

Technology-Based Entrepreneurs: Does Internet Make a Difference?

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ABSTRACT. This paper is an empirical analysis of the personal characteristics of Italian high-tech entrepreneurs. We analyze differences in the characteristics of founders according to the sector of operation of the start-up. In particular, we investigate whether entrepreneurs in Internet related activities differ from those operating in other ICT industries (especially in manufacturing). For this purpose, we analyze a sample composed of 246 entrepreneurs that between 1984 and 1999 established 116 new firms that operate in ICT manufacturing and service industries and are located in Northern Italy. The findings highlight that Internet entrepreneurs generally are younger and less educated (especially in technical fields) than the other sample founders. They quite often are at their first professional experience; if they have prior working experience, it generally is in unrelated industries. Such findings are related to evolutionary theories that emphasize the role of the nature of technical change and of the stage of the industry life cycle in influencing the characteristics and behavior of new firms and their founders.

1. Introduction

In the 1990s, growing attention was devoted by economists and policy makers to entrepreneurship and new technology-based firms (NTBFs). The reason may be traced to the evidence that small and new firms account for a substantial share of the new jobs created in those countries such as the U.S. that have displayed a strong employment record.¹ In addition, the view has been rapidly gaining ground that high-growth start-ups, especially those operating in high-tech industries play a crucial role for the renewal of the economic system. In particular, they are believed to provide the U.S. with an innovation-based competitive

advantage in key sectors of the so-called “new economy” such as software, E-commerce and communication equipment. Such view is corroborated by the success stories of Microsoft, Oracle, Cisco, American on line, Yahoo!, and other Internet outfits.

The concern that Europe is a laggard in the NTBF sector triggered a policy-oriented research effort aimed at analyzing factors that favor or inhibit the birth of NTBFs and influence their post-entry performances (see EC, 1996a, b). In particular, a conspicuous body of new evidence was developed on the characteristics of high-tech entrepreneurs in numerous European countries (for a survey see Storey and Tether, 1998a).

One of the objectives of the present paper is to supplement the evidence provided by such studies with comparable data relating to Italian founders of NTBFs. Note that Italy is a very interesting case. On the one hand, propensity towards entrepreneurship is especially high in Italy (see for instance Blanchflower and Oswald, 1999) and small firms account for a disproportionately high share of total employment.² On the other, Italy exhibits a poor performance in high-tech industries, with the ratio of research expenditures to GNP being close to 1%, that is less than half the value of France or the U.K.

Moreover, it is important to emphasize that the evidence provided by previous studies on the characteristics of high-tech entrepreneurs mainly concern manufacturing industries. This work aims to extend such evidence to service industries which are related to or have been rejuvenated by the development of Internet. For one thing, as was said earlier, sectors such as E-commerce, other Internet services, software and multimedia content are at the core of the “new economy” and are presently dominated by young, highly successful U.S. firms, even though there is evidence that

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Europe is catching up.³ What is even more interesting, Internet involves a technological revolution which is likely to have quite disruptive consequences on established technical knowledge and consolidated business models. In addition, markets for Internet services still are in the very early stage of the life cycle, especially in Italy which so far has been a latecomer in the diffusion of the new technology. So arguments inspired by evolutionary theories of technical change suggest that the characteristics of Internet entrepreneurs may differ from those of founders of NTBFs in other industries. In this paper, we intend to address empirically such research question. This would provide some initial insights into whether policy measures that are traditionally considered as suitable to support NTBFs also apply to Internet start-ups.

For this purpose, we consider a sample composed of 241 entrepreneurs which between 1984 and 1999 established 116 new firms that operate in ICT manufacturing and service industries and are located in Northern Italy. We analyze entrepreneurs' age at foundation of the start-up, educational qualifications, prior working experience, and motivations of the self-employment choice. We devote particular attention to differences in the personal characteristics of founders according to the sector of operation of the start-up. In particular, we investigate whether entrepreneurs in Internet related activities are different from those operating in other ICT industries (especially in manufacturing).

The findings of the study highlight the presence of an industry-specific effect: Internet entrepreneurs generally are younger and less educated (especially in technical fields) than the other sample founders. They quite often are at their first professional experience; if they have prior working experience, it generally is in unrelated industries.

The remaining of the paper is organized as follows. In the next section we present the data set. In Section 3 we analyze the aforementioned personal characteristics of founders of Italian NTBFs. In Section 4 we turn attention to motivations of the self-employment choice. Some summarizing remarks which also highlight the policy implications of the findings of this work, in Section 5 concluded the paper.

2. The data set

The data set used in this paper has been developed at Politecnico di Milano in 1999. The sample is composed of 241 founders of 116 Italian NTBFs that operate in one of the following Information and Communication Technology (ICT) sectors: Internet (namely Internet service and access provision and E-commerce), software, multimedia content, and manufacturing industries of ICT (i.e. communication equipment, computers and electronics⁴). In this paper, a NTBF has been defined as a young firm founded after 1984, which at the date of foundation was independent (i.e. not controlled by another firm).

Table I presents the composition of sample founders by sector of operation. Only 10% of entrepreneurs operates in manufacturing, while the remaining 90% is distributed among Internet (25%), multimedia content (8%) and, above all, software (56%). So, most founders operate in services; these sectors either belong to the new paradigm of Internet or have been recently rejuvenated by it (as in the case of both software and multimedia content). Note that Internet markets will be aggregate within a whole sector even though such activities (e.g. Internet service provision and e-commerce) may require different technical skills. This decision is mainly due to two reasons. First, statistical considerations lead us to divide the sample into (no more than) four industry categories. Second, these activities belong to the same technological paradigm which is new and different with respect to those of the other categories of firms.

Data collection was carried out in 1999 by the following process. The first step consisted in identifying target firms that complied with the above mentioned criteria relating to age and sector

TABLE I
Industry composition of founders of NTBFs

Sector	Number of founders	%
Internet		
(ISP, E-commerce)	60	24.9
Software	136	56.4
Multimedia content	20	8.3
ICT manufacturing	25	10.4
Total sample	241	100%

of operations and were located in Northern Italy.⁵ Unfortunately, data provided by official national statistics did not allow to obtain a reliable description of the universe of firms from which a representative sample could be extracted. Therefore, we had to resort to a number of other sources. These include lists of newly established firms provided by the Milan Chamber of Commerce and national industrial associations (AIIP, ANIE, ANEE), on-line and off-line firm directories (such as Kompass), and lists of participants in industry expositions. Information provided by the national financial press, specialized magazines and other sectoral studies was also considered. Altogether, 343 firms were selected for potential inclusion in the sample.

Second, the selected firms were contacted by phone by educated interviewers who explained to the entrepreneurs the purpose and other details of the survey, and checked for compliance with the requirements for consideration in the survey. This reduced the size of the “universe” to 260 firms. Then a questionnaire was sent to such firms either by fax or by e-mail. The questionnaire has a quantitative/qualitative nature. The first section contains information on characteristics of the entrepreneurs such as age, education, prior working experience, and motivations of the self-employment decision. The second section comprises further questions concerning the characteristics of the start-up firms and their post-entry performances in terms of growth and innovative activities. The final (qualitative) section is devoted to factors that promote or inhibit growth and innovation. In this paper, we will focus on the first section of the questionnaire; results relating to the other sections will also be mentioned when they are pertinent to the objective of the study.

Lastly, the data set was completed by telephone and through some direct interviews with the selected entrepreneurs; this final step was crucial in order to obtain missing data and to check the accurateness of answers.

3. The characteristics of founders of Italian NTBFs

3.1. Age

The age at which an agent takes the self-employment decision clearly depends on aspects such as his risk aversion, financial constraints and the need for technological and market competencies which may have been acquired through both education and prior working experience (Roberts, 1991). Empirical studies show that this choice usually occurs when an individual is between 30 and 40.⁶ On the one hand, both risk aversion and the cost of leaving an employment position are positively correlated with age, due to family concerns and career patterns (see for instance the job shopping models of Johnson, 1978; Miller, 1984). This effect would decrease the age of the self-employment choice, with other things being equal. On the other hand, entrepreneurship may not be an option for younger workers due to lack of professional and relational skills and liquidity constraints. As to this latter aspect, the older an individual the larger the amount of capital he can build up to start a new business (Evans and Jovanovic, 1989).

In high-tech environments, raising capital may be even more difficult because information asymmetries are more severe. So, technology-based starters are generally found to be older than other starters (see for instance Donckels, 1989). In particular, this effect is likely to depend on the specific nature of the sector in which new firms operate: financial (and knowledge) barriers to entry are influenced by industry characteristics.

Table II sheds some light on the age profile of NTBF founders depending on the industry. First, at the date of firm's foundation, the average age of Italian high-tech entrepreneurs is 33, which is in line with the international evidence (see footnote 7). Second, and more interesting, there are sizable differences in the age of entrepreneurs across sectors of operations of the start-ups. In particular, Internet-based founders represent the youngest category (average age of 28), whilst entrepreneurs of ICT manufacturing firms are the eldest (40). In order to gain further insights we have proceeded to compute t-tests between the average age of entrepreneurs of different sectors. These tests confirm that the above mentioned

TABLE II
Age of founders of Italian NTBFs

Sector	Minimum	Average ^a	Maximum
Internet (ISP, E-commerce)	19	28.5***	46
Software	18	33.3	53
Multimedia content	21	36.4*	63
ICT manufacturing	23	39.9***	67
Total sample	18	33.0	67

^a *t*-test of the difference between the average age of founders belonging to a given sector and that of the rest of the sample.

* Significance level greater than 10%.

*** Significance level greater than 1%.

differences are statistically significant at conventional levels.

A thorough analysis of the determinants of such phenomena lies beyond the scope of the paper. Nonetheless, some preliminary remarks are in order. First, it is worth emphasizing that in manufacturing the minimum optimal scale is substantially higher than in services, especially those linked to Internet. Accordingly, the start-up size of sample firms is equal to 18 employees in ICT manufacturing industries and to 4 in the other sectors (in particular, 3 employees for Internet, 4 for software and 5 for multimedia content). Thus, an individual needs a larger amount of financial resources to set up a new firm in manufacturing. Given that entrepreneurs of Italian NTBFs usually use their personal savings to finance their activities (Giudici and Paleari, 2000),⁷ it follows that those that operate in manufacturing industries need to wait longer before being able to leave their previous job, having accumulated sufficient financial resources to found a start-up. This argument helps explain why entrepreneurs in ICT manufacturing industries are significantly older than those that operate in services.

However, we think that there is more than that as to cross-sectoral differences in the age of sample entrepreneurs. An additional reason for such differences, which explains in particular the younger age of Internet entrepreneurs, resides in the industry life cycle and the nature of technological change associated with Internet. While the manufacturing sectors of ICT are based on consolidated technological trajectories which originated in the '70s and early '80s, Internet is a new competence destroying technological

paradigm;⁸ markets for new services arising from it are still in their infancy, especially in Italy. It follows that in ICT manufacturing sectors, market and technological competencies accumulated by founders of NTBFs through education and prior working experiences (in particular, in incumbent firms operating in the same industry of the start-up) play a key role in determining post-entry performances. Conversely, the new paradigm of Internet makes prior knowledge largely obsolete. In order to be successful, new innovative ideas radically departing from consolidated technological patterns and new business models based upon untried capabilities and skills must be developed. Under such conditions, barriers to entry are lower, as newcomers enjoy a knowledge advantage with respect to incumbent firms (see Gort and Klepper, 1982; Agarwal and Gort, 1996)⁹ and, what is more important for the purpose of the present paper, their extent is only loosely related to entrepreneurs' education and previous working experience. The remainder of the paper is dedicated to analyze these issues in greater detail.

3.2. Education

The education of NTBF founders is generally recognized as a key element to understand the post-entry performance of high-tech start-ups (Jo and Lee, 1996). Empirical evidence show that entrepreneurs working in high-tech environments have an excellent education career. For instance, Autio et al. (1989) find that 90% of Finnish founders of NTBFs have followed higher education. A similar result has been found for U.K. (85% with graduate degree and 48% with

doctorate, see Westhead and Storey, 1994), Belgium (80% have followed higher education, Donckels, 1989) and Germany (more than 50% with an engineering degree, Licht et al., 1995).

Before proceeding with the evidence of educational attainments of founders of Italian NTBFs, a preliminary remark is in order. Italian graduate degrees can be hardly compared to most European degrees. Indeed university education programs generally are longer: they last for no less than 4 or 5 years, depending on the specific topics (4 years for social sciences and most scientific degrees, 5 years for engineering), and the average time needed for graduation is longer than 6 years (again, it depends on the specific field).

Table III presents evidence on the level of educational attainment of Italian technology-based entrepreneurs. The low percentage of graduated entrepreneurs (38%) may thus be partially due to the Italian institutional context.¹⁰ In addition, only 20% of founders has a graduate degree in sciences directly linked to ICT sectors such as electronic and telecommunication engineering and computer sciences; 5% has a degree in other technical branches (i.e. other fields of engineering, mathematics, physics and chemistry), 10% in social sciences and 3% in humanities or medicine.

Besides institutional factors, the low level of educational attainment of sample founders is due to industry-specific effects. Indeed, while prior evidence relating to other countries is based on samples of entrepreneurs working in high-tech manufacturing, in this study the overwhelming majority of start-ups is in industries directly (ISP, E-commerce) or indirectly (software, multimedia

TABLE III
Education of founders of Italian NTBFs

Education	Number of observations	%
ICT graduate degree ^a	48	19.9
Other technical graduate degree ^b	12	5.0
Economic graduate degree ^c	23	9.6
Other graduate degree ^d	8	3.3
ICT high school ^e	28	11.6
Other high school ^f	122	50.6
Total sample	241	100.0

^a Graduate degree in: electronic and telecommunications engineering, computer science.

^b Graduate degree in: other engineering, mathematics, physics, chemistry.

^c Graduate degree in: economics, law and political sciences.

^d Graduate degree in: humanities, medicine, architecture.

^e High school leaving certificate in: electronics, computer sciences and telecommunications.

^f Other high school leaving certificate.

content) connected with Internet. Table IV distinguishes findings on education attainments depending on the sector in which NTBF founders actually operate. Chi-squared tests for multinomial distributions have also been performed in order to detect the existence of significant differences across sectors. The tests, which for sake of synthesis are illustrated in the Appendix (see Table A.1), show that the null hypothesis that such differences are statistically insignificant can be rejected at conventional levels, with the only exception of the software industry. Again results show two opposite patterns depending on the stage in the life cycle of ICT sectors. In ICT manufac-

TABLE IV
Education of founders according to the sector of operation of the start-ups

Education ^a	Internet		Software		Multimedia content		ICT manufacturing	
	Obs.	%	Obs.	%	Obs.	%	Obs.	%
ICT graduate degree	7	11.7	29	21.3	3	15.0	9	36.0
Other technical grad. degree	3	5.0	9	6.6	0	0.0	0	0.0
Economic graduate degree	6	10.0	13	9.6	4	20.0	0	0.0
Other graduate degree	1	1.7	3	2.2	3	15.0	1	4.0
ICT high school	6	10.0	13	9.6	0	0.0	9	36.0
Other high school	37	61.6	69	50.7	10	50.0	6	24.0
Total sample	60	100.0	136	100.0	20	100.0	25	100.0

^a See Table III.

turing, the level of educational attainment of founders of NTBFs is significantly higher than that of Internet entrepreneurs, even though it is still lower than in other European countries. 40% of founders is graduated and 72% has followed an ICT education (either through a higher education degree, 36%, or by means of an ICT high school, 36%). Conversely, Internet entrepreneurship is populated by young businessmen with a rather poor education background: of them only 28% has a graduate degree and 22% has followed an ICT education. Founders of NTBFs in the software and multimedia content industries have an intermediate profile. On the one hand, as concerns higher education, they are similar to those of ICT manufacturing industries: 40% and 50% of founders of firms operating in software and multimedia content provision has a graduate degree, respectively. On the other hand, as to technical competencies, they look very similar to Internet businessmen: only 31% and 15% of them have followed an ICT education, respectively.

To sum up, we have found that the evidence on educational attainments of founders of Italian NTBFs in ICT industries significantly differs from that of prior studies relating to other countries. This may be due to institutional factors (i.e. a country-specific effect) that in Italy lower the percentage of the self-employment population with higher education degrees (this evidence is corroborated by other studies, see for instance Brown and Sessions, 1999). However, the findings also show that there are considerable differences depending on the sector in which businessmen operate. In ICT manufacturing industries the share of entrepreneurs with a technical educational background is considerably higher than in other sectors, in accordance with the view that technical competencies acquired through education are key for the post-entry performance of new firms. At the other end of the spectrum there are Internet-based activities. Founders of E-business firms are found to have a significantly poorer technical education background: 73% of them has not followed any technical education versus only 28% of founders of ICT manufacturing firms.

3.3. Prior working experience

In order to complete the picture of the characteristics of high-tech entrepreneurs, we present evidence on the prior working experience of founders of NTBFs. Because high-tech start-ups depend heavily on founders' knowledge and skills, we expect these latter to have developed considerable experience in related technological and market activities. In order to gain insights into the working background of Italian technology-based founders, we have divided prior employment status a) depending on whether the sample entrepreneurs already have working experience or not, and b) as far as the former group of founders is concerned, according to the sector of operation of the firm in which founders were previously employed. Within ICTs we have distinguished between four industries: 1) electronics, 2) computer industry, 3) telecommunications (both the production of communications equipment and the provision of telecommunication services), and 4) software and E-business. Moreover, competencies deriving from a working experience in traditional and multimedia publishing may be important, at least for entrepreneurs working in the provision of multimedia content. Thus, we have defined a "spin-off" as a founder who was previously employed in anyone of the aforementioned industries (that is, ICT industries and publishing).

Table V shows findings on working background. 42.4% of sample founders can be defined as spin-offs, given that before founding the firm they were working within ICT industries or in

TABLE V
Prior working experience of founders of Italian NTBFs

	Observations	%
Electronics	10	4.1
Computer industry	11	4.6
Telecommunications (equipment and services)	12	5.0
Software, Internet	62	25.7
Publishing (traditional and multimedia)	7	3.0
Working experience in other industries	90	37.3
First working experience	49	20.3
Total sample	241	100.0

publishing. Of these, only 13.7% were previously employed in the electronic, computer or telecommunication industry, that is in sectors dominated by large firms and research organizations which are recognized by previous studies as the main incubators (together with public research organizations) of successful high-tech start-ups (see Carayannis et al., 1998). Some 25.7% were previously employed in software houses and Internet companies; these usually are, at least in Italy, very small firms.¹¹ More than 37% of sample founders have prior working experience in sectors outside ICTs and publishing, and 20.3% have no working experience.

Again we observe sizable differences in the entrepreneurs' working profile depending on the sector in which they decide to entry (see Table VI). Founders of Internet companies are mainly at their first working experience (40%); if they have a working background this derives either from software (21.7%) or from a sector other than ICTs and publishing (31.7%). Similarly, founders of multimedia content companies and software houses were previously employed in firms operating in the software industry or outside ICT. However, in this case the percentage of founders at the first working experience is significantly lower than that of Internet businessmen (16.2% and 10% for software and multimedia content, respectively). Finally, founders of ICT manufacturing firms have a very different working profile: most (68%) are spin-offs having a prior working experience in a ICT sector, and only 4% of them

is at the first working experience. Again, we run chi-squared tests for multinomial distributions to assess the robustness of the empirical findings. The results are reported in the Appendix (see Table A.2). For each sector in which the sampled entrepreneurs operate out of the four considered, the distribution of founders across the various categories of working background turned out to be significantly different, at conventional levels, from the one of the remaining entrepreneurs.

It is quite interesting to combine the results on founders' age at the time the start-up was established and education so as to sketch out the average duration of their working experience before becoming self-employed. We concentrate attention on the findings concerning Internet companies and ICT manufacturing firms. As to founders of these latter firms, the average age, at the date of firm's foundation, is 37 for those with a high school leaving certificate and 44 for those with a higher education degree. Considering that in Italy students leave on average the high school at 19 and the university at 27, this implies 18 (for founders with high school) and 17 years (for those with higher education) of professional experience before the foundation of a NTBF. This period proves to be much shorter for Internet entrepreneurs. Indeed, by doing the same calculation one derives that prior professional experience lasts for only 9 and 4 years for founders of Internet companies with high school leaving certificate and higher education degree, respectively.

TABLE VI
Previous working background according to the sector of operations of the start-ups

	Internet		Software		Multimedia content		ICT manufacturing	
	Obs.	%	Obs.	%	Obs.	%	Obs.	%
Electronics	0	0.0	4	2.9	3	15.0	3	12.0
Computer industry	2	3.3	9	6.6	0	0.0	0	0.0
Telecommunications	0	0.0	0	0.0	0	0.0	12	48.0
Software, Internet	13	21.7	42	30.9	5	25.0	2	8.0
Publishing	2	3.3	4	2.9	1	5.0	0	0.0
Working experience in other industries	19	31.7	55	40.5	9	45.0	7	28.0
First working experience	24	40.0	22	16.2	2	10.0	1	4.0
Total sample	60	100.0	136	100.0	20	100.0	25	100.0

3.4. Summing up: the characteristics of NTBF founders

In order to gain further insights into the relation between the characteristics of founders of NTBFs and the sector of the start-up, we have computed bivariate correlations. Table VII illustrates variables that capture founder's characteristics. *Age* is the standardized value of founder's age at the date of start-up. *Education* and *ICT degree* are two measures of the level of education attainment of NTBF founders. In particular, *Education* is a categorical ordered variable which is 2 when the founder has a technical higher education degree, 1 if he has another graduate degree, and 0 otherwise (i.e. high school). *ICT degree* is a dummy variable that captures technical skill acquired through education: it is one for founders with ICT education (either high school leaving certificate or graduate degree). Prior working experience is

evaluated through the variables *Spin-off* and *First job*. The former is a dummy variable that equal one for founders with prior working experience in ICT and related sectors: electronics, computer industry, telecommunications, software, e-business, and publishing. The latter is a dummy variable which is one for founders with no working background.

Table VIII presents bivariate correlations between measures of characteristics of NTBF founders and industry dummies. As stressed before, it emerges a scenario with two opposite types of high-tech entrepreneur. On the one hand, individuals that decide to start an Internet activity are significantly younger, less educated and with few (if any) prior working experience. This may be the outcome of two complementary explanations. First, the advent of the new Internet paradigm and the associated birth of new markets have created new business opportunities which

TABLE VII
Definition of variables describing the characteristics of founders of Italian NTBFs

Variable	Description
ICT manufacturing, Software, Internet, Multimedia content	Dummy variables equal to 1 when the NTBF founder operates in ICT manufacturing, software, Internet, and multimedia content provision respectively ; 0 otherwise.
Age ^a	Founder's age at the date of firm's foundation.
Education ^b	Categorical variable, which is 2 for founders with ICT or other technical graduate degree, 1 for founders with other graduate degree (e.g. social sciences, humanities), 0 for founders with high school leaving certificate.
ICT degree ^b	Dummy variable equal to 1 for founders with ICT education (either with graduate degree or with high school); 0 otherwise.
Spin-off	Dummy variable equal to 1 for founders with prior working experience in ICT sectors.
First job	Dummy variable equal to 1 for founders at their first job; 0 for founders with some prior working experience (inside or outside ICT sectors).

^a Standardized value, null mean and unity variance.

^b For a definition see Table III.

TABLE VIII
Bivariate correlations

Sector	Age	Education	ICT education	Spin-off	First job
Internet	-0.2904***	-0.1257**	-0.1223**	-0.1630**	0.2814***
Software	0.0308	0.0683	-0.0160	0.0244	-0.1175*
Multimedia content	0.1115*	0.0113	-0.1071*	0.0163	-0.0772
ICT manufacturing	0.2608***	0.0569	0.2963***	0.1768***	-0.1381**

*** Significance level greater than 1%; ** Significance level greater than 5%; * Significance level greater than 10%.

encourage entry of a large number of new entrepreneurial firms. So, lower entry barriers and business expectations of an expanding market have caused an excess of entry of newly established firms (Camerer and Lovo, 1999), the majority of which is run by entrepreneurs who lack both managerial and technical competencies. In the long run, competition will lead to a shake out, selecting efficient firms and forcing less efficient ones to exit. Second, as was said earlier, Internet is a competence destroying paradigm. Therefore, technological and managerial knowledge related to previous experience becomes very fast obsolete, and reproducing consolidated patterns of behavior may be detrimental to business success. E-founders are thus more likely to be both less educated than other ICT entrepreneurs and at their first working experience. If one focuses attention on E-founders that do have prior working experience, they are less likely to be spin-offs.

On the other hand, founders of ICT manufacturing firms are older, more educated (at least as regards technical education) and with more professional experience in ICT sectors. Indeed, ICT manufacturing industries are in a more mature stage of the life cycle and enjoy lower industrial turbulence. Moreover, they are based on rather consolidated technological knowledge. In this case, competencies acquired through both education and professional experience are crucial.

In an intermediate position, software and multimedia content are industries which have been partially revitalized by the advent of Internet. Within these sectors, the market is populated by entrepreneurs in their mid-to-late 30s with good educational attainments (but not specifically technical) and some working experience inside and outside ICTs.

4. Motivations of the self-employment decision

The interviewed entrepreneurs were asked to choose one or more (out of six) motivations and factors which have been the most important ones to shape the start-up decision.¹² Selected motivations are of four types. First, entrepreneurs may be induced to start a new business because of negative future prospects of the mother firm.¹³ Of these defensive motivations, concern about future

career developments within the mother firm and skepticism about prospects of the mother firm seemed to us as the most relevant ones. Turning attention to psychological factors, we concentrate on entrepreneurs' willingness to manage autonomously their working time and aversion to a hierarchical corporate culture. By following the income choice approach (see Blanchflower and Oswald, 1998), we include motivations regarding an expected increase in the entrepreneur's income by becoming self-employed. Within this approach, the self-employment decision of a potential founder working for a firm occurs when the discounted utility from present and prospect income flows within the company (or with other possible employment relations) is lower than the discounted expected utility of the income flow from the independent activity. A similar framework applies to the case of an individual at his first job experience. In this case he compares the discounted expected utility of the income flow from the independent activity with an outside market option (i.e. the income potentially assured by an employment relation). Of course, the choice depends highly on an individual's risk aversion and degree of myopia, capital constraints and environmental uncertainty. Finally, entrepreneurs may be of a Schumpeterian type, being mainly motivated by the willingness of introducing a product or process innovation.

Table IX shows findings on motivations of the self-employment choice of founders of Italian NTBFs. In particular, column 2 reports the ranking of motivations for the entire sample of founders, and columns 3 to 6 present rankings once we distinguish the four industry categories of high-tech entrepreneurs. As prior empirical evidence has found (see Storey, 1982; and Vivarelli, 1991), the desire to manage working time turns out to be the most important factor underlying the self-employment choice: 48% of sample founders indicate this factor as a major determinant of the start-up choice. Given the high-tech nature of start-ups, innovation related motivations have a similar importance, with the percentage of NTBF founders indicating this factor being as high as 47%. Also, the prospect of earning a higher income in the new venture scores a high value (40%), though lower than the one of the previous two factors. Instead, defensive motivations (i.e.

TABLE IX
Ranking of motivations influencing the self-employment choice (%)^a

Motivation	Total sample	Internet	Software	Multimedia content	ICT manufacturing
Desire to manage working time	47.8	52.6	47.2	40.0	50.0
Belief in introducing an innovation	46.7	52.6	49.1	40.0	30.0
Perceive potential for higher income	40.2	63.2	39.6	10.0	30.0
Aversion to hierarchical corporate culture	32.6	36.8	34.0	20.0	30.0
Concern about future career developments	17.4	26.3	17.0	0.0	20.0
Skepticism about prospects of the mother firm	13.0	10.5	11.3	10.0	30.0

^a Percentage of founders quoting a motivation; multiple choices are allowed.

concern about future career developments within the prior company and skepticism about prospects of the mother firm) do not seem to be very common causes of a corporate spin-off (17% and 13%, respectively). Finally, aversion to hierarchical corporate culture is in the middle of the list (fourth motivation with a percentage equal to 32.6%), pointing again to the non marginal role played by psychological motivations of entrepreneurs. In other words, besides economic rational calculations the self-employment choice heavily depends on the particular structure of entrepreneurs' preferences.

As for all other characteristics of high-tech founders, also motivations are significantly related to industry factors. Within E-founders, start-up motivations are linked to high profit expectations associated with the take-off of the market for Internet-based services. Indeed, within this category of founders the perceived potential for income increase scores a percentage as high as 63.2% (the highest value in our sample). This confirms, at least partially, that in the infancy of a new industry overconfidence and excess of entry characterize entrepreneurs' behavior (Camerer and Lovo, 1999).¹⁴ After an industry shakeout when industrial turbulence decreases and competitive selection forces are at work, profit expectations are less positive. Indeed, within the manufacturing sectors of ICT entrepreneurs' motivations to establish a new firm are relatively more defensive (30% of them quote the bad prospects of the mother firm versus 13% of the total sample and 10.5% of Internet founders).

5. Conclusions

In this paper we have analyzed the personal characteristics of 241 founders of NTBFs that operate in ICT sectors and are located in Northern Italy. We have considered both manufacturing (i.e. electronics, communication equipment, computers) and service (software, multimedia content, ISP and E-commerce) sectors.

In this perspective, the first contribution of this work to the literature is that it allows to compare the evidence on such characteristics of Italian entrepreneurs as their age at foundation's time, educational background, prior working experience, and motivations of the self-employment choice with that provided by previous studies relating to other European countries. However such comparison, which highlights the existence of a country-specific effect, should be taken with caution. Indeed, while our sample is composed by a disproportionate number of founders operating in ICT services (90%), existing evidence on the characteristics of NTBF entrepreneurs is mainly based upon samples of firms active in high-tech manufacturing. Nonetheless, these and other findings (see Brown and Sessions, 1999) suggest that the institutional setting may deeply influence the self-employment decision. Even though Italian entrepreneurs are on average in the mid 30s like their European counterparts, they have lower educational qualifications, especially in technical fields. In addition, among sample entrepreneurs the percentage of spin-offs, that is of entrepreneurs having prior working experience in sectors related to the activity of the new firm, is considerably lower than in other countries. A possible explanation may be the long duration of higher

education programs in Italy which is likely to negatively affect the propensity of graduated individuals to setting up a new firm: as risk aversion rapidly increases with age, the later an individual graduates, the less likely that he will take the self-employment choice. Beyond the characteristics of the education system, there may be other institutional factors, related for instance to the organization of the labor and financial markets in Italy and to national corporate law, that may influence risk aversion of highly educated individuals, and consequently the birth rate of NTBFs and the personal characteristics of high-tech entrepreneurs. We think that a thorough analysis of the impact of the institutional context based on international comparisons, would considerably extend our understanding of the phenomenon of NTBFs.

Institutional differences offer a limited explanation of the data presented in this work. Indeed, it has been shown in the previous sections that there are sizable cross-sectoral differences as to the characteristics of Italian high-tech entrepreneurs, with founders of ICT manufacturing and Internet firms being at opposite extremes. The former are on average in their early 40s at the date of establishment of the start-up; they are more educated, at least as regards technical education, and generally have developed professional experience in ICT industries before becoming self-employed. The latter are younger and less educated; quite often, they are at the first working experience. If they do have prior working experience, it usually is in sectors unrelated to the activity of the new firm. In addition, as to the motivations of the self-employment choice, among E-founders expectations of a substantial income increase play a key role. On the contrary, in the ICT manufacturing category defensive motivations are relatively more important. Software and multimedia content industries, which have been rejuvenated by the commercial success of Internet, turned out to be in an intermediate position.

Such evidence allows some intertwined and complementary explanations relating to the industry life cycle and the nature of the technological changes connected with the development of Internet. Internet has been described by previous studies as a new technological paradigm. Due to its competence destroying nature, prior

knowledge and skills, pertaining to both the technological and managerial spheres, rapidly become obsolete. Innovative technical ideas and new business models, which depart from consolidated ways of thinking, are required for business success in Internet activities. In addition, markets for Internet services still are in their very infancy, especially in Italy. This has a series of implications. On the one hand, barriers to entry are lower in Internet-based industries due to the knowledge advantage enjoyed by newcomers with respect to incumbent firms. In addition, there may be overconfidence on the part of Internet entrepreneurs as to the profit potential associated with the new technology. Excess entry of unfitted individuals may well result. On the other hand, distinctive capabilities in Internet activities are likely to be only loosely related to those developed by an E-founder through education or in previous professional occupations. Therefore the fact that E-founders exhibit lower educational qualification and less (and more unrelated) working experience than other ICT entrepreneurs comes as no surprise.

In order to be able to discriminate between the above arguments, further empirical evidence is needed. In particular, one should try to relate the post-entry growth and innovative performances of NTBFs that operate in different sectors to the personal characteristics of entrepreneurs. This study is high in the authors' research agenda.

Nonetheless, it is important to emphasize that the results so far obtained clearly show that Internet does make a difference, even though we are only able to presume why. Such evidence has important policy implications.

As a result of the considerable attention which in the '90s has been devoted by the economic literature to NTBFs as a key driver of economic renewal, wide consensus has developed as to the main obstacles that inhibit growth of such firms and the policy measures that are most suitable to remove them. In this context special emphasis has been placed on such factors as the inadequacy of the banking system, the need for specialized financial institutions such as venture capital firms which are better suited to deal with problems arising from information asymmetries, the lack of marketing and managerial skills on the part of high-tech entrepreneurs, and the difficulty experienced by NTBFs in hiring skilled personnel.

The idea that NTBFs are “special” and thus require ad-hoc policy measures has gained ground among economists and then also among policy makers (see for instance Storey and Tether, 1998b). We agree with such argument. Nonetheless, we also claim that there is a case for paying more attention to cross-sectoral differences than it has been done so far. In other words, it is important to adjust policy measures according to the idiosyncratic characteristics of different industrial settings. Such reasoning especially applies to Internet-based activities. Building a coherent policy framework to effectively support Internet start-ups, a move which in our view will play a key role for the competitiveness of Europe, goes far beyond the objectives of the present work. Suffice here to mention that recognizing that activities related to Internet have special requirements is a necessary premise to this end. For instance, indirect demand-side support policies aimed at favoring the self-sustained take-off of a European mass market for Internet services¹⁵ might turn out to be as effective as highly popular supply-side policy measures such as those aimed at increasing the supply of Ph.D.s in science and technology fields or those targeting failures of financial markets.

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Appendix

Multinomial chi-squared tests on the distributions of NTBF founders by educational qualification are based on a smaller number of categories than those considered in Table IV due to small number problems (i.e. we want to avoid situations in which a category has a null value for some sectors).

Thus, we have proceeded to aggregate the six categories into three: 1) technical graduate degree (i.e. ICT and other technical graduate degrees), 2) other graduate degree (i.e. economic and other graduate degrees) and 3) high school living certificate (i.e. ICT and other high school). The null hypothesis is that the distribution does not depend on the specific sector of operation of the start-up. Results of multinomial tests are presented in Table A.1.

TABLE A.1
Education of NTBF founders according to the sector of operation: multinomial tests

Sector	Test (2)
Internet	17.251***
Software	2.713
Multimedia content	61.831***
ICT manufacturing	62.241***

*** Significance level greater than 1%.
Degrees of freedom in parenthesis.

As for education, the number of categories of founders' working background has been reduced with respect to those of Table VI. In this case we have run multinomial chi-squared tests on the distributions of founders by working experience after reducing the number of classes from seven to four: 1) working experience in ICT manufacturing (i.e. electronics, computer industry and telecommunications), 2) software and Internet background, 3) other working experience (i.e. publishing and working experience outside ICT), and 4) first working experience. Again the null hypothesis is that there are no sectoral biases.

TABLE A.2
Working experience of NTBF founders according to the sector of operation: multinomial tests

Sector	Test (3)
Internet	140.829***
Software	21.973***
Multimedia content	33.407***
ICT manufacturing	395.429***

*** Significance level greater than 1%.
Degrees of freedom in parenthesis.

Notes

¹ According to data from the U.S. Small Business Administration, between 1992 and 1996 small and medium firms (i.e. number of employees lower than 500) created 11.8 million of new jobs, while larger firms lost almost 650,000 jobs. In addition, Acs et al. (1999) show that for the five years period from 1990 to 1995 births of new establishments (which actually also include new branches of existing firms) contributed 25.9% to the net job creation rate of 7.1%. Gross job creation was found to be heavily concentrated among high growth new firms, especially those that are in innovative industries (see Birch and Medoff, 1994; Kirchoff, 1994; Reynolds and White, 1997). See also OECD (1996).

² In 1992, Italian firms with less than 20 employees accounted for 38.7% of total employment, a value that is five times as large as that of the U.S. and three times as large as that of the U.K. (see OECD, 1998).

³ This is indirectly witnessed by the growing attention that the international economic and financial press is devoting to European E-firms (see for instance the cover stories of Business Week, January 31, February 7 and March 6, 2000).

⁴ These sectors correspond to the following four-digit industries (NACE-CLIO classification): communication equipment 31.30, computers 30.02, electronics 32.20.

⁵ The decision to confine the analysis to Northern Italy was due to practical reasons; as the identification of target firms was a very time consuming process, we were forced to concentrate efforts in geographical areas where the likelihood of finding ICT-based NTBFs was sufficiently high. In this respect, note that Northern Italy accounts for over 50% of Information Technology expenses of Italian firms and over 65% of total employment in the industries considered in the present work (see again ISTAT, 1999).

⁶ Autio et al. (1989) studying a sample of Finnish founders of NTBFs find an average age equal to 34. In the French case NTBFs' founders are on average 37 year old at the date of foundation (GMV Conseil, 1989). They are between 30 and 50 in the U.K. (Westhead and Storey, 1994).

⁷ Indeed 95% of sample founders have financed their start-up using their personal savings.

⁸ For a definition of technological paradigm and technological trajectories see Dosi (1982). On the difference between *competence destroying* and *competence enhancing* technological change see Tushman and Anderson (1986). Finally, for a thorough analysis of the characteristics of the Internet paradigm see Colombo and Garrone (1997).

⁹ Note that the large number of new entrants may also be the result of overconfidence on the part of E-founders as to the profit opportunities of start-ups. This issue will be addressed in greater detail in Section 4.

¹⁰ Note also that since risk aversion is positively related to age, the later an individual graduates, the less likely he takes the self-employment choice. Thus, an institutional system in which individuals graduate very late will have a disproportionate number of entrepreneurs with a very low level of educational attainment. Indeed, individuals with higher degrees, being older will generally take the employment choice.

¹¹ In 1996, 87% of software houses had 5 or less employees,

versus 41% of firms in the communications equipment sector and only 1% in the computer and other office equipment industry.

¹² For evidence on the role of entrepreneur's personal motivations on firm's post-entry performance see Arrighetti and Vivarelli (1999).

¹³ Note that these factors apply only to entrepreneurs with previous job experience.

¹⁴ The concepts of overconfidence and excess of entry are nicely summarized by the following words of Joe Roth, chairman of Walt Disney Studios: "If you only think about your own business, you think, 'I've got a good story department we're going to go out and do this.' And you don't think that everybody else is thinking the same way. In a given weekend in a year you'll have five movies open, and there's certainly not enough people to go around." (*Los Angeles Times*, 1996; quoted in Camerer and Lovallo, 1999).

¹⁵ Examples of such measures include subsidization of Internet wide-band access, introduction of PCs in schools, and the development of Internet-based public services so as to capture indirect network externalities. For more details see Colombo and Delmastro (2000).

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