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Abstract

Purpose - According to the paradigm of the Triple Helix, universities are moving from their traditional roles of research, teaching, and knowledge dissemination to an entrepreneurial role. Specifically, they contribute to innovation and competitiveness by creating academic spin-offs (ASOs). In such a context, the diffusion of digital technologies are impacting both on the development of new forms of academic entrepreneurship and on the motivations of academics in launching ASOs. Grounded on a recent reconceptualization developed on identity theory, this study investigates the motivations that lead an academic to establish a spin-off and if, how and why these motivations vary over time.

Design/methodology/approach - An extensive online survey was performed in order to obtain a final database of 151 Italian ASOs. Different statistical techniques were used, such as Cluster analysis and ANOVA, to identify different ASO profiles and to understand how and why these profiles change over time.

Findings – The results suggest that motivations change over time: while financial aspects become less important, academics give more importance to other issues. Time, experience and financial gain influence the evolution of academic entrepreneurs' motivations over time.

Practical implications - Insights derived from the study could help policy-makers and practitioners in understanding better this phenomenon and the possible evolution of such academic motivations in the context of digitalization, and enable them to act accordingly to foster academic entrepreneurship.

Originality/value - The main contributions of the present study are the addition of empirical knowledge to the scant and anecdotal literature existing to date and the inclusion of cognitive and psychological theoretical perspectives in the academic entrepreneurship debate. Moreover, it is believed that no other study has investigated the above topics in the Italian context.

Keywords: academic spin-offs; academic entrepreneurship; motivations; identity perspective; microfoundations; Italy.

Paper type - Research paper

Introduction

The paradigm of the Triple Helix emphasizes the role of universities in the modern knowledge-based economy (Eztkowitz, 2003). According to this paradigm, universities are moving from their traditional role of research, teaching, and knowledge dissemination to an entrepreneurial one (Hayter, 2011; Marzocchi et al., 2019; Passaro et al., 2018; Schillo, 2018; Shane, 2004). The extant literature investigates the contributions of universities to innovation and competitiveness through a wide range of academic entrepreneurship activities, ranging from patenting to the creation of new firms (Culkin, 2016; Kakouris, 2016; Leitch and Harrison, 1999; Phan and Siegel, 2006; Rothaermel et al., 2007; Woolard, 2008).

In more detail, academic spin-offs (ASOs) are new firms established to exploit the results of universities' research. There have been several attempts in the literature to define ASOs. Although a universal definition does not exist, according to different scholars (Bigliardi et al., 2013; Galati et al., 2017; Mathisen and Rasmussen, 2019; Miranda et al., 2018; Pattnaik and Pandey, 2014), a number of common features are identifiable. These refer to the founders, the parent institution, their objective and their main activities. Indeed, an ASO is usually set up within the academic context by professors, researchers or Ph.D. students (Ben-Hafaïedh et al., 2018; Kolb and Wagner, 2018; Hayter et al., 2017), who may or may not be currently affiliated with the parent organization, i.e. a university or other academic institution (Bock et al., 2018; Franzoni and Lissoni, 2009). An ASO exploits knowledge created within a university or other academic institution, with the final aim of developing products or services, commercializing technology and generating profit. Consequently, the transfer of core technology from an academic institution into a new company represents its main activity.

There have been many extensive studies about ASOs and their importance for the local socio-economic development. The key areas investigated are the university (Bigliardi et al., 2015), the economic systems (Clarysse et al., 2011), or the ASO itself. As far as the latter is concerned, life cycle process (Helm and Mauroner, 2007; Vanaelst et al., 2006; Vohara et al., 2004) and growth in terms of success or performance (Bigliardi et al., 2013; François and Philippart, 2019; Jung and Kim, 2018; Mathisen and Rasmussen, 2019; Vohara et al., 2004) are the most investigated issues.

In Italy, the creation of ASOs has increased significantly in recent decades also due to a new dedicated

regulatory framework that supports technology transfer (Fini et al., 2009; Meoli and Vismara, 2016). To date, the establishment of ASOs represents a consolidated phenomenon in that country, which has attracted the interests of scholars (Iacobucci and Micozzi, 2015). Meoli and Vismara (2016) stressed that understanding the determinants of such a rapid increase in the rate of establishment of ASOs in the Italian context is of crucial importance. However, despite this interest, previous studies analyzing the Italian scenario focused on the role of environmental and institutional factors, such as the support provided by the government, university, and the local context (Fini et al., 2009; Galati et al., 2017; Horta et al., 2016; Meoli and Vismara, 2016; Rizzo, 2015). Their investigations refer to the role of a number of supporting mechanisms, such as: venture capital and direct financial support, initiatives launched by public agencies or local government, local industrial composition and economic cycles, and technology transfer offices (TTOs). On this ground, scholars are recently focusing on the investigation of new digital technologies able to develop digital spin-offs, alumni start-ups, patent applications processes, creation of digital platforms supporting entrepreneurial competences, as well as to feed up the founders' motivations (Malita, 2012; Rippa and Secundo, 2019). These technologies are expected to expand the impact and the opportunities of academic entrepreneurship in the next years (Barbieri et al., 2018; Elia et al., 2017) by reducing the barriers between invention and new venture creation (Elia et al., 2020). In a nutshell, this means that such digital solutions can motivate students, researchers and professors in launching academic spin-offs (Elia et al., 2020).

What is missing in these debates is a deeper understanding of the involvement of a key player, the university scientist (Jain et al., 2009), which represents the main gap identified in the literature dealing with the Italian scenario (and that is also poorly addressed in the international literature). Investigating the microfoundations of academic entrepreneurship could be crucial, because motivations are key to understanding the participation of Italian academic scientists in the technology commercialization process, and such motivations represent the spark and the subsequent engine of the new entrepreneurial venture activity (Lockett et al., 2005). According to Jain et al. (2009), understanding these micro-level issues influences key macro-level entrepreneurial outcomes, such as start-up formation and regional development.

Embarking into the world of technology commercialization is often a non-trivial challenge for

academics, because this involvement usually requires those individuals to alter their role identity (Jain et al., 2009). This change involves the modification of the set of activities performed by a scientist, imposes the need to face market pressures that are distant from the academic ones and, thus, to reassess the beliefs, priorities, abilities and even the view of the meaning of the academic entrepreneur's work (Pratt et al., 2006). Therefore, an examination of the evolution of motivations of academics under these circumstances, as carried out in the present study, could shed light on the drivers and the nature of these initiatives, thus offering insights to policy-makers involved in designing interactions between different stakeholders within the technology transfer context. Moreover, this issue could be very important when considering that the rapid diffusion of digital technologies that support academic entrepreneurship is likely to have a further impact on the evolution of the motivations of academics. This because such technologies can enable a further shift of the motivations of academic entrepreneurs, increasing the generation of social value through the involvement of different stakeholders, and thus contributing to the well-being of society by applying research and diffusing technologies outside the university (Fayolle and Redford, 2014; Malita, 2012).

Based on these premises, the aim of this study is to investigate the motivational factors that lead an Italian academic to establish a spin-off and to investigate whether, how and why these motivations vary over time. To do this, the study uses a combination of cognitive and psychological theories of entrepreneurship, specifically the role identity and social identity ones proposed by Gruber and MacMillan (2017), as well as the findings of the very few studies that have investigated motivations in academic entrepreneurship and their evolution over time (Hayter, 2015; Jain et al., 2009).

The main contribution of the present study, in addition to the provision of empirical knowledge to the scant and anecdotal literature existing to date, lies in the inclusion of such a theoretical perspective (Gruber and MacMillan, 2017) in the academic entrepreneurship debate. The evolutionary perspective on scientists' motivations provided by this study could lead to a better understanding of the success and survival of ASOs.

Drawing on existing works, this study first outlines the debate on entrepreneurial behavior based on identity theories, as well as what is currently known about academics' motivations. Then, after describing the objective and the methodology, survey data from a sample of Italian ASOs are

presented, which enables the investigation, both at the outset and at the present time, of scientists' motivations for engaging in technology commercialization activities and the degree to which different factors affect the evolution of their motivations. The paper concludes by summarizing and discussing the results in terms of theoretical contribution and implications for future research.

Theoretical background

Microfoundations' perspectives on academic entrepreneurship

Recent decades have witnessed a remarkable change in the disposition of universities towards commercialization activity (Jain et al., 2009; Owen-Smith, 2005;). The proliferation of studies analyzing this phenomenon, at different levels of analysis, confirms the relevance of the topic in the academic debate (e.g., Brennan and McGowan, 2006; Galati et al., 2017; George, 2005; Jain and George, 2007; Phan et al., 2005; Pattnaik and Pandey, 2014; Thursby and Thursby, 2002). A promising new stream of literature is now focusing on both the adoption of digital technologies to support different academic entrepreneurship activities, and on the analysis of new innovation opportunities offered by these tools to universities (Rippa and Secundo, 2019).

Missing from the academic conversation, especially in the Italian debate, is the understanding of the involvement of the main 'actor' in the academic entrepreneurship process: the university scientist. The investigation of the microfoundations of academic entrepreneurship stems from the fact that, contrary to teaching, engagement with industry is a discretionary choice for academics and constitutes a critical component of both universities' economic development efforts (Hayter, 2011) and their 'third mission' goals.

In his pioneering contribution, Schumpeter (1947) distinguished entrepreneurs from other individuals who are engaged in invention activities. While inventors seek new outcomes, entrepreneurs seek new profit streams. Schumpeter noted (1947: 152): "It is particularly important to distinguish the entrepreneur from the 'inventor' (…) there is no necessary connection between the two functions. The inventor produces ideas, the entrepreneur 'gets things done', which may, but need not, embody anything that is scientifically new. Moreover, an idea or scientific principle is not, by itself, of any importance for economic practice (…) 'getting new things done' is not only a distinct process, but it is

a process that produces consequences that are an essential part of capitalist reality". An academic entrepreneur performs both functions, seeking not only new outcomes through his research efforts, but also commercialization paths through spin-offs.

In agreement with Jain et al. (2009), the present study contends that focusing on scientists is crucial in order to gain a deeper understanding of academic entrepreneurship. This view originates from the studies of Zucker and Darby (1996) and of Lockett et al. (2005), who stressed that the commercialization process of universities is affected tremendously by the behavior of scientists. Consequently, understanding the cognitive and social-psychological processes of scientists who reshape their career trajectories by pursuing entrepreneurial paths should become central in the debate about ASOs.

There are several different theoretical approaches for exploring the underlying sense-making processes of university scientists engaged in commercialization activity. All are based upon the identity perspective (Gruber and MacMillan, 2017), which enables entrepreneurial behavior to be assessed differently from the traditional views embedded in economic rationality. The identity perspective claims that individuals behave in ways that they consider appropriate for themselves in a specific context, and that human beings have a fundamental need for self-definition and for finding their own place in society (Mead, 1934; Tajfel, 1972). Although the following theories have been developed independently in the psychology and sociology disciplines, scholars (Powell and Baker, 2014; 2017) have tried recently to integrate them to establish a better view of the self (Stets and Burke, 2000).

Self-determination theory was the first approach used to analyze the motivations of academic scientists to engage in technology commercialization (Lam, 2011). This framework, which derives from social psychology, emphasizes that extrinsically-motivated behavior can be transformed into intrinsically-motivated behavior as individuals internalize the values and behavior regulation associated with it in support of the psychological need for autonomy and self-determination (Hayter, 2015). Lam (2011) used this framework to classify scientists according to the degree to which they self-identify with technology commercialization goals. She used three categories: introspection (individual's internal values and behavior are not congruent), identification (individual's internal values and behavior are congruent), and integration (individual's internal values and behavior are

perfectly related). Her findings suggest that, when dealing with commercialization issues, traditional scientists are often introspective and primarily motivated by research funding and reputational benefits ('ribbon'), hybrid scientists embody identification and are mainly driven by knowledge application and intellectual interest ('puzzle'), while entrepreneurial scientists, embodying integration, are mainly motivated by money ('gold').

The second approach is social identity theory (Tajfel, 1972), which has only recently been applied to entrepreneurship research (Gruber and MacMillan, 2017). This approach extends the scope of research on entrepreneurial behavior to embrace behaviors devoted to advance the lives of others in the social space (Gruber and MacMillan, 2017). By so doing, it provides a home not only for traditional research on entrepreneurial behavior, but also for its contemporary extended conceptualization, thus including issues such as sustainable and social entrepreneurship.

The third approach, using role identity theory, focuses more on role-related behaviors of individuals, thus helping to understand the drivers of individuals, having different roles, toward the creation of new firms (Cardon et al., 2009; Stryker, 1980). The understanding of a person's role and related behaviors stems from his/her observations of others performing the specific role, as well as the personal expectations and meanings linked to the role (Stryker, 1980). According to Stets and Burke (2000), such expectations and meanings create a set of standards that drive a person's behaviors.

Gruber and MacMillan (2017) combined role identity and social identity theories after highlighting the complementary nature of them. Their work lead to a new classification of entrepreneurs based on two variables, namely social identity and role identity, which were used to predict the expected entrepreneurial behavior. They proposed three different social identities of entrepreneurs (Darwinian, Communitarian and Missionary). Darwinian entrepreneurs are characterized by focusing on 'the self' and pursuing their private, economic self-interest through the implementation of traditional business logics, and by viewing the competition as their primary frame of reference in the social space. Communitarian entrepreneurs are focused on the community. They try to support (and believe they also deserve support from) their social community by pursuing logics that embody shared norms, beliefs, and trust. Finally, Missionary entrepreneurs follow a mission-driven logic, thus focusing on society in its broader meaning. They follow a cause by embodying a strong sense of responsibility for

the world, thus deriving self-worth from behaving and acting to improve the world.

Although the classification of Gruber and MacMillan (2017) was not focused on academic entrepreneurship, including their considerations in this context could be useful to gain a deeper understanding of such phenomenon.

Why do academics become entrepreneurs? An overview of motivations

The emerging research in this context questions the primacy of the profit motive and shows that entrepreneurial rationales are multiple, interrelated, and complex (Hayter, 2011). Scholars investigating academics' motivations to engage with industry usually tend to group them according to their nature. A generally accepted classification categorizes motivations as financial (or pecuniary) and non-financial (or non-pecuniary) (e.g., D'Este and Perkmann, 2011; Friedman and Silberman, 2003).

Pecuniary motivations

The literature identifies profit maximization and growth as important (if not the most important) motivations that lead an entrepreneur to establish a company (Baumol, 2010). In other words, individuals become entrepreneurs when they see an opportunity to increase their income.

The same may happen in the academic context: an academic may create an ASO in order to pursue higher profits and generate personal payoffs (D'Este and Perkmann, 2011). A study based on Hungarian ASOs demonstrated that 90% of academics create an ASO in order to supplement their relatively low remuneration (Novotny, 2014). The expected benefits from commercialization play an important role in determining an academic's engagement in entrepreneurship (D'Este and Perkmann, 2011; Phan and Siegel, 2006;).

Besides this direct effect of financial motives, other scholars showed that monetary incentives have an indirect effect on entrepreneurial intention (Goethner et al., 2012). In addition, at many universities a royalty sharing policy exists providing financial incentives for the disclosure of inventions, thus motivating academic researchers to commercialize their ideas (Bercovitz and Feldman, 2006; Jensen and Thursby, 2001; Lowe, 2006).

Non-pecuniary motivations

Although for decades economics research assumed that entrepreneurs were solely motivated by profit, non-financial motivations have now been found to exist (Cassar, 2007; Moskowitz and Vissing-Jorsensen, 2002). This is particularly true in the academic context, as contributions suggest that academics that start working with industry are not motivated necessarily by financial and growth factors (Hayter, 2011).

In particular, D'Este and Perkmann (2011) concluded that universities should focus on non-monetary incentives in order to foster academic entrepreneurship. Specifically, confirming previous works (Baldini et al., 2007; Morales-Gualdrón et al., 2009), they argued that the motivations specific to the academic sector are regarded as more important than financial factors. In a similar way, Lam (2011) stressed that financial motivations are of secondary importance to reputational or intrinsic ones. However, Rizzo (2015) highlighted two contrasting patterns among Italian academics: a pattern whereby young academics create an ASO in order to find a job position and "*a way to escape the bottlenecks of the Italian academic system*", and an opposite pattern where senior academics create an ASO mainly to achieve monetary payoffs. Clearly, academics are not always motivated by profit when creating an ASO.

D'Este and Perkmann (2011) highlighted the role of professional development and learning in motivating academics. Specifically, with learning, they meant access to information on industry problems and industry research, and the possibility of becoming part of a network. They found that academics are also motivated by the opportunity to apply research, which in turn generates feedback from industry. Jain et al. (2009) emphasized the role of ASOs in achieving social benefits and impact, by disseminating the research results and creating jobs.

To date, the desire for freedom and independence are recognized as drivers for starting ASOs (Doutriaux and Peterman, 1982). This result is confirmed by surveys among high-technology entrepreneurs (Hessels et al., 2008; Wiklund et al., 2003). Academics view their ASO as a means to disseminate the results of their research and get new technologies out of the university (Hayter, 2015; Minshall and Wicksteed, 2007), supporting previous research defining ASOs as vehicles for

knowledge and technology diffusion (Acs et al., 2004; Audretsch et al., 2006). Related to technology diffusion, Hayter (2015) highlighted that an ASO is a way of working with the commercial world. Over time, academics learn how to avoid bureaucracy related to commercialization and technology diffusion "*without breaking the rules*".

Even if academics fear that university-industry collaborations may threaten their intellectual freedom, such interactions create new opportunities. Specifically, in addition to financial resources, other types of resources may also be obtained from industrial partners, such as information, skills or technologies (Huszár et al., 2014). Moreover, the engagement with industry provides benefits to academics, such as: accessing laboratory equipment provided by industry, materials, data for research and research resources in general (D'Este and Perkmann, 2011; Hayter, 2015; Murray, 2002). Also, the access to and expansion of knowledge are regarded as key motivations to create a company (Morales-Gualdrón et al., 2009).

There are additional studies highlighting that academics start working with industry with the objective of acquiring additional research funds, research grants and learning (Baldini et al., 2007; Fini et al., 2009).

ASOs also create employment opportunities for senior scientists, young researchers and Ph.D. students that have started their scientific careers, or students that have not yet completed their studies (Etzkowitz, 2002). Unfortunately, these individuals often cannot continue their scientific careers in academia, and thus look for other employment opportunities in their field of expertise (Rizzo, 2015).

Several studies found that being unemployed or the risk of becoming unemployed (Ritsilä and Tervo, 2002), the lack of prospects in the current job and a general dissatisfactory situation (de Silva, 2013) are all critical motivational factors that may lead an academic to establish an ASO.

Moreover, the creation of an ASO may improve the quality of an academic entrepreneur's activities, both in terms of teaching and research, thus leading to an enhancement of traditional university responsibilities (Hayter, 2015).

Other motivations are the desire to increase prestige, signal achievements and gain reputation both in the university and in the industry (Dietz and Bozemann, 2005; Göktepe-Hulten and Mahagaonkar, 2010). Indeed, academics use to participate in conferences and realize publications in order to

demonstrate their research results and to boost their reputation in the academic environment. Other contributions signaled the demand for recognition by peers as a key motivation (Meyer, 2003; Stuart and Ding, 2006).

If and why do academic entrepreneurs' motivations change over time?

Although numerous studies have investigated the motivations driving academics to create ASOs, only Hayter (2015) and Jain et al. (2009) examined also if, and why, these motivations change over time. Consequently, the analysis of the reasons that determine their evolution over time refers only to these studies. Jain et al. (2009) proposed that scientists often invoke rationales congruent with their existing role identity when they contemplate modifying it, retain cherished aspects of their extant role identity even as they alter it, and take proactive steps to ensure the preservation of their existing role identity. Consequently, they claimed that role identity modification under these conditions is akin to a morphing process, in which a switch-like shift from one role identity to another is difficult. Moreover, they suggested that a scientist's professional role identity is a hybrid, combining elements from different vocations. This implies that a hybrid role identity is negotiated, contested and dynamic in nature, particularly if there are inherent contradictions in the practices and norms of the professions (scientist and entrepreneur) being combined.

According to Hayter (2015), time, experience, and learned lessons were the most common reasons why academics' motivations have evolved, becoming less naïve when compared to the initial ones. The academics interviewed recognized that they had neither the market knowledge nor the technical and managerial capabilities required to commercialize their products and technologies. They also stressed that their parent institution and its TTO often do not provide the support or resources needed in terms of the administrative and legal knowledge required. These needs often lead to a change in ASOs' strategies and founders' motivations: for instance, academics recognized their need in terms of knowledge and capabilities, and therefore changed their focus. The same academics revealed they continued their involvement within the ASO for reasons other than money, such as public service and job creation.

Preliminary conclusions

Looking at the status quo of research, it is evident that the existing literature on the motivators of academics' entrepreneurial behavior offers fundamental insights into the phenomenon. Firstly, based on the analysis of the extant literature, it is suggested that the motivations of academic scientists to establish an ASO can be synthesized as shown in Table 1.

(Insert Table 1 here)

Five main groups of motivations emerged. The first (and most obvious) refers to financial motivations. As stressed before, an increase in personal income is a well-recognized motivational factor, which can effectively motivate individuals to participate in commercialization. Also, the seeking of intellectual property rights (IPR) falls within this group. This group of motivations is labeled 'financial'. A second group, labeled 'public service', includes motivations related to the applicability of research for social and job concerns, technology diffusion, gaining information about industry research and problems, and so on. This group falls within the social identity theory's arguments. The third group is 'community', representing motivations that refer to the creation of possibilities for the community (Ph.D. students, colleagues, firms, university) in which the scientist is involved, in line with the communitarian perspective proposed by Gruber and MacMillan (2017) based on the combination of social and role identity theories. The fourth, grounded on the role identity theory, includes the 'funding' motivations, related to expectations about accessing funding for research and all the research incomes deriving from both the government and industry, and the access to materials, equipment, research expertise and knowledge from industry. Finally, grouped into 'job enhancement', are all those motivations that refer to the improvement of a scientist's job deriving from the ASO's establishment, rooted in the self-determination and role identity arguments.

Secondly, the review of the extant literature manifested the need to improve the understanding of how and why academic scientists' motivations evolve over time. However, taking cognizance of the work of Jain et al. (2009) and Hayter (2015), the main reasons for modifying the initial set of motivations are:

- Time and experience
- Required market knowledge
- Required administrative and legal knowledge
- Required managerial knowledge
- Lack of support from the parent organization and TTO
- Financial gain
- Public service

Objective and methodology

Three aspects of the evolution of the founders' motivations were investigated: (i) the founders' initial motivations for starting the entrepreneurial activity; (ii) the founders' current motivations that lead them to continue with the entrepreneurial activity; (iii) the role played by several factors in confirming or modifying the initial set of motivations.

The investigation was carried out via a statistical survey of Italian ASOs. Italy represents a very interesting setting for this research due to the attributes of its academic system, namely: i) shortage of public and private funds to invest in research activities, ii) difficulties in starting an academic career, iii) difficulties in achieving economic, financial and professional satisfaction, iv) limited University-industry collaborative relationships, v) limited propensity towards academic entrepreneurship. Therefore, the results of this investigation of Italian academics' motivations could also help to identify the most advantageous university and public policies.

At first a web questionnaire was developed, organized into four sections (see Appendix 1). The first section was designed to acquire some background information, including the industry the ASOs belonged to. In the second section, a series of items was proposed to investigate the level of importance assigned to the motivations at the foundation of the ASOs. These items were measured using a 5-point Likert scale, where 1='not important at all' and 5='fundamental'. These are 'perceptual' measurements, being representations of what each founder considers relevant or not. The third section investigated the level of importance assigned to the same motivations, but with reference

to the present time. Again, a 5-point Likert scale was used. The same questions were asked in both the second and third sections. Finally, in the fourth section, factors affecting motivations over time were included and measured using the same 5-point Likert scale.

The intention was to propose a clear and simple questionnaire to potential respondents, so as to reduce problems ascribable to validity and reliability. To achieve this, before launching the survey, a pre-test was conducted on nineteen known academic entrepreneurs. This was to check whether or not: (i) the respondents understood fully the questionnaire, what each factor was measuring, and the Likert scales (face, content, and criterion validity), (ii) the respondents expressed similar ratings at different points in time (reliability), and (iii) the answers allowed the identification of differences (discrimination). Testing factorial validity was not important, because the factors were measured as stand-alone entities, without sub-items. According to the indications that emerged from the pre-test, the questionnaire was revised several times (by reformulating questions) to reach the final version.

The sample of ASOs was obtained from the database "http://www.spinoffricerca.it", created by the Innovation and Entrepreneurship Center of the Università Politecnica Delle Marche, NetVal and the Management Institute of Scuola Superiore Sant'Anna. To be included in the sample, an ASO had to:

- be currently active; and
- be founded between 2007 and 2011.

In other words, included in the study were all those ASOs that were currently operating and were from 5 to 10 years old. Following the approach of Hayter (2015), non-active ASOs were excluded so as to explore the motivations of academic entrepreneurs that were still trying to develop their firms. Although the inclusion of non-active ASOs in the investigation could have been of interest, it would not have been within the scope of the study. The final sample comprised 443 ASOs. The targeted respondents were the founders.

The link to the final questionnaire was then mailed to the sample, from which there were 151 replies (a response rate of 34%). The procedure of Armstrong and Overton (1977) was implemented to assess late response bias. By controlling for current size (in terms of the number of employees and turnover) and age, the t-test for each variable showed no significant difference ($p>0.1$). Figure 1 presents the main industries in which the ASOs operated.

(Insert Figure 1 here)

Data analysis and results

Data were collected between May and July 2017 and then analyzed using SPSS23.0, following the framework depicted in Figure 2.

In the first step, two cluster analyses were performed; the aim being to group the 151 ASOs into homogeneous categories of companies with regard to the five motivations proposed, both at their foundation and currently. As a result, there emerged different profiles of ASOs, and the first two objectives of the study were answered.

In the second step, a univariate ANOVA analysis was carried out aimed at understanding the role played by the seven factors that could affect motivations over time within the different clusters, investigating differences and similarities within clusters.

(Insert Figure 2 here)

Motivations at the foundation

As first, by analyzing the data collected in section 2 (concerning the establishment of ASOs), it emerged that academics ranked their motivations in order of importance (mean): Funds and resources (4.42), Job enhancement (3.81), Financial (3.78), Community (3.13), and Public service (2.57).

The same data were then subjected to a K-means cluster analysis, using squared Euclidean distance, in order to group ASOs into homogeneous categories with regard to the five motivation variables as perceived at their foundation. The number of clusters was determined following three main criteria: (i) the clusters' sizes, (ii) the plausibility of the clusters identified, and (iii) the statistical properties in terms of the relationship between within-cluster and between-cluster variance (Calinski and Harabasz, 1974). This analysis yielded two clusters, which were well-differentiated ($\alpha<0.1$), and with very high significance levels ($\alpha<0.001$) in all the five variables. Table 2 shows the centers of the final clusters.

(Insert Table 2 here)

Cluster 1 is composed of 59 ASOs and, compared with Cluster 2, is characterized by more financial, public service and job enhancement motivation. It has an unexpected characteristic, in that its ASOs were established as a result of somewhat contrary motivations. In fact, in this cluster, both the 'self' and 'other' perspectives were rated as important by the founders. This result could be explained by the fact that, at the foundation, mixed and confused motivations could emerge, because the academics are starting something that is very different from their typical job. For this reason, this cluster was given the label 'Foggy'.

Conversely, the 92 ASOs in Cluster 2 are characterized by higher motivations related to funding and access to resources for their community of students, Ph.D., and colleagues. This result seems more coherent; thus this cluster was given the label 'Improvement', for it seems that the entrepreneurial activity was mainly motivated by the need to obtain the financial, human and technical resources to improve academic research and teaching activities. There were no significant differences in terms of size or industries within the two clusters.

Age, industry and size were examined as control variables. The t-test performed on the age variable showed no significant difference ($p>0.1$). As for industry, the qualitative scrutiny performed on the frequency distribution of firms (it is not possible to implement multivariate tests, such as the chi-squared test, as frequency data are sometimes too low, according to Galati and Galati, 2019) showed a quasi-random distribution of firms belonging to different industries in the two clusters, thereby suggesting that no significant insights can be derived from it. Regarding size differences between the clusters, the t-tests performed (considering turnover and number of employees) showed no significant difference ($p>0.1$). Therefore, none of these variables seem to be able to explain the differences between clusters.

Current motivations

The same analyses were then repeated using the data collected in section 3. The means calculated for each motivation showed that the same academics rated their motivations differently. Specifically, they placed less value on Financial motivation (2.81). The means of the other motivations, in order of importance, were: Funds and resources (3.95), Job enhancement (3.38), Community (3.11), and Public service (3.01).

Subsequently, a K-means cluster analysis was carried out, using squared Euclidean distance, in order to group firms into homogeneous categories with regard to the same five motivation variables, but as perceived by the founders at the present time. The number of clusters was determined following the same criteria adopted in the previous cluster analysis. This analysis yielded three clusters, which were well-differentiated ($\alpha<0.1$), with very high significance levels ($\alpha<0.001$) in all the five variables (Table 3).

(Insert Table 3 here)

Cluster 1 is composed of 50 ASOs and is characterized by the highest level of Public service and Job enhancement motivations. Founders of ASOs included in this group seem to be currently motivated by the desire to contribute to their well-being and to the well-being of society. For these reasons, it was given the label 'Well-being oriented'. Cluster 2 is composed of 68 ASOs characterized by very low financial and public service motivations but highly oriented toward funding and access to resources. Thus, it was labeled 'Community-oriented'. Finally, Cluster 3, labeled as 'Market-oriented', is composed of 33 ASOs. Founders of these ASOs are currently motivated only by financial gain, devoting very low attention to issues like access to resources and job enhancement.

As for control variables, no significant differences were observed in terms of age or industries within the three clusters. In fact, the ANOVA performed on the age variable showed no significant difference ($p>0.1$), and the qualitative scrutiny performed on frequency distributions of firms with reference to the industry variable denoted the absence of significant variations in clusters configuration. Size of the ASOs was also used as a control. However, the ANOVA analyses implemented (considering turnover

and number of employees) showed no significant difference ($p>0.1$). Therefore, none of these variables seem to be useful to explain differences between clusters.

Evolution of motivations

Changes occurring

The cluster analyses enabled the tracking of how the founders of the ASOs belonging to the initial two clusters modified their motivations and shaped the current three clusters, thus showing how motivations have evolved over time. Figure 3 describes this evolution.

(Insert Figure 3 here)

Figure 3 shows the clusters obtained as a result of the first and of the second cluster analyses, on the left and on the right side, respectively. The arrows show how and how many ASOs belonging to the Foggy or Improvement clusters have moved into the Well-being oriented, Community-oriented and Market-oriented final clusters. For example, of the 59 ASOs labeled as Foggy at their foundation, 24 have become Well-being oriented, 5 Community-oriented and 30 Market-oriented. Figure 3 also shows the original cluster of the ASOs in each of the three final clusters (as discussed below).

Two main issues arise. The first is that, at the foundation, motivations were more homogeneous (two clusters were identified instead of three). Thus, some factors have affected the motivations of the founders over time. The second refers to the number of ASOs that moved from the initial two clusters to the final three clusters. 30 (91%) of the 33 Market-oriented ASOs belonged originally to the Foggy cluster, while only 3 (9%) were founded as Improvement ASOs. In contrast, 63 (93%) of the 68 ASOs belonging to the final Community-oriented cluster derive from the initial Improvement cluster. Finally, of the 50 ASOs in the Well-being oriented cluster, 24 (48%) were originally Foggy ASOs, and the other 26 (52%) were Improvement ASOs.

This should imply that scientists who started their entrepreneurial journey motivated by the desire to improve both their community and access to funds and resources (belonging to the Improvement

cluster) seem to preserve such motivations over time. It seems that these scientists, which represent the majority in the cluster, have clear goals from the beginning and their motivations remain stable. Only a portion of scientists belonging to the Improvement cluster at the foundation experienced a variation in their motivations such that they entered the Well-being oriented cluster. This, combined with the fact that only 3 ASOs included in the Market-oriented cluster derive from the Improvement one, implies that starting an ASO without having a market orientation will rarely result in commercial motivation. Conversely, the fact that 30 out of the 33 ASOs included in the Market-oriented cluster derive from the Fuzzy one implies that, despite puzzling motivations, starting an entrepreneurial journey with the desire to achieve outputs for both personal interests, and for society as a whole, could lead to market-oriented ASOs.

ANOVA with Post-Hoc tests

As previously stated, academics gave different evaluations for their motivations at the foundation and after some years, thus suggesting that motivations have somehow evolved. The mean values assigned to each motivation are depicted in Figure 4, from which it seen that Financial, Funds and resources and Job enhancement are valued lower when compared to the foundation, while Public service becomes more important. The importance of Community as a motivator changed very little over time.

(Insert Figure 4 here)

Finally, a one-way ANOVA (Tables 4 and 5) with post hoc tests was carried out in order to determine whether or not there were differences within clusters in terms of the factors that had affected motivations over time. These analyses were intended to identify either a confirmation or an evolution of the original motivations, based on data collected by section 4 of the questionnaire.

Table 4 shows the level of importance as attached to the factors that lead the founders to change (or not) their motivations to continue the ASO, in comparison to the motivations that lead them to create the ASO. Table 4 also shows that more importance was given to the factors Time and experience, Required market knowledge, and Financial gain.

Specifically, the results demonstrate that the main reasons for the evolution of motivations for Well-being oriented ASOs were, in order of importance, Public service and the Lack of support from the parent organization and TTO. The founders of Community-oriented ASOs ascribed higher values to Time and experience and Required market knowledge (equally important), as well as to the Required administrative and legal knowledge. Finally, the founders of ASOs that moved into the Market-oriented cluster were mainly influenced by Financial gain and Time and experience.

Furthermore, Table 5 shows significant differences ($\alpha<0,01$) within clusters in terms of Required market knowledge, Lack of support from the parent organization and TTO, and Public service. This necessitated an additional test to verify the differences within each cluster. The post hoc procedures selected were the Bonferroni and Hochberg's (GT2), given the different sample sizes of the three clusters, together with the Games-Howell procedure because of the uncertainty of knowing whether the population variance is equivalent (Field, 2005). The post hoc tests revealed significant differences within each cluster regarding the three above-mentioned dependent variables, but also highlighted fine-grained similarities.

(Insert Table 4 here)

(Insert Table 5 here)

Discussion and conclusions

The present study focused on entrepreneurial action, self-reported motivations, and how motivations evolve over time, topics which had not been addressed previously in the academic literature dealing with the establishment of ASOs in Italy. Starting from the classification of the proposed motivational factors, this research firstly investigated the motivational factors that formed the basis of entrepreneurial intention.

Although the respondents valued many motivations as important, the results highlighted that the most important motivations were Funds and resources and Job Enhancement. In other words, at the foundation, Italian academics were mainly motivated to create ASOs by the search for research funding, due to the funding constraints of the academic environment, as well as to create job

opportunities, mainly due to the difficulties for young scientists in finding a permanent position within the academic environment. Profit and commercialization were important, but were not the main motivators. Those interviewed were divided into two different groups (Foggy and Improvement), according to the importance assigned to the various motivational factors at the foundation. In general, the founders of Foggy ASOs valued all the motivations higher than did the founders of Improvement ones, the exceptions being the access to resources and access to funds (these were the least important motivations). In particular, the prospects of higher-income played an important role in establishing an ASO, also for the necessity to supplement university salary and to achieve an acceptable quality of life. These ASOs were also established in order to increase employment, by creating jobs for academics and researchers or students. This group of academics paid more attention to the problem of the 'academic bottleneck' and recognized that ASOs offered opportunities for hiring young researchers even if, to a lesser extent, Foggy ASOs were also seen as a way to contribute to the well-being of society. Conversely, Improvement ASOs were established because of the need to gain access to funds for their research activities, or to access resources that their founders could not find within the university. Indeed, the founders of these ASOs recognized that collaboration with industry may provide benefits to their research activities, by establishing relationships with others external to the university, securing funds for graduate students, and allowing access to laboratory equipment.

The investigation of if, and how, these motivations changed over time confirmed that motivations evolved over the years. In particular, while the financial aspects became less important, over time academics recognized that other issues were of higher importance. This result appears to be in line with other studies that highlight the shift of the traditional motivations behind academics from pure economic value to social and democratic ones generated through the involvement of further university stakeholders (e.g. PhD students, graduates, researchers etc.) (Fayolle and Redford, 2014; Rippa and Secundo, 2019). Motivations at the foundation were relatively homogeneous (only two groups of ASOs), but over time academics differentiated their motivations. While a group of academics continued to be interested in financial gain (even if it did not represent an end in itself), thus continuing their activity to derive personal pay-offs from the commercialization of their knowledge and technologies, two further groups of ASOs emerged. The Well-being oriented group viewed an

ASO as a means of employing students and graduates, of mitigating the challenge of finding an academic job, and as a way of contributing to the well-being of society by applying research and diffusing technology outside of the university. Finally, the third group of ASOs emerged, characterized by low financial motivations but highly oriented toward funding and access to resources.

The analyses also allowed an understanding of why academic entrepreneurs' motivations changed over time. Time and experience were the most common responses. Over time, academics recognized that they did not have the market knowledge (and to a lesser extent the managerial skills) required to commercialize their inventions and develop their ASO. In contrast with Hayter (2015), this study highlighted that financial gain remained a critical motivation for academics to continue their entrepreneurial activity. The less important reasons for the change of motivations were public service, the ineffectiveness of connections with TTOs in terms of support, and the lack of administrative and legal knowledge. In addition, motivations changed according to the characteristics of each group of ASOs. The founders of ASOs that moved towards the Well-being oriented group were mainly led by public service and the lack of support from the parent organization and TTO, while those that moved towards the Community-oriented group were more motivated by the experience acquired and the lack of market and administrative knowledge. Finally, the founders of ASOs that became Market-oriented were mainly influenced by financial gain and the required market knowledge.

This research found no significant effect of other variables, i.e. age, industry, and size, in explaining differences between clusters. This may be due to the preliminary nature of the study and the lack of an adequate sample to effectively analyze the role of the industry. However, the results show a quite heterogeneous distribution of ASOs within the clusters with reference to these variables, thereby suggesting a limited correlation of age, industry, and size with motivations and their evolution over time. This seems to support the microfoundation perspective on which the study is grounded, thereby reinforcing the idea that the focus of these kinds of analyses should be mainly on the individual academic.

Theoretical contribution

Firstly, this study contributes to the literature dealing with Italian ASOs by investigating the microfoundations of academic entrepreneurship. This could be crucial, because motivations are key to understanding the participation of Italian academic scientists in the technology commercialization process. The study takes a different approach compared to the previous ones that analyzed the Italian scenario by focusing on the role of environmental and institutional factors on the establishment of ASOs (Fini et al., 2009; Galati et al., 2017; Horta et al., 2016; Meoli and Vismara, 2016; Rizzo, 2015). The identification of distinct clusters with reference to the motivations of scientists engaged in commercial activities supports the results of Lam (2011), who claimed that there is no one single type of entrepreneurial scientist driven by a common motive.

The present study also helps to move beyond the traditional profit-oriented and self-centered stereotype of academic entrepreneurs, thus contributing to fill the gap, identified by Gruber and MacMillan (2017), concerning the lack of empirically grounded understanding of the most important role identities in entrepreneurship. In accordance with their theoretical reconceptualization, which distinguishes Darwinian, Communitarian, and Missionary entrepreneurs, the findings of this study suggest the existence of clusters of similar founders of ASOs, i.e. academic entrepreneurs. It is inferred that the three clusters that emerged when investigating the current motivations of academic entrepreneurs can be easily associated with the trichotomy. In fact, Cluster 1, labeled as Well-being oriented and characterized by the highest level of Public service and Job enhancement motivations, can be considered similar to the social identity or archetype of the Missionary entrepreneur, who pursues a missionary logic that embodies a strong sense of responsibility for the world by acting to improve the well-being of society. Cluster 2 (‘Community-oriented’) is similar to the archetype of the Communitarian entrepreneur, because he wants to support his social community through funding and access to resources, which for scientists is represented primarily by Ph.D. students and colleagues. Cluster 3 (‘Market-oriented’) is close to the Darwinian entrepreneur social identity, as the focus is on his private and economic self-interest, somehow similar also to the ’gold’ archetype suggested by Lam (2011).

However, the results demonstrate the existence of these three categories of entrepreneurs not at the

foundation, but only after some years. In fact, a fuzzy situation appears at the foundation. Academic entrepreneurs seem to be confused about the motivations that drive their decision to establish the ASO, as confirmed by the existence of only two clusters, one of which (Foggy) includes 'hybrid' motivations ascribable to both selfish and altruistic perspectives. Conversely, after some years, academic entrepreneurs' motivations seem to be affected by several variables, such as time, experience, and lack of required market and managerial knowledge. These variables influence academic entrepreneurs' social identity and, therefore, their motivations to go on with the ASO. In other words, these variables 'scatter the shadows' of academic entrepreneurs' motivations, shaping their own motivations as a result of the match between the initial set of motivations and reality. According to this perspective, which confirms that proposed by Hayter (2015), it is possible that a confused and somehow naïve scientist (in terms of motivations), who aims to establishing a venture based on his research outcomes, becomes less naïve after facing not only real managerial and market issues, but also real and positive applications of his research on society. This finding also supports the results of Lam (2011), who stressed that motivations and behaviors are not fixed, but may evolve over time due to orientational shifts.

Furthermore, the identification of the cluster labeled as Foggy seems to confirm the effectuation approach to entrepreneurship developed by Sarasvathy (2001). This approach was established in opposition to the causal one, which presumes the need for a targeted search, in which the entrepreneur should begin by setting a specific goal, and then trying to gather all the means needed to reach his goal (Drucker, 1998). Conversely, the effectual approach assumes that the only requirement for the entrepreneur is to have an idea, a spark, and to develop this idea with the available resources and according to what happens over time. Following these lines, the presumption is that the absence of a precise goal could have an impact on motivations to establish an ASO, positing that the lack of a clear goal can be related to a lack of clear motivations. This is because, as suggested by Locke and Latham (2002), goals direct attention and effort toward goal-relevant activities, having a strong motivational effect, while the lack of a precise direction could lead people to take action without being fully aware of what is motivating them. This suggests that the 'Foggy' cluster could include those entrepreneurs who followed this approach at the foundation.

It is concluded that these results could be of importance for scholars, because they could represent a further step towards a better understanding of the cognitive and social-psychological processes associated with scientists reshaping their career trajectories and pursuing entrepreneurial paths. From this viewpoint, it can be supposed that the adoption of digital technologies in supporting academic entrepreneurship activities is likely to have a significant further impact on the evolution of academic motivations, moving them towards a wider social and democratic value generated through the involvement of more university stakeholders (Rippa and Secundo, 2019).

Implications for policy-makers

The identity perspective adopted could help policy-makers to understand what motivates academic entrepreneurs. In general, this study confirms what has been stressed in the literature with reference to the role of pecuniary motivations. The analyses demonstrated the importance of pecuniary motivations, but also identified several non-pecuniary ones. Consequently, incentives should be devoted not only to provide financial support, but also to other issues. In more detail, according to the existence of different clusters, it is suggested that policy-makers should consider the possibility of further stimulating academic entrepreneurship by following two main avenues.

Firstly, the existence of a cluster focused on the market should force policy-makers and administrators to improve TTOs' capabilities and resources, thus making them key commercialization partners. Some scholars (Bigliardi et al., 2015) stressed that Italian TTOs seem to be not ready to support commercialization activities, thus calling for more efforts and attention towards these institutions. This is because they could serve as effective intermediaries between the ASO and other stakeholders (i.e. funds, banks, customers, other firms, etc.). In addition, an improvement in terms of access to funds, deriving from effective TTOs, would also have an impact on the motivations of entrepreneurs belonging to the cluster labeled as 'Community Oriented', which could expand their community.

Secondly, the existence of the Foggy and Well-being oriented clusters suggests the need for acknowledging entrepreneurial efforts at an academic level. Entrepreneurial activity imposes extra burdens on scientists, reducing the amount of time available for research. Given that an academic career is largely focused on research, and that the majority of commercially active academics prefer to

accord priority to their academic role (Jain et al., 2009), it can be argued that entrepreneurship can be considered, to some extent, a brake on academic research. Conversely, if academia would somehow acknowledge the importance of ASOs for scientists' careers, academics may be better motivated to act also as entrepreneurs. In Italy, this issue has started to be considered in recent years, but further progress is needed. Reinforcing the importance of entrepreneurship activities in an academic career could also have a strong effect on scientists' goal settings before the foundation of the ASO, and thus on scientists' motivations (Locke and Latham, 2002), thereby stimulating the creation of ASOs and regional growth.

Limitations of the study

This paper has several limitations. The first relates to the sample: only Italian ASOs were investigated, and so the same study should be replicated in different countries. Indeed, as highlighted by Chiesa and Piccaluga (2000), the context in which the phenomenon is investigated may influence the results. Italy, for example, shows a lower number of ASOs when compared to other countries, due to the high level of risk aversion of Italian academics to create ASOs, which influences their motivations. Also the perceptual nature of the analysis represents a limitation. Furthermore, controlling only for size, industry, and age, and not for the context in which the ASOs operate, limits the ability to infer about the role of additional factors in the debate.

Another limitation is that this study considered only motivations and factors that affect their evolution, without including the effects of motivations on performance. For example, how the evolution of motivations affects the growth of ASOs was not investigated. Although this was not the aim of the study, it could be of interest to investigate whether there is a correlation between motivations and output variables, which calls for further research.

Non-active ASOs were excluded from the analyses in order to remove the risk of introducing a survival bias. Consequently, investigating the motivations of currently active ASOs provided only a partial representation of the entire 'picture', because nothing can then be inferred about how and why the motivations of the founders of ceased ASOs began and evolved.

Finally, the respondents were asked to report past events, which could lead to the so-called

retrospective bias in the data analysis. Check items in the questionnaire were used to verify the reliability of the collected data and to minimize such bias.

Future research

Future research should try to overcome these limitations. Specifically, it should investigate the potential relationship between the context in which scientists operate and their motivations. The context comprises variables such as the university and its commercial orientation, the existence of digital technologies for supporting academic entrepreneurship, the local features, the industrial environment and the public support in terms of regional funding. These variables could affect scientists sense making and motivations, thus future research is needed in this direction.

Moreover, linking motivations with firms' performances could be a further avenue for scholars. This study identified distinct clusters, both at the foundation and after some years. Firstly, it could be of interest to understand whether the initial motivations of scientists could improve or hinder their commercial success after some years. In addition, it would be interesting to investigate whether or not the evolution of motivations that take place over time could be considered to be an antecedent of commercial success. It is recommended that the focus of these studies should be on factors that trigger successful outputs, which could be only a part of those investigated in the present study that focused only on motivations.

Also, exploring how, and why, the motivations the founders of ceased ASOs began and evolved could shed further light on this complex debate. It is probable that the motivations of scientists who have decided to terminate an ASO are quite different from those who are continuing their commercialization efforts. However, it is felt that this investigation deserves a different perspective, from which it would be possible to comprehend whether the decision to end the ASO could derive from a shift in motivations and commitment or from the effect of several contextual factors.

Finally, future research should focus on the impact of digital technologies on the evolutionary path of academic motivations, and on the established forms of academic entrepreneurship. These technologies will undoubtedly have a noteworthy impact on motivations, because they could instigate several challenges that need to be faced in starting and developing a commercial activity.

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Appendix 1. The questionnaire (short version)

Section 1. General information

Please provide the following information about the spin-off:

Number of employees: _____

Turnover: _____

Sector: _____

Section 2. Motivations at the foundation

Please rate how important were the following motivations before establishing the spin-off, where 1=not important at all and 5=fundamental.

Motivation	**Brief explanation**	**Rating**
Financial	I want to establish the spin-off to gain money and integrate my low remuneration.	1-5
Public service	I want to establish the spin-off to help the society to grow, by bringing research onto the market and create market opportunities.	1-5
Community	I want to establish the spin-off to find a job and provide resources to my peers.	1-5
Funds and resources	I want to establish the spin-off to obtain access to funds, resources, and knowledge, avoiding bureaucracy.	1-5
Job enhancement	I want to establish the spin-off to improve the quality of my teaching and research activities, increase the prestige and gain reputation.	1-5

Section 3. Current motivations

Please rate how important are, today, the following motivations for enduring the spin-off activity, where 1=not important at all and 5=fundamental.

Motivation	**Brief explanation**	**Rating**
Financial	I want to gain money and integrate my low remuneration.	1-5
Public service	I want to help the society to grow, by bringing research onto the market and create market opportunities.	1-5
Community	I want to find a job and provide resources to my peers.	1-5
Funds and resources	I want to obtain access to funds, resources, and knowledge, avoiding bureaucracy.	1-5
Job enhancement	I want to improve the quality of my teaching and research activities, increase the prestige and gain reputation.	1-5

Section 4. Reasons for modifying the initial set of motivations

Please rate how important were the following reasons in modifying the initial set of motivations (those indicated in Section 2-before establishing the spin-off), where 1=not important at all and 5=fundamental.

Reason	Brief explanation	Rating
Time and experience	Time and experience acquired during these years of spin-off activities modified my initial set of motivations.	1-5
Required market knowledge	The level of market knowledge required for managing the spin-off was high and modified my initial set of motivations.	1-5
Required administrative and legal knowledge	The level of administrative and legal knowledge required for managing the spin-off was high and modified my initial set of motivations.	1-5
Required managerial knowledge	The level of managerial knowledge required for managing the spin-off was high and modified my initial set of motivations.	1-5
Lack of support from parent organization and TTO	The experienced lack of support from my university and TTO modified my initial set of motivations.	1-5
Financial gain	The level of financial gain achieved modified my initial set of motivations.	1-5
Public service	The potential well-being that my spin-off could provide to society modified my initial set of motivations.	1-5

Table 1. Summary of motivations discussed in the literature.

Motivation	References
Financial	Bercovitz and Feldman, 2006; Jensen and Thursby, 2001; Lowe, 2006; Egeln et al., 2003; Phan and Siegel, 2006; Baumol, 2010; Hayter, 2011; D'Este and Perkmann, 2011; Novotny, 2014
Public service	Hayter, 2015; Minshall and Wicksteed, 2007; Jain et al., 2009; D'Este and Perkmann, 2011; Hayter, 2015
Community	Etzkowitz, 2002;Hessels et al., 2008;Wiklund et al., 2003; Rizzo, 2015
Funds and resources	Baldini et al., 2007; Fini et al., 2009;Huszár et al., 2014; D'Este and Perkmann, 2011; Hayter, 2015; Murray, 2002; Morales-Gualdrón et al., 2009
Job enhancement	Ritsilä and Tervo, 2002; de Silva, 2013; Dietz and Bozemann, 2005; Göktepe-Hulten and Mahagaonkar, 2010; Meyer, 2003; Stuart and Ding, 2006

Table 2. Final clusters centers (motivations at the foundation), distribution of firms within the two clusters and t-tests on control variables.

	Clusters		
Motivations	**Foggy**	**Improvement**	
Financial	4.47	3.34	
Public service	3.90	1.72	
Community	1.92	3.91	
Funds and resources	4.10	4.62	
Job enhancement	4.39	3.45	
Industry	# of spin-offs	# of spin-offs	
ICT	11	22	
Electronics	14	12	
Biotech	10	13	
Medicine	4	12	
Civil Eng. and Archit.	5	10	
Agri-food	3	8	
Energy	2	5	
Others	10	10	
Tot.	59	92	
T-tests on control variables			
Age			**t-test** (Sig.)
Mean	7,814	7,739	0,981
Std. Dev.	1,559	1,398	
Size (turnover)			
Mean	316847	289641	0,746
Std. Dev.	197917	159583	
Size (number of employees)			
Mean	9,915	8,533	0,409
Std. Dev.	8,059	5,145	

Table 3. Final clusters centers (current motivations), distribution of firms within the three clusters and ANOVA on control variables.

	Clusters				
Motivations	**Well-being oriented**	**Community-oriented**	**Market-oriented**		
Financial	3.22	1.66	4.55		
Public	4.42	2.00	2.94		
Community	2.28	4.54	1.42		
Funds and resources	3.82	4.59	2.82		
Job enhancement	4.56	3.36	1.61		
Industry	# of spin-offs	# of spin-offs	# of spin-offs		
ICT	9	16	8		
Electronics	5	12	9		
Biotech	7	13	3		
Medicine	6	8	2		
Civil Eng. and Archit.	9	4	2		
Agri-food	4	5	2		
Energy	2	1	4		
Others	8	9	3		
Tot.	50	68	33		
ANOVA on control variables				**ANOVA**	
Age				**F**	**(Sig.)**
Mean	7,780	7,779	7,727	0,016	0,984
Std. Dev.	1,360	1,495	1,567		
Size (turnover)					
Mean	299840	294691	312424	0,112	0,894
Std. Dev.	157543	181394	192702		
Size (number of employees)					
Mean	8,500	9,265	9,545	0,313	0,732
Std. Dev.	7,584	5,640	6,295		

Table 4. Descriptive statistics-factors affecting the evolution of motivations.

Reasons		*Mean*	*Std. error*
Time_and_experience	1	4.300	0.065
	2	4.500	0.061
	3	4.394	0.086
	Total	*4.411*	*0.040*
Required_market_knowledge	1	4.220	0.104
	2	4.500	0.061
	3	4.121	0.095
	Total	*4.324*	*0.050*
Required_administrative_and_legal_knowledge	1	3.020	0.101
	2	3.059	0.086
	3	3.000	0.123
	Total	*3.033*	*0.057*
Required_managerial_knowledge	1	3.420	0.107
	2	3.368	0.086
	3	3.454	0.138
	Total	*3.404*	*0.060*
Lack_of_support_from_parent_organization_and_TTO	1	4.060	0.112
	2	2.397	0.141
	3	3.121	0.178
	Total	*3.106*	*0.102*
Financial_gain	1	4.140	0.081
	2	4.162	0.097
	3	4.212	0.121
	Total	*4.166*	*0.058*
Public_service	1	4.280	0.118
	2	2.426	0.169
	3	2.879	0.203
	Total	*3.139*	*0.117*

Table 5. One-way ANOVA on factors affecting the evolution of motivations

Reasons		***Sum of squares***	***Df***	***Mean square***	***F***	***Sig.***
Time_and_experience	Between groups	1.164	2	0.582	2.435	0.091
	Within groups	35.379	148	0.239		
	Total	*36.543*	*150*			
Required_market_knowledge	Between groups	4.004	2	2.002	5.581	0.005
	Within groups	53.095	148	0.359		
	Total	*57.099*	*150*			
Required_administrative_and_ legal_knowledge	Between groups	0.090	2	0.045	0.089	0.915
	Within groups	74.745	148	0.505		
	Total	*74.834*	*150*			
Required_managerial_knowle dge	Between groups	0.187	2	0.093	0.168	0.845
	Within groups	82.171	148	0.555		
	Total	*82.358*	*150*			
Lack_of_support_from_parent _organization_and_TTO	Between groups	79.690	2	39.845	38.140	0.000
	Within groups	154.615	148	1.045		
	Total	*234.305*	*150*			
Financial_gain	Between groups	0.105	2	0.053	0.104	0.901
	Within groups	74.756	148	0.505		
	Total	*74.861*	*150*			
Public_service	Between groups	101.852	2	50.926	36.196	0.000
	Within groups	208.228	148	1.407		
	Total	*310.079*	*150*			

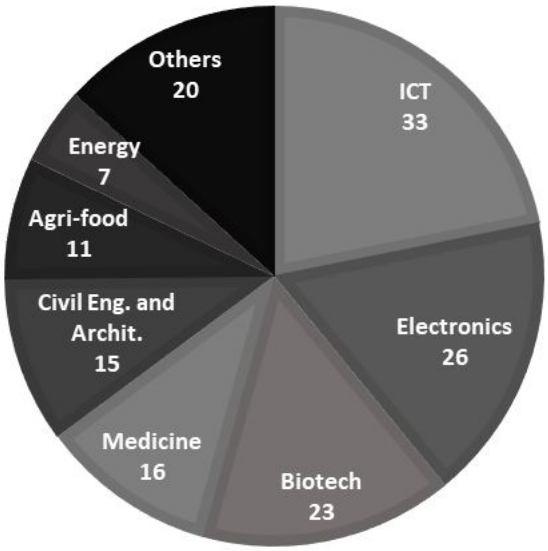

Figure 1. Number of ASOs for each industry.

step 1	*objective (i):* to investigate the founders' initial motivations for starting the entrepreneurial activity *objective (ii):* to investigate the founders' current motivations that lead him to go on with the entrepreneurial activity
	method: cluster analysis
step 2	*objective (iii):* to understand the role played by several factors in confirming or modifying the initial set of motivations during the time
	method: one-way ANOVA with post-hoc tests

Figure 2. The two-step framework.

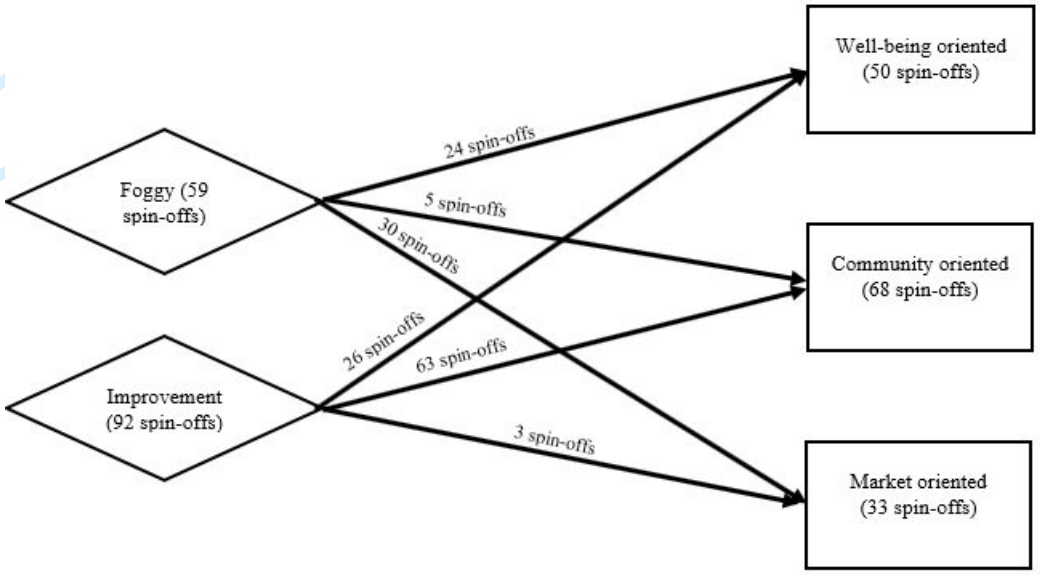

Figure 3. Evolution of ASOs founders' motivations.

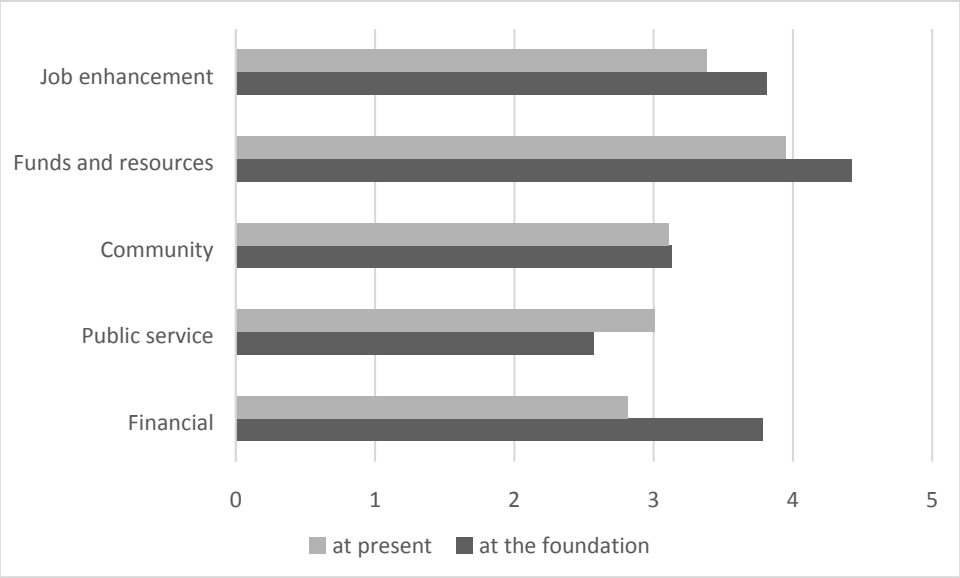

Figure 4. Motivations towards entrepreneurship.