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The Heterogeneity of the Development Process of New Technology-Based Firms

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Abstract
This work investigates the variety of development processes of start up firms in a regional setting. The existing literature on entrepreneurship lacks accurate analysis of the processes that lead an idea of business to become an established firm. The present paper moves one step towards filling this gap by dynamically investigating the process development of a self-contained population of 78 new technology based firms (NTBFs) in the North Italian region of Emilia-Romagna. By clustering the firms in similar organisational configurations at three different points in time, the results show that it is possible to observe that firms develop along different, sometimes overlapping paths. Our findings contributes to the understanding of the dynamics of the entrepreneurial process and lead to important policy implications.

Keywords: Entrepreneurship; Firm development process; New technology-based firms; Start-ups; Regional policies; Cluster analysis

JEL Classification: L26, L53, O32, O38

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1. Introduction

Entrepreneurship, conceived as the creation and development of a new firm, has been recently considered a most important process for encouraging innovation and growth (Audretsch and Keilbach 2004, OECD 2003). Western economies therefore assisted to the increase in policies aimed at stimulating the process of the creation of new firms (Bianchi and Labory 2006, Audretsch 2004): the focus is mostly on enabling the generation of new technology based firms (NTBFs), broadly considered as "all new firms operating in 'high technology' sectors" (Storey and Tether 1998, p. 934). Such firms are considered the main drivers of technological change and economic growth, particularly at the regional level, because of the proximity character of knowledge spillovers (Audretsch and Feldman 1996, Autio and Yli-Renko 1998).

The literature concerned with entrepreneurship have highlighted the heterogeneous nature of new firms. This heterogeneity is on the one hand positive, because it adds diversity to the environment augmenting its possibilities of innovation (Audretsch and Keilbach 2004) and on the other hand it complicates the policy making process, because of the high rate of early failure of such firms (Bartelsman et al. 2005).

In fact the *ex ante* heterogeneity of firms, in terms of sectors, founders characteristics and technological opportunity to name but a few elements, makes it quite difficult to understand whether the business idea will lead to a survival firm or not, or to an high growth firm or not (e.g. Santarelli and Vivarelli 2007). Although some targeting mechanisms would be desirable in order to avoid a compromise in competitiveness by subsidizing failing firms (Santarelli and Vivarelli 2007, Schneider and Veugelers 2010, Moncada-Paternò-Castello 2011), it however emerges from the literature that entrepreneurial policies should not hamper variety, either in terms of sector, R&D intensity, size and age and avoid *ex ante* pick up winners (Audretsch and Thurik 2001, Holzl 2010, Bishop 2011).

The wide variability of firms' entry characteristics and the learning element within firms is then reflected in a high variability of the paths of development of such firms (Penrose 1959, Nelson 1991, Metcalfe 2004, Raffa and Zollo 1996). However, even though such variability in the process of development of firms seems to be nowadays well acknowledged, our understanding of the issue is still weak (Dosi et al. 2008). Our intention is to give evidence of the variability of paths different firms experience in their development process.

Moreover, policies toward entrepreneurship mostly focused on the provision to individuals, organisations or geographical areas of those elements that the literature found correlated with a high rate of generation, of growth and of survival of start up firms in successful contexts, making little considerations about the development process of firms, and particularly to the idiosyncrasies in such processes.

The purpose of this work is to investigate the variety of development paths of firms. If entrepreneurial policies aim at stimulating the creation, development and survival of firms, our insights point to the need of taking into considerations different, and *ex ante* uncertain, needs. From this perspective the prevalent static nature of policies aimed mainly at providing entry incentives and resources should be overcome. Moreover, scholars of innovation argued that the positive impact of new start-ups on regional growth is particularly important when new start-ups are able to survive after a certain time threshold (Fritsch and Noseleit 2009).

Section 2 briefly reviews the literature on NTBFs especially concerning their process of development; section 3 delineates the conceptual framework grounding our analysis; in section 4

the empirical analysis is developed, and then some concluding thoughts are put forward in section 5.

2. The development process of NTBFs

NTBFs have been widely studied in the last few decades. Most of the economics and management literature in this field is concentrated on the identification of the determinants to the creation and success of such typology of firms (e.g. Chorev and Anderson 2006). Nevertheless, more recently some efforts have been made in order to investigate the variety characterising firms' knowledge base and behaviour (see e.g. Mustar et al. 2006).

The literature stressed that the number and quality, in terms of performance, of NTBFs created depends on some features of the individual or team that undertake the entrepreneurial activity and on some characteristics of the environment in which the entrepreneurial phenomenon takes place. It has therefore been noted that the ideal potential high tech entrepreneur is an individual with managerial and entrepreneurial capabilities (Walter et al. 2006, Krabel and Mueller 2009), that wants to exploit a patented invention (Teece 1986, Shane 2004) and that has already developed a useful social capital (Anderson and Jack 2002, Shane and Stuart 2002, Landry et al. 2006). The context that better supports such individuals should be endowed with an elevated number of high tech firms, universities and R&D centres in order to stimulate knowledge spillovers (Friedman and Silberman 2003), the presence of supporting infrastructures such as science parks and incubators (Link and Scott 2005), the presence of venture capitalists and a regulatory environment favouring entrepreneurship (Henrekson and Rosenberg 2001).

Scholars that focused on the heterogeneity of NTBFs investigated how *ex ante* differences matter in the post-entry survival rate, productivity, employment and so on. In particular, works have highlighted the variety of start-ups according to specific elements , such as age, size, their resource base, their sectoral affiliation or market of reference, their financial needs and constraints, their ties with other organisations or supporting partner infrastructure (e.g. Santarelli and Vivarelli 2007). Such works derived a high variety of knowledge bases within firms, and some patterns of success have been revealed. However variety is intrinsic in the innovation process and a recipe for success is clearly not reachable (Dosi et al. 2008).

Recent studies, some of which refer to academic spinouts, started to observe how NTBFs or firms in general evolve through time (see e.g. Colombo and Delmastro 1999). In particular Clarysse and Moray (2004) analysed the decision making process and the human resources organisation of an academic start-up in the very early stages of development: they found very flat hierarchies at the very beginning of the development process that slowly evolve in the building of an organisational structure, mainly due to external shocks and market preferences. Vohora et al. (2004), in a dynamic approach, found that each academic start-up must overcome some obstacles in order to develop, that is in order to acquire and build the capabilities required to become a sustainable firm in the market. Muller (2010) undertook a duration analysis and found that different firms proceed in the growing path at different speeds.

Finally, Druilhe and Garnsey (2004) pointed to the non-linearity of the process development: they revealed that the academic start-up development process leads to a change in their resource endowment and connected business model. They highlighted the role of resources in shaping such changes, both within the firm and in the environment. A similar point has also been made by Augier

and Teece (2008) by pointing to the interdependence between managerial and entrepreneurial strategic choices and idiosyncratic patterns of knowledge accumulation, from which the coordination approach of internal and external knowledge emerges.

3. The organisation of knowledge in NTBFs' development process

Entrepreneurship, broadly considered, is a process that takes place in circumstances of asymmetric information, in which the entrepreneur is the figure able to perceive a latent business opportunity, whose mission it is to economically exploit it (Shane and Venkataraman 2000). In this work we study the creation and development of innovative start-ups, therefore we deal with a Shumpeterian-type of entrepreneurship process, in which new ideas are introduced in the market place and in which a considerable degree of uncertainty is tackled by the team of founders (Shumpeter 1934, Metcalfe 2004).

The conceptual starting point of this study is the recognition that in order to develop, the firm needs to collect many, dispersed and indivisible bits of different knowledge (Hayek 1945, Henderson 1994, Berry 1996) and that those bits interact and shape each other in the process of firm development (Saemundsson 2005, Antonelli 2006). Firms are therefore considered as repositories of knowledge (Nelson and Winter 1982, Kogut and Zander 1992, Dosi et al 2000): resources, production processes and coordination activities, both within and across the firm boundaries, not only define the products a firm puts on the market but also represent the knowledge base on which the behaviours of the firm are settled (Antonelli 2006, 2008).

Works about the knowledge dynamics of firms tended to be confined or on the resources and production processes development, or on the coordination mechanisms adopted by the firm (Langlois and Foss 1997). A close conceptualisation has been put forth by Dosi et al (2008) that recognised two sometimes overlapping groups of knowledge bases as crucial to be studied in order to better understand the dynamics of firms and industries: "technological competences" and "organizational competences". The first regards the "pieces of scientific and technological knowledge" while the second refer to the "pieces of knowledge [...] concerning the governance of coordination and social interactions within the organisation and with outside entities" (Dosi et al 2008, p. 1170).

Nevertheless, academic literature, especially empirical, mainly addressed the issue by means of static analysis or on resources or on incentives mechanisms (e.g. Di Gregorio and Shane 2003, Friedman and Silverman 2003), leading to implications often implicitly grounded on the assumption that "the transformation of homogeneous inputs into homogeneous outputs takes place according to given technical 'blueprints' know to all" (Langlois and Foss 1997, p. 9). Moreover entrepreneurship policies have mainly concentrated toward the increase of the total number of firms created (Holzl 2010). It emerges that policies has been primarily directed to provide a context some particular resources or incentive schemes, with the aim of replicating the performance of recognised successful contexts, without taking into account the processes that led that context to be characterised as such (Feldmann 2001, Druilhe and Garnsey 2000).

The purpose of this work is to give evidence that entrepreneurial policy would take advantage in considering the variety in the path of firm development. In order to do so we seek to investigate the evolution of the overall organisation of knowledge of firms. By referring to the organisation of

knowledge, we mean to jointly analyse the characteristics of production and resources with the organisational configuration the firm adopts to coordinate its activities both within and across its boundaries. The empirical analysis will consider as part of the first group the resources of the firm, both technological and human, while the second group refers to the structure the firm adopts in order to manage the innovation process (Teece 1996), that is, in order to coordinate internal and external knowledge.
Given these conjectural grounds, we observe how these two sets of knowledge are differently handled by firms during their development. The purpose is to analyse the development process of a population of firms towards the lens of the organisation of knowledge.

4. Empirical analysis

4.1. Data

The data set is composed by a population of business ideas awarded by the Regional Authority to receive a specific policy supporting tool, named "Spinner Programme", observed at three different points in time. Spinner objective is the realization of projects aimed at the valorisation of human capital, promotion of research, technology transfer and innovation activities, also and above all by the creation of *new firms operating in high tech sectors*. To this end the policy provided resources and complementary services to selected teams of founders in order for them to conduct a feasibility study of the duration of one or two years. A total of 78 awarded business ideas constituted as firms and 61 survived over one year after constitution. This group constitute our sample. We can consider the sample of innovative start-ups as a self-contained population of firms for two main reasons: first of all, all firms have been equally treated, because they all have been created under the Spinner programme. Moreover, the characteristics of the region strengthens such considerations: indeed, the Emilia-Romagna region appears to be a self-contained economic system because of the shared cultures and values on the one hand, and the high number of SMEs involved in robust networking relationships, the consequent high level of division of labour and the elevated level of formal and informal institutional activities on the other hand (Brusco 1982, Leonardi and Nanetti 1990, Doloreux and Parto 2005, Bianchi and Ramaciotti 2005).
For this analysis we used the Spinner Programme database. All ideas of business awarded by the programme were in fact asked to compile the same survey in three different and specific points in time. The first point in time, named T_0, gives a picture of the situation described in the project with which the teams applied to the regional call. Each award, based on the evaluation of such projects, corresponded to a one- or two-year supported programme, depending on the specifics of each project, in which the team of founders was provided with a grant and specific training at both a scientific and managerial level. Moreover, the award made it possible to take advantage of some consultancy services, such as services on intellectual property rights, technical developments and marketing. Consequently, in the first year (or two, depending on the duration of the award), the selected teams should have tested the feasibility of the business and constituted the firm together with the provision of a detailed business plan at the end of the award. This information represents the second point in time, T_1, and reveals the situation of the firm at the moment of constitution. Finally, firms were surveyed a third time, T_2: this point in time represents the situation of firms that were active in the marketplace more than one year after constitution. Therefore our three time

periods represent three snapshots of the business idea: before its exploitation, at the firms' constitution, and few years after the firms being on the market. A brief summary statistics of the sample characteristics is presented in the next two paragraphs, while the next tables summarise the economic sectors at which different firms belongs, and their size. All firms belong, as requested by the Spinner policy, to high tech sectors, among which "electronics" and "ICT" are two most important ones, accounting together for more than an half of total firms. The second table below shows that firms tend to averagely remain small: this is due either because firms at constitution tend to be small (e.g. Clarysse and Moray 2004), and because the time frame analysed remain quite short. The average size (among firms and among the three points in time taken into consideration) is in fact 4.38 employees, and only the 10.25 per cent of firms have 6 or more employees.

Sector	**Freq.**	**Percent.**
Energy and environment	1	0.01
Aerospace	1	0.01
Pharmaceuticals	2	0.03
Nanotechnology	2	0.03
Mechanics	4	0.05
Medical	4	0.05
Chemical	6	0.08
Other	9	0.12
Biotechnology	9	0.12
Electronics	15	0.19
ICT	25	0.32

Average components	**Freq.**	**Percent.**	**Cum.**
3 or less	20	25.64	25.64
between 3.1 and 4	20	25.64	51.28
between 4.1 and 5	19	24.36	75.64
between 5 and 6	11	14.11	89.75
more than 6.1	8	10.25	100
total	78	100	
Average	4.38625		
St. dev.	1.719489		

4.2. Methodology

In the analysis we concentrated on two aspects: the resource endowments together with the production processes, and the organisational structure. The first aspect refers to the characteristics of human capital and technology, while the second refers to some specific factors giving an explanation for the organisational configuration of firms. Let us explore each of the two sets of variables.

4.2.1. Measures of resources and production

Concerning human capital, we investigated the percentage of: academics, people with previous industrial experience and of temporary workers in the team. People with industrial experience represent a proxy of the managerial capabilities of the team, while the unemployed or temporary workers are considered because seeking work is often a cause of undertaking entrepreneurial experiences (Santarelli and Vivarelli 2007). These analysed characteristics of human capital have been acknowledged by the literature because they are related to higher productivity and growth. In particular a higher educational level, managerial experience and entrepreneurial capabilities are usually associated with firms that perform better and that have a higher probability of survival and growth (Brüderl et al. 1992, Colombo and Grilli 2005).
Regarding technology, we looked at the level of appropriability of the innovation put on the market. This is considered a crucial factor by the literature, because it allows the newborn firm to return the investment of the innovation and above all to be protected from imitators (Teece 1986, 1996, Shane and Stuart 2002). We looked at the presence of patents and we related the number of products put on the market with the number of patent applications filled. We therefore assumed that the higher the number of patents per product is, the higher will be the likelihood of generating profits and therefore of surviving.
Given this evidence, we can hypothetically identify two opposite types of firms: a 'high profile' NTBF that will display an elevated number of patents, a high number of academics and of managerially experienced people, while it will have none or few temporary or unemployed workers. On the other extreme we identify the 'low profile' NTBF, which will display no patents, no academics or personnel with industrial background, but will be mainly constituted by unemployed personnel. Table 1 summarises the measure of resources and productions variables, and presents the sample descriptive statistics. All variables have been normalised, and range between 0 and 1.

Table 1: Variables description for measures of resources and production

Acronym	Variable Description	Min	Max	Mean
Patent	(Patents / number of products)	0	1	0.154
Managerial Competences	(People with previous industrial experience / number of total personnel)	0	1	0.091
Temporary Workers	(1 - Share of temporary workers)	0	1	0.361
Academics	(Academics / number of total personnel)	0	1	0.348

4.2.2. Measures of organisational configurations

Regarding the organisational approaches adopted by the firm we mainly refer to Teece's paper (1996) that is concerned with the organisational configurations recognized in different typologies of innovative firms. In particular Teece (1996) identifies five organizational factors which are: hierarchies, integration, degree of specialisation, culture and external linkages. Moreover, he distinguishes various archetypes of innovative firm, according to different combinations of degrees of these organizational factors.

To express these concepts we used the following variables: the number of products (or services) provided to the market as a proxy of specialisation; the scientific differentiation of the team, in terms of scientific bachelor's degree, as a proxy of horizontal diversification, or integration of competences; presence of a direct channel connecting the firm to the market, as a proxy of downstream linkages present within the firm. Finally, given the average small size of the firms because of the start-up nature, and the difficulties concerned with hierarchies measurements we simply calculated the ratio between non-founders and total personnel.

Matching Teece (1996) analysis with the literature, it emerges that at constitution NTBFs display the features of the Teece's (1996) 'stand-alone inventor' (Clarysse and Moray 2004, Vohora et al 2004): a recently created NTBF tends to be very specialised, has very flat hierarchies, has a low level of integration, and possibly has some downstream connections with the external market environment. With established firms in the market, NTBFs display the features of the Teece's (1996) 'Silicon Valley-type of firm': some level of integration and hierarchies, not strongly specialised scope, a high level of external linkages and no need for direct downstream connections with the marketplace. Such typology of firms are the ones usually used for case study research.

We therefore expect two opposite firms' profiles: a "Silicon Valley-type of firm' that shows high level of hierarchies, integration and external linkages, and low level of specialisation and downstream market connections on the one hand, and a "Stand Alone inventor" that organises contrarily. Variables are summarised in Table 2.

Table 2. Variables description for measures of organisational configuration

Acronym	Variable Description	Min	Max	Mean
Specialisation	Number of products	0	1	0.242
Horizontal Diversification	Number of scientific background / number of total personnel	0	1	0.482
Hierarchy	Number of employees / number of total personnel	0	1	0.117
Downstream Linkages	Number of direct connection / number of products	0	1	0.110
General External Linkages	Number of established connection with the environment	0	1	0.330

Using all this information we conducted a cluster analysis in order to group NTBFs through time (T_0; T_1; T_2), according to the variables above. This allowed us to divide firms into different possible groups described above ('Silicon Valley-type versus 'Stand Alone' and 'High profile' versus 'Low profile'). Moreover, the availably of three different time periods allowed us to study the development path of firms, pursuing our idea that NTBFs may develop following different and sometimes overlapping routes.

4.3. Analysis

The analytical tool identified to investigate how firms are structured according to the variables of reference and to see eventual movements towards different groups is the cluster analysis. The aim is twofold: first it tries to identify if NTBFs can be clustered according to our variables, and second it seeks to reach a deeper understanding of the development paths of such firms. The idea is that different firms assemble in different groups according to the different periods of time. In other words, firms in the same group at the same stage of development may move to, or come from, different groups. From a statistical point of view this means the firms should be classified into different groups in the three different time stages, and then it should be studied if the composition of the stage is the same over time or if there is a kind of recombination of firms among clusters, which may illustrate their development path.

The cluster analysis has been conducted starting from the two groups of variables listed in the tables above. Nevertheless, the analysis was not directly conducted on the raw variables. Instead we chose to synthesize the two main concepts represented by the variables (i.e. resource and production processes, and organisational structures) generating two synthetic measures, taking the average of the values of two variable groups (Hair et al. 2006). In this way we generated two indexes, named K1 and K2, representing the two main dimensions of interest, and we used their standardized value to perform the actual cluster analysis.

We are in fact not interested in the specific values assumed by each variable that composed either K1 and K2, but at the general organisational structure and factors endowment of different firms at different points in time. Building the cluster analysis on single variables could have been a valid alternative, which would have provided more information on how and how much the different firms have developed across the three different time periods. This approach, however, although interesting, would have deviated the analysis from the understanding of the average evolution path of firms. Such alternative approach would have permitted an analysis of the eventual presence of patterns among firms in terms of their development route. In other words, looking to single variables instead than looking to indexes would have allowed to study patterns, but would have rendered more difficult the identification of the variability of organisation of knowledge among firms in their development process. A summary of the index composition is summarised in Table 3.

Table 3. Indexes description

Acronym	Description	Variables included
K1	Index representing the measure of resources and production	Patent; Managerial Competences; Temporary Workers; Academics
K2	Index representing the measures of organisational structure	Specialisation; Horizontal Diversification; Hierarchy; Downstream Linkages; General External Linkages

Another option could have been to reduce the variable number by means of a factor analysis, using factor scores in the sequent cluster analysis (Hollenstain 2003), but some authors suggest that using factor scores in a cluster analysis may lead to a poor representation of the actual data structure (Hair et al. 2006; Rohlf 1970). After the data simplification step, we performed a hierarchical cluster analysis on T_0, T_1 and T_2, in order to obtain a first clustering of our firms. From a technical point of view, for the hierarchical procedure, we used the Chebychev distance measure[2] and an average distance grouping method, while to select a specific cluster solution we mainly used the following two principles: (a) the presence of a significant jump in the value of the agglomeration coefficient, (b) the credibility and interpretability of the results (Manly 1986). With this procedure we obtained the first set of cluster solution. The clustering process in T_0 and T_1 suggested a possible 4 cluster solution and a possible 5 cluster solution, while it suggested either a 5 cluster solution or a 6 cluster solution in the third period. This was due to the fact that between T_1 and T_2, 17 firms did not survive, becoming part of a "failed firm cluster". For these reasons we dropped these observations from T_2, and reran the cluster analysis, obtaining (with a smaller sample of 61 firms) both a 5 and a 4 cluster solution. In all three cases we preferred the four cluster solution, mainly because it was easier to interpret.

Moreover, after this first step we didn't proceed to the direct cluster interpretation, but, on the contrary, we used the cluster centroid of the hierarchical analysis as a starting seeds point of a following non-hierarchical cluster procedure. For this specific analysis we used a non-hierarchical cluster method because it gives the possibility of using an optimizing clustering procedures. In other terms, K-means non-hierarchical clusters procedure allows to reassign observations once an observation already in a cluster becomes closer to another cluster (that is not the cluster to which it was currently assigned) (Hair et al. 2006). For this reason we considered the non-hierarchical process with non random cluster seeds as superior to the hierarchical methods. The results of the non-hierarchical method, with their relative final cluster centroids for the three time periods are summarised in the following table. In line with the hierarchical cluster analysis, we imposed a 4 cluster solution. In the following tables the average K1 and K2 for the four clusters in the three periods of time are also summarised.

[2] We conducted the same hierarchical analysis also using the "squared Euclidean distance" as a measure, and found basically the same results.

Table 4. Cluster centroids, Non-hierarchical procedure.

	T_0		T_1		T_2	
	K1	**K2**	**K1**	**K2**	**K1**	**K2**
Cluster A	-0.504	-0.888	-0.162	-0.934	-0.079	-0.990
Cluster B	-0.657	0.831	-0.726	0.324	-1.175	0.931
Cluster C	1.064	-0.857	1.422	-0.280	1.524	-0.420
Cluster D	1.151	0.899	0.697	1.377	0.239	0.586
Mean of K1 and K2	0	0	0	0	0	0
St. Dev. of K1 and K2	1	1	1	1	1	1
N	78		78		61	

From the tables above is possible to derive some communality among time in terms of cluster characteristics, that can be summarised as:

1. Cluster A: firms are generally characterised by a lower endowment of both K1 and K2. This therefore refers to a type of firm that we could think of, as emerged by the literature, as a low profile stand-alone inventor
2. Cluster B: firms characterised by a low level of K1 and an above the average level of K2. Such firms can be considered as being composed by probably no academics, no personnel with industrial background but many temporary or unemployed workers and presumably no patented invention to exploit. On the other hand the level of K2 is high: some level of hierarchies and some horizontal diversification, many external linkages and probably more than one product on the market.
3. Cluster C shows a level of K2 below the average and an above the average level of K1. This cluster is composed of firms well endowed in terms of resources, possibly exploiting a patented invention and/or requiring specialised complementary assets. The organisational structure is very specialised, that is with flat hierarchies, not horizontally diversified, with one or very few products on the market, probably a direct connection to the market place but rare general external linkages.
4. Cluster D resembles the high profile Silicon Valley type of firm and shows above the average level of both K1 and K2. It therefore should embrace firms well endowed in terms of resources and technology and with a quite diversified production organised with some hierarchies and highly connected to the environment.

Starting from the results of the cluster analysis, we focus here on the intra-cluster movement of firms between the different time periods. In doing so we analysed the transaction of firms among cluster between different points in time, in order to see if firms generally behave similarly through time or if they generally move among different clusters, following different paths. The first step of this analysis is conducted through the inspection of the contingency table (expressed in relative values), in order to study the association between two different points in time. In this case, rows and columns represent the different clusters found above, and the cells value show the share of firms that move from cluster to cluster. For example the value 5.1 of the second cell in the first row means that the 5.1% of the firms were in Cluster B at time T_0 and are in Cluster A at time T_1. In this way it is possible to account for the presence of dependence among time periods. In particular, if we

have strong dependence across time it means that firms tend to be stable in terms of organisational characteristics, while the lack of dependence means that they change rapidly across time. From a visual point of view this can be seen looking at the main diagonal elements of the table; if the majority of the firms (the higher percentage) are on the diagonal this means that we are in presence of dependence (firms remain in the same cluster in which they were before), while if the off diagonal element has an important share of firms this means that there is not a strong dependence across times. More generally we can perform a Cramer's V statistic (Cramer 1946), which allow to measure the strength of association or dependency between two categorical variables. In this way we can have a synthetic and easy to interpret measure of dependence, which assumes the value equal to 1 in the case of perfect dependence and a value equal to 0 in the case of stochastic independence. Firstly, we analysed the relationship between T_0 and T_1. In this specific case there is not a clear dependence between the cluster in T_0 and T_1, as confirmed by the value of the Cramer's V statistic. Nevertheless some persistence exists, and a conspicuous group of firms that were in cluster A or B in the first period tends to remain in the same group in period T_1.

Table 5. Intra-cluster firms movement between T_0 (columns) and T_1 (rows). Relative values.

T_1	T_0				
	A	B	C	D	TOT
A	21.8%	5.1%	6.4%	1.3%	34.6%
B	10.3%	19.2%	2.6%	2.6%	34.6%
C	1.3%	1.3%	6.4%	3.8%	12.8%
D	0.0%	6.4%	0.0%	11.5%	17.9%
TOT	33.3%	32.1%	15.4%	19.2%	100.0%
Cramer's V	0.481				

Moreover, the table below that refers to the transition between T_1 and T_2, confirms previous results, presenting a very similar result for the dependence statistic.

Table 6. Intra-cluster firms movement between T_1 (columns) and T_2 (rows). Relative values.

T_2	T_1				
	A	B	C	D	TOT
A	21.8%	2.6%	1.3%	0.0%	25.6%
B	1.3%	12.8%	0.0%	3.8%	17.9%
C	3.8%	0.0%	6.4%	1.3%	11.5%
D	2.6%	12.8%	1.3%	6.4%	23.1%
DEAD	5.1%	6.4%	3.8%	6.4%	21.8%
TOT	34.6%	34.6%	12.8%	17.9%	100.0%
Cramer's V	0.433				

Finally this last table represents the association between T_0 and T_2. In this case the absence of dependence is more evident, the off diagonal element represents more than the 50% of the total

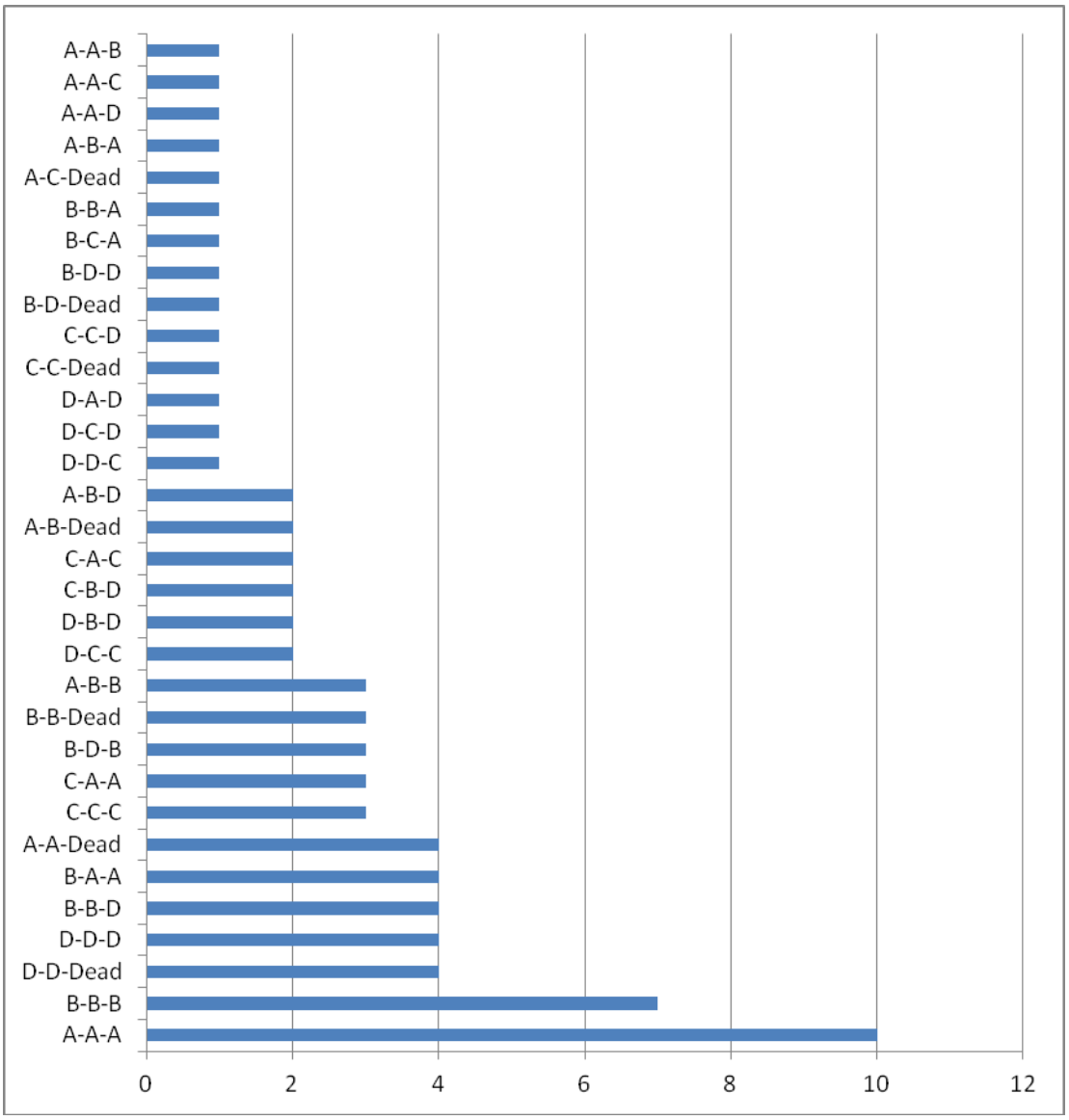
firms and the Cramer's V is lower than before. In other terms being in a determinate cluster at T_0 does not affect the firm's development path.
Although we are not dealing with any specific pattern identification, we can note that firms tend to move from T_0 to T_1 from an unstructured configuration (i.e. Cluster A) toward a more structured configuration (i.e. Cluster D): in fact in T_0 33% of firms belong to Cluster A, while only 25% of firms belong to the same cluster at time T_2. Similarly at time T_0 firms belonging to Cluster D are 19% compared with 23% of firms in time T_2, also considering that 21% of firms exited the market.

Table 7. Intra-cluster firms movement between T_0 (columns) and T_2 (rows). Relative values.

	T_0				
T_2	A	B	C	D	TOT
A	14.1%	7.7%	3.8%	0.0%	25.6%
B	5.1%	12.8%	0.0%	0.0%	17.9%
C	1.3%	0.0%	6.4%	3.8%	11.5%
D	3.8%	6.4%	3.8%	9.0%	23.1%
DEAD	9.0%	5.1%	1.3%	6.4%	21.8%
TOT	33.3%	32.1%	15.4%	19.2%	100.0%
Cramer's V	0.362				

Summarising, the above tables tells us that in the early stages of development the analysed firms tend to change their organisational configuration rapidly, or in other terms to move from one cluster to another. Finally, in the next figure we depict all possible development paths made by firms across the three time periods. In this case different bars represent different firms development paths. The first one, A-A-B, for example means that only one firm developed remaining in Cluster A in the first two time periods, and then moving to cluster B in the third one. As expected, there is a great heterogeneity, and firms evolved in significantly different ways.

Figure 1. Firms paths of development



Our findings confirm our conjectures, the cluster analysis revealed that different firms organise differently among themselves and a significant number of them modify their organisational structure during their development process. However two main points can be raised by observing the patterns of firms developments. First of all some persistency is recognised in the paths A-A-A and B-B-B: this persistency may be motivated by the short time interval that for many firms is only just over three years, one of which is about the business feasibility study. The second point that may be raised is that a conspicuous number of firms instead of moving toward cluster D, as could be expected, tend to move back to cluster A, like paths C-A-A or B-A-A: such patterns may be motivated by the fact that a firm, when entering the market place, realise the need of a deep reorganisation in order to respond to market feedback (Vohora et al 2004), and therefore re-organise in a more under structured way.

5. Conclusions

The present work first of all discusses the dynamic character of entrepreneurship. In particular it is argued that entrepreneurship is a process and therefore it must be approached in a dynamic way. This statement applies both in terms of its analytical concerning, and at the level of policy design and implementation.

The major contribution of this work concerns the investigation of the variety of processes of developments of start-ups. Our study highlighted the heterogeneity nature of paths that NTBFs belonging to the same context follow in their development process. We gave evidence that a population of start-up firms organise differently among each other and shape specific paths of development that are likely to be different and sometimes overlapping. Our work therefore points to the need of not considering homogeneous the process of firm development, as it often happens, especially in empirical studies on NTBFs.

From a policy perspective important implications can be derived: both academics and policy makers should consider the heterogeneity of firm structures and the variety of development paths of such structures in the route that lead a business idea to become an established firm in the market. Instead of only replicating some recognised best practices aimed at the provision of the determinants, a process that revealed to be particularly evident at the regional level (Hospers and Beugelsdijk 2002), policies should give more attention not only to firm specific features but also to the highly idiosyncratic character of their route of development.

This means that a regional policy framework, although careful in not distorting competition or in altering the market selection process, should aim at providing its contexts with those resources, incentives and institutions that allow start-ups to acquire the knowledge they need (Metcalfe 1998, Landabaso 1997), independently of the stage of their development. That is to say, a regional policy framework directed to favour entrepreneurship, should be open and adaptive: able to respond to the delayed and unexpected knowledge needs of start-ups, that emerge only during their development process toward becoming an established firms in the market, by definition largely unpredictable ex ante.

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Appendix

In the following table is it possible to track the firm's movements between the different clusters. The table show that firms development paths are rarely homogeneous.

ID	T_0	T_1	T_2
1	A	A	A
2	C	A	C
3	B	D	B
4	D	D	D
5	D	D	D
6	D	C	C
7	C	C	C
8	D	D	Dead
9	B	B	A
10	D	D	D
11	D	D	D
12	D	B	D
13	D	C	Dead
14	C	C	C
15	B	D	D
16	B	D	B
17	A	A	A
18	A	A	A
19	A	A	A
20	B	B	D
21	C	A	C
22	D	D	Dead
23	C	C	D
24	D	B	D
25	C	A	A
26	B	B	B
27	B	A	A
28	C	C	Dead
29	B	B	B
30	A	B	D
31	D	A	D
32	D	D	Dead
33	A	A	A
34	A	A	D
35	B	B	B
36	A	A	A
37	D	C	C
38	C	A	A
39	B	B	B

ID	T_0	T_1	T_2
40	A	A	A
41	A	B	Dead
42	C	C	C
43	B	D	Dead
44	B	A	A
45	A	A	A
46	B	B	B
47	B	B	D
48	B	B	Dead
49	B	B	B
50	B	D	B
51	A	B	A
52	D	D	C
53	A	A	Dead
54	A	C	Dead
55	A	A	Dead
56	A	B	D
57	D	D	Dead
58	A	A	Dead
59	B	B	D
60	C	A	A
61	A	A	Dead
62	A	A	C
63	A	A	B
64	A	B	B
65	B	B	D
66	A	B	Dead
67	B	C	A
68	A	B	B
69	B	B	Dead
70	B	B	Dead
71	A	A	A
72	A	B	B
73	B	A	A
74	C	B	D
75	B	A	A
76	A	A	A
77	B	B	B
78	C	B	D