and we turned to the restricted CF estimator. Findings of the unrestricted CF estimates are very close to the restricted ones. They are available from the authors upon request. All estimates are corrected for heteroskedasticity.

<sup>20</sup> In fact, one would expect that unobserved factors reflecting founders' entrepreneurial talent positively affect both growth and the likelihood of obtaining external private equity financing. A reason for the negative correlation of the error terms might be that profitable firms that are able to finance growth internally select out of the external equity market. A detailed analysis of this interesting issue lies beyond the scope of the present paper.

to other industries (*Otherworkexp*). In Model 3, we further decompose industry-specific work experience in *Techworkexp* and *Commworkexp*; the former variable reflects work experience in technical functions (i.e., R&D, design, engineering, and production), while the latter is related to marketing, sales, and customer care. In addition, we consider whether within the founding team there are individuals with prior managerial experience (*DManager*). Lastly, in Model 4 we add *DEntrepreneur*; this dummy variable equals 1 if one or more founders were previously involved in entrepreneurial episodes. As this information is available only for a subsample of firms, the number of usable observations is reduced to 440. These variables are aimed at providing a detailed description of the nature of the human capital of founders. Even though the wealth of founders depends on their human capital, it is unlikely to be related to the specific nature of their education and professional experience. Therefore, if these variables turn out to differently influence growth, this supports the competence-based view that the human capital of founders is closely related to the distinctive capabilities of NTBFs.

Let us first consider education attainments. The coefficients of *Techeduc* and *Ecoeduc* are both significant at conventional confidence levels in all models (with the exception of *Techeduc* in Model 3 IV and Models 4). This indicates that while the years of education of founders generally do not influence firms' growth, graduate education in economic and managerial fields, and to a lesser extent in technical and scientific fields indeed has a positive effect. Moreover in accordance with [Hypothesis 1](#), the null hypothesis that the years of economic-managerial graduate education have the same impact on growth as the years of graduate education in technical-scientific fields is rejected by a *F*-test ( $F(1) = 8.56$  and  $10.47$  in Model 1 IV and CF, respectively. Similar results are obtained in the remaining models). Let us now consider professional experience. In Model 2, *Specworkexp* has positive coefficients, significant at 99%; the coefficients of *Otherworkexp* also are positive, but only weakly significant. Even though the former coefficient is much larger than the latter, the null hypothesis that the difference between the two coefficients be null cannot be rejected by a *F*-test at conventional confidence levels ( $F(1) = 1.82$  and  $1.62$  in the IV and CF estimates, respectively). So

strictly speaking, [Hypothesis 2](#) according to which founders' work experience in the same industry of the NTBF has a more positive effect on firms' growth than work experience in other industries cannot be accepted. The estimates of Model 3 help clarify the role of industry-specific professional experience. The coefficients of *Techworkexp* are positive and significant at 99%, while those of *Commworkexp* though positive, are insignificant; the difference between the two coefficients is statistically significant at 95% ( $F(1) = 4.24$  and  $4.27$  in the IV and CF estimates, respectively). Therefore, it is industry-specific work experience in technical functions that leads to superior growth. This confirms the contention of [Hypothesis 3](#) that the industry-specific work experience of the founding team differently affects growth according to its functional nature.

Let us now draw attention to managerial and entrepreneurial experiences. The coefficients of *DManager* are positive in all models, but insignificant. Contrary to the prediction of [Hypothesis 4](#), the managerial competencies of founders do not seem to significantly influence the performance of firms. Note however that *DManager* positively affects recourse to external private equity financing and that this has a large positive effect on growth. Therefore, the positive coefficient of this variable in previous studies may be the result of a spurious correlation due to omission of relevant variables pertaining to the financial structure of firms in the specification of the growth equation. By contrast, *DEntrepreneur* has positive coefficients in Model 4 significant at conventional confidence levels. In accordance with [Hypothesis 5](#), firms established by "serial entrepreneurs" turn out to enjoy superior growth. Note also that according to the estimates of the selection equation, firms established by these individuals also are more likely to receive private equity financing, as is apparent from the positive, almost significant coefficient of *DEntrepreneur*.

Lastly, [Hypothesis 6](#) claims that the combination of complementary capabilities within the founding team of NTBFs leads to synergistic effects and more rapid growth. For this purpose, let us consider the results of the estimates illustrated in [Table 5](#). In these specifications interactive terms among selected human capital characteristics of founders are added to the set of explanatory variables. In particular, we focus

Table 5  
The determinants of firms' growth: synergistic effects among human capital characteristics

	Model 5 Log size	Model 6 Log size	Model 7 Log size	Model 8 Log size	Model 9 Log size
$a_0$ , Constant	0.157 (0.254)	0.141 (0.256)	0.118 (0.256)	0.122 (0.256)	0.112 (0.256)
$a_1$ , <i>Ecoeduc</i>	0.142 (0.071)**	0.204 (0.065)***	0.206 (0.070)***	0.229 (0.066)***	0.206 (0.065)***
$a_2$ , <i>Techeduc</i>	0.026 (0.021)	0.037 (0.021)*	0.051 (0.023)**	0.035 (0.022)	0.038 (0.021)*
$a_3$ , <i>Techworkexp</i>	0.023 (0.008)***	0.022 (0.008)***	0.028 (0.010)***	0.025 (0.008)***	0.026 (0.009)***
$a_4$ , <i>Comworkexp</i>	-0.008 (0.014)	-0.015 (0.014)	0.015 (0.019)	-0.009 (0.014)	-0.008 (0.016)
$a_5$ , <i>Otherworkexp</i>	0.007 (0.005)	0.008 (0.005)	0.008 (0.005)	0.007 (0.005)	0.008 (0.005)
$a_6$ , <i>DManager</i>	-0.045 (0.161)	-0.039 (0.159)	0.020 (0.164)	0.210 (0.243)	-0.016 (0.201)
$a_7$ , <i>Techeduc</i> × <i>Ecoeduc</i>	0.063 (0.025)**	–	–	–	–
$a_8$ , <i>Tecworkexp</i> × <i>Comworkexp</i>	–	0.003 (0.001)**	–	–	–
$a_9$ , <i>Teceduc</i> × <i>Tecworkexp</i>	–	–	-0.003 (0.003)	–	–
$a_{10}$ , <i>Ecoeduc</i> × <i>Tecworkexp</i>	–	–	0.013 (0.018)	–	–
$a_{11}$ , <i>Teceduc</i> × <i>Comworkexp</i>	–	–	-0.010 (0.005)**	–	–
$a_{12}$ , <i>Ecoeduc</i> × <i>Comworkexp</i>	–	–	-0.014 (0.009)	–	–
$a_{13}$ , <i>DManager</i> × <i>Teceduc</i>	–	–	–	-0.047 (0.064)	–
$a_{14}$ , <i>DManager</i> × <i>Ecoeduc</i>	–	–	–	-0.221 (0.139)	–
$a_{15}$ , <i>DManager</i> × <i>Tecworkexp</i>	–	–	–	–	-0.007 (0.024)
$a_{16}$ , <i>DManager</i> × <i>Comworkexp</i>	–	–	–	–	-0.001 (0.023)
$a_{17}$ , Age	0.083 (0.007)***	0.084 (0.007)***	0.082 (0.007)***	0.084 (0.007)***	0.084 (0.007)***
$a_{18}$ , <i>NFounders</i>	0.089 (0.030)***	0.086 (0.030)***	0.086 (0.030)***	0.087 (0.029)***	0.088 (0.030)***
$a_{19}$ , <i>Locdevelop</i>	0.001 (0.001)	0.002 (0.001)	0.001 (0.001)	0.001 (0.001)	0.002 (0.001)
$a_{20}$ , <i>DPrivate equity</i>	1.383 (0.590)**	1.318 (0.590)**	1.292 (0.595)**	1.503 (0.616)**	1.305 (0.585)**
$a_{21}$ , <i>Lambda</i>	-0.267 (0.315)	-0.243 (0.317)	-0.229 (0.317)	-0.337 (0.327)	-0.241 (0.315)
Adjusted R <sup>2</sup>	0.295	0.291	0.291	0.291	0.287

Restricted CF estimates. All two-tailed tests. Huber-White standard errors in parentheses. Number of observations is 506. For the sake of synthesis we omit to report estimated coefficients of industry dummies.

\*  $p < 0.10$ .

\*\*  $p < 0.05$ .

\*\*\*  $p < 0.01$ .

on the educational attainments of founders and their industry-specific and managerial experiences.<sup>21</sup> For the sake of synthesis, in Table 5 we only present restricted CF estimates.<sup>22</sup>

In Model 5, the interactive term between *Techeduc* and *Ecoeduc* is positive and significant at 95%. The same applies to the coefficient of the interactive term between *Techworkexp* and *Comworkexp* in Model 6.

<sup>21</sup> We also considered interactive terms involving founders' entrepreneurial experience. They turned out not to be statistically significant at conventional confidence levels. The remaining results are unchanged. For the sake of synthesis, they are not reported in the paper; they are available from the authors upon request. Conversely, we did not consider founders' work experience in sectors other than the one of the new firm as its functional nature (i.e., whether technical or commercial) is unknown.

<sup>22</sup> Results of IV estimates are very similar and available from the authors upon request.

This latter result indicates that in spite of the fact that the years of industry-specific commercial work experience of founders do not affect growth, the positive effect on growth of the years of industry-specific technical work experience is larger when it is combined within the founding team with greater industry-specific commercial experience. As to the remaining interactive terms, the null hypothesis that their coefficients be equal to null can never be rejected at conventional confidence levels (the values of the *F*-tests are equal to 1.21, 1.32, and 0.04 with 4, 2, and 2 degrees of freedom in Models 7, 8, and 9, respectively). Altogether, these findings only partially support Hypothesis 6. They highlight that the presence of synergistic effects of founders' capabilities is limited to some specific entrepreneurs' knowledge dimensions (technical plus economic education and technical plus commercial industry-specific work experience) but it does not apply

a priori to all the domains of founders' human capital characteristics.

## 6. Discussion and conclusion

In this paper, we have examined the relation between the human capital of the founding team and the growth of NTBFs. This issue is hardly new in the literature. Previous empirical studies have generally highlighted a positive effect on growth of variables that mirror the education attainments and the prior work experience of founders. Nevertheless, this evidence does not allow to tease out the “wealth” and “capability” effects of founders' human capital. On the one hand, the human capital and the wealth of individuals are positively correlated (Xu, 1998; Astebro and Bernhardt, 1999). Accordingly, studies emphasizing capital market imperfections suggest that founders with greater human capital have access to greater financial resources and thus are able to relax the financial constraints that otherwise hinder firms' growth. On the other hand, competence-based theories argue that the distinctive capabilities of NTBFs are closely associated with the knowledge and skills of their founders (Cooper and Bruno, 1977; Feeser and Willard, 1990). Therefore, firms established by individuals with greater human capital enjoy superior growth because of their unique capabilities. Whether it is the “wealth effect” or the “capability effect” of founders' human capital that explains NTBFs' growth still is an open question, in spite of the fact that it has important implications for both would-be entrepreneurs and policy makers. If the positive impact on growth of the human capital of founders were simply to be traced to easier access to financing, this would reveal the presence of binding financial constraints to growth. Hence, potential entrepreneurs should concentrate efforts on the search for adequate financing to start a new high-tech venture. Moreover the “funding gap” (Cressy, 2002) would be the key target of technology policy. Conversely, evidence that founders' distinctive capabilities play a key role for growth would bring the “knowledge gap” to the fore. In other words, both potential entrepreneurs and policy makers should carefully consider that in addition to financing, NTBFs find it difficult to have access to outside competencies and other resources; if these competencies and resources are not available

within the founding team, this may severely limit growth.

In addressing this research question, we have considered a sample composed of 506 Italian young firms that operate in high-tech sectors, both in manufacturing and services. We have departed from previous literature in three respects. First, we have taken advantage of a more fine-grained description of the human capital of founders than the one available in most previous studies based on the estimates of econometric models relating to large samples of firms. Second, we have explicitly investigated the existence of synergistic gains that arise from the presence within the founding team of individuals with heterogeneous human capital characteristics, a situation that is germane to the competence-based argument. Third, we have controlled for the impact on firms' growth of other variables, including access to external private equity financing. The likelihood of resorting to this source of financing may depend on the human capital characteristics of founders. In addition, it may be affected by unobserved factors that also influence growth; so failure to adjust for the endogeneity of the financial structure of firms may have led to biased estimates in previous studies.

The findings of the paper support the argument inspired by competence-based theories that the capabilities of founders as are reflected by their human capital characteristics, are a key driver of NTBFs' growth. In fact, both the education and the work experience of founders were found to differently affect firms' growth according to their specific nature. More precisely, while the years of education of founders are not related to growth, the years of undergraduate and graduate education in economic and managerial fields and to a lesser extent in technical and scientific fields do positively affect growth. As to professional experience, NTBFs established by individuals who have greater work experience in technical functions in the same industry of the new firm and have been involved in prior entrepreneurial ventures exhibit superior growth, with all else equal. Conversely, work experience in other industries or in the same industry in commercial functions turns out to play a negligible role. Furthermore, the fact that founders previously had a managerial position in another firm seems not to affect firms' growth; this notwithstanding, firms founded by these individuals are more likely to obtain external private

equity financing, which in turn has a sizable positive effect on growth. So, the association highlighted by previous studies between managerial experience and growth may be the result of a spurious correlation.

In addition, we have provided evidence that there are synergistic effects originating from the presence within the founding team of specific complementary capabilities. They arise from university education in economic-managerial and technical-scientific fields and from industry-specific work experience in technical and commercial functions. In particular, absent technological competencies founders' commercial competencies have negligible influence on firms' performance; nonetheless, if these latter competencies are present within the founding team, the positive contribution to growth provided by the simultaneous presence of technical competencies considerably increases.

We think that these results are very interesting, as they extend our understanding of the factors that drive the growth of NTBFs. As was mentioned above, they have important implications for potential entrepreneurs and policy makers, and also stimulate new research questions. In this perspective, two directions for future research seem especially promising. First, our estimates indicate that recourse to outside private equity financing has a very large positive contribution to growth, once we control for endogeneity. We have also shown that the likelihood of resorting to this source of financing depends on the education of founders, their managerial experience and other observable factors. Quite surprisingly, it was found not to depend on other human capital characteristics that positively influence firms' growth, notably the industry-specific technical work experience of founders. In addition, we provided evidence that unobservable factors that positively affect growth might have an opposite effect on the likelihood of resorting to outside private equity financing. This evidence is compatible with a situation in which NTBFs that have a high "hidden value" and would potentially grow at rapid rate, self-select out of the capital market, thus lowering their actual rate of growth (for a similar view see [Astebro, 2002](#); [Kon and Storey, 2003](#)). It might also signal that in Italy, being part of an "old boys network" helps more in getting access to outside private equity capital than having specialized knowledge and skills. In order to gain further insights into this important issue, it is fundamental to analyze

the different sources of outside equity financing used by NTBFs (i.e., venture capital, corporate venture capital, equity capital provided by banks and other financial intermediaries) and to assess their differential impact on firms' growth. Unfortunately, this was not possible due to lack of data, but remains high in our research agenda. Second, our findings indicate that NTBFs enjoy highest growth when both industry-specific technical and commercial skills are combined together within the founding team, a situation that was not common in our sample of firms. Consequently, many new firms that are created by individuals with sophisticated technical skills, have a technology-driven competitive advantage and would potentially enjoy rapid growth, suffer from lack of complementary commercial competencies; this may finally jeopardize growth. Therefore, these firms face the dilemma of how to obtain external support so as to fill their "knowledge gap". Previous studies (see for instance, [McGee et al., 1995](#); [Eisenhardt and Schoonhoven, 1996](#); [Stuart et al., 1999](#); [Lee et al., 2001](#)) suggest that alliances with larger corporations may provide NTBFs with access to much needed complementary commercial assets (i.e., sale force, brand name, customer care, distribution facilities). Help may also be obtained from venture capitalists. In fact, in addition to providing financing, venture capitalists allegedly use their managerial skills and network of contacts to assist entrepreneurs of participated companies in domains where these latter lack autonomous expertise (see for instance, [Gorman and Sahlman, 1989](#); [Mac Millan et al., 1989](#); [Barry et al., 1990](#)). Nevertheless, these moves are not without drawbacks. In particular, to the extent that partners, be they a venture capitalist or a large corporation, are equipped with sufficient "absorptive capacity" ([Cohen and Levinthal, 1990](#)), such linkages expose the new firm to the risk of increasing technological spillovers and possibly dilapidating its technology-based competitive advantage (see [Hamel, 1991](#)). See also the literature on the double sided moral hazard problem inherent in venture capital financing, for instance, [Yosha, 1995](#); [Ueda, 2002](#)). As is recognized by [Cooper \(2002, p. 218\)](#), further research work is needed to gain a better understanding of the circumstances under which alliances and other external linkages are an efficient growth vehicle for NTBFs and of the governance structure and organizational mechanisms that are most suitable for this purpose.

Table A1  
The determinants of firms' growth: OLS estimates without controls for endogeneity

	Model 1 Log size	Model 2 Log size	Model 3 Log size	Model 4 Log size
$a_0$ , Constant	-0.333 (0.386)	0.120 (0.257)	0.119 (0.256)	0.125 (0.273)
$a_1$ , Education	0.038 (0.017)**	–	–	–
$a_2$ , Ecoeduc	–	0.240 (0.053)***	0.237 (0.053)***	0.190 (0.059)***
$a_3$ , Techeduc	–	0.045 (0.019)**	0.043 (0.019)**	0.036 (0.021)*
$a_4$ , Workexp	0.012 (0.005)**	–	–	–
$a_5$ , Specworkexp	–	0.020 (0.007)***	–	–
$a_6$ , Techworkexp	–	–	0.025 (0.008)***	0.020 (0.009)**
$a_7$ , Comworkexp	–	–	-0.004 (0.013)	-0.015 (0.014)
$a_8$ , Otherworkexp	–	0.010 (0.005)*	0.008 (0.005)	0.003 (0.006)
$a_9$ , DManager	–	-0.008 (0.145)	0.034 (0.146)	0.193 (0.146)
$a_{10}$ , DEntrepreneur	–	–	–	0.263 (0.099)***
$a_{11}$ , Age	0.079 (0.007)***	0.082 (0.007)***	0.084 (0.007)***	0.082 (0.007)
$a_{12}$ , NFounders	0.082 (0.029)***	0.086 (0.029)***	0.086 (0.029)***	0.087 (0.030)***
$a_{13}$ , Locdevelop	0.002 (0.001)*	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)
$a_{14}$ , DPrivate equity	0.972 (0.168)***	0.849 (0.173)***	0.880 (0.169)***	0.868 (0.176)***
Adjusted $R^2$	0.264	0.290	0.290	0.283

All two-tailed. Huber-White standard errors in parentheses. Number of observations is 506, except for Model 4 where number of observations is 440. For the sake of synthesis we omit to report estimated coefficients of industry dummies.

\*  $p < 0.10$ .

\*\*  $p < 0.05$ .

\*\*\*  $p < 0.01$ .

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## Appendix A

See Table A1.

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