Born to be successful: start-up patenting activity determinants

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Abstract: Patenting is fundamental to start-up survival and growth. Research indicates that patenting enables start-ups to protect their ideas from competitors, profit from their inventions, and signal their value to stakeholders. Drawing on the resource-based theory, the paper shows that start-ups' patenting activity is related to both external and internal conditions. Relying on a sample consisting of 195 start-ups, located in Italy and France, the market scenario, that is, market dynamism and concentration, is found to affect start-ups' patenting activity. Also, the paper shows that start-ups' age is negatively related to patenting, and that entrepreneur narcissism has different impacts based on its prevailing characteristics: entitlement/exploitativeness is positively related to patenting, grandiose exhibitionism is negatively related to it, while leadership/authority shows no connection with this activity.

Keywords: start-up patenting activity; market scenarios; start-up age; entrepreneur narcissism.

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"A start-up is a company working to solve a problem where the solution is not obvious, and success is not guaranteed." Blumenthal (2013), co-founder and co-CEO of Warby Parker

1 Introduction

Start-ups offer new products or services by applying modern technologies, or rethinking old products and services to produce different and more effective solutions (Talaulicar et al., 2005; Tzabbar and Margolis, 2017). To grow and survive, start-ups are required to make strategic decisions involving significant investment in innovative activities (Talaulicar et al., 2005). Research underlines the importance of innovation to start-ups (Rosenbusch et al., 2011; Song et al., 2008), suggesting that its beneficial effects lie in the improvement of new venture efficiency and effectiveness as well as the increase in industry competition (Criscuolo et al., 2012; Dahlqvist and Wiklund, 2012; Sazvar and Yahyazadehfar, 2019).

Patenting is of crucial importance to innovation and has several advantages for start-ups (Helmers and Rogers, 2011; Holgersson, 2013). Patent applications have been on an upward trajectory since 2003, and globally 3.17 million patent applications were filed with patent offices worldwide during 2017 (WIPO, 2018). China's National Intellectual Property Office (CNIPA) received 1.38 million patent applications in 2017. The European Patent Office (EPO) has seen small but stable growth since the early 1980s.

This growth in patent applications is vital to innovation since it means there are more inventions which could come to market, contributing to the economic growth and improving peoples' lives (EPO, 2018).

The basic condition which enables technological development is a system for the protection of intangible assets (Levine and Sichelman, 2019). Start-ups use patents to protect their ideas from competitors and to secure freedom to operate in the market (Blind et al., 2006). Patenting enables the start-up to profit from its inventions and protects its competitive advantage (Helmers and Rogers, 2011). In addition, patent ownership positively affects investors' start-up evaluation by providing a strong signal of its potential (Hsu and Ziedonis, 2008).

However, patenting represents a large expense for start-ups. The cost of obtaining a patent, will depend on the technology, patent prosecutor, and claims, but it can range from $10,000 to $50,000, and maintenance fees in the USA alone can amount to roughly $3,000 to $13,000, conditional on how large the firm is over the life of the patent (Levine

and Sichelman, 2019). Patent litigation is also expensive for start-ups. The costs associated with patent litigation vary significantly between jurisdictions. For example, in France, cost estimates for each party range between USD 60,000 and USD 250,000 (WIPO, 2018).

When dealing with patent challenges can be prohibitive, start-ups could use trade secret protection. Trade secrecy concerns a range of information, including software, code, algorithms, and other technical information. Trade secret protection does not require an attorney to ensure security or filing fees. It is especially useful for incremental innovation among start-ups, where the value of the innovation may be relatively trivial, and it takes time to assess whether more expensive protection, such as patenting, is necessary (Levine and Sichelman, 2019). Accordingly, keeping information from being disclosed is an important reason for start-ups to use trade secrecy, especially if the trade secret is the firm's only asset (Olander et al., 2009). Of course, the damage to a start-up from losing valuable trade secrets to competitors can be profound (Carlson, 2017). Thus, start-ups must invest in robust protection programs.

Most of the previous works on start-up performance focus on either the internal or external conditions that influence patenting behaviour, but do not provide a comprehensive understanding of the phenomenon (Sine et al., 2006). In the present, a model that investigates the influence of internal and external factors on start-up patenting is developed. In particular, it is explored how market scenarios, start-up age, and entrepreneurs' narcissism impact on start-up patenting activity. It has been decided to focus on these factors because market scenarios (i.e., market concentration and market dynamism) are responsible for the competitiveness inside industries and they impact on patenting choice (De Vries et al., 2017). Start-ups' age enables to shed light on patenting dynamics during the start-up life cycle since the innovations introduced by entrants during their first phase can affect start-ups' patenting behaviour in more advanced stages (Huergo and Jaumandreu, 2004). Finally, entrepreneurs' personality traits impact on the performance (Abdullah et al., 2018) and in particular on the start-up patenting activity. Entrepreneurs are defined as individuals who are the most influential members (i.e., decision-makers) in a firm, thus encompassing the founder and/or principal owner. Personality traits are individual behaviour characteristics that explain the different actions taken by people in similar situations and suggest why some entrepreneurs are more successful than others (Leonelli et al., 2016). Focus is made on entrepreneur narcissism because narcissism is a prevalent trait in leadership positions and it is perceived by others as being effective and influential (Engelen et al., 2016; Judge and LePine, 2007). Moreover, the strategic choices made by narcissistic CEOs differ systematically from those made by their non-narcissistic counterparts (Chatterjee and Hambrick, 2007). Narcissists can be described as individuals who are arrogant, haughty, grandiose, superior, and authoritarian (Campbell et al., 2004; Wales et al., 2013). They expect special treatment and admiration and tend to overestimate their abilities (Maccoby, 2003; Rosenthal and Pittinsky, 2006).

The present study builds on the resource-based theory, which points to strategic resource (i.e., tangible and intangible) ownership and competencies as crucial features for firms to develop competitive advantage (Grant, 1991). Empirically, this study relies on a sample consisting of 195 Italian and French start-up ventures founded between 2009 and 2015. The results suggest that market scenario, start-up age, and entrepreneur narcissism significantly affect patent possession.

A higher level of market concentration and market dynamism is found to increase the propensity to patent, start-up older age decreases such inclination, and entrepreneur personality has controversial results.

This work contributes to patenting literature by providing a more comprehensive vision of start-up patenting determinants (Helmers and Rogers, 2011). It is believed that a comprehensive vision compared to a single factor study, offers a completer and more universal visualisation. Moreover, the results shed light on the direct effects entrepreneur personality has on patent propensity meeting the request made by Kato et al. (2015) about the need for more studies in this field.

The remainder of the paper is organised as follows. The following section reviews the related literature and presents some testable hypotheses. Section 3 describes the data and variables used in the analysis. Section 4 presents the empirical methods and results, and the final section includes some concluding remarks.

2 Theoretical background and hypotheses

2.1 External determinants of start-up patenting activity

The need to understand external drivers of innovation is important in many different industries, such as consumer electronics, automobiles, and software (Turner et al., 2010). An important issue in economics is how market structure affects innovation (Gayle, 2001; Schumpeter, 1950).

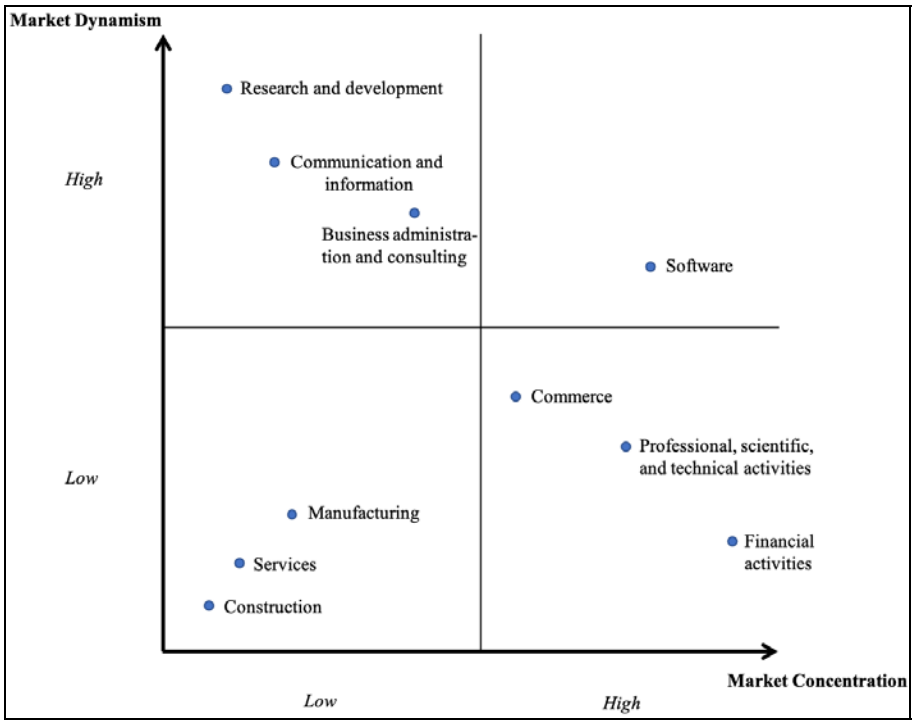
The type of competition in the market where new ventures operate has a significant impact on their propensity to patent (Blazsek and Escribano, 2016; De Vries et al., 2017). However, existing literature revealed an inconclusiveness of the relationship between market structure and innovative activity (Gayle, 2001; Kamien and Schwartz, 1982).

In growing or emerging markets, resources are plentiful and mistakes are not as costly as in less productive environments where disparities in market access can hinder small firms from competing against larger companies (Im et al., 2015). Therefore, the focus is on two key characteristics related to markets: market concentration and market dynamism.

Market concentration refers to the degree of competition in a market (Miller, 1987). The more concentrated an industry, the larger the share of production being consolidated in the hands of a smaller set of firms (Turner et al., 2010). In highly concentrated markets there are fewer price wars, less competition, higher market power, and higher barriers to market entry (Bamiatzi et al., 2016). Economic arguments suggest alternative views on concentration and innovation. Schumpeter (1950) claims that imperfectly competitive markets promote a rapid technical progress. He posits that more concentrated industries are more conducive for innovation. Scholars in the Schumpeterian tradition argue that increasing concentration provides firms with greater opportunity to appropriate the returns of their investments in innovation, and propose that concentration facilitates innovation (Scherer, 1992; Schumpeter, 1950). However, other scholars also suggest that as concentration increases, firms face less competitive pressure to stimulate the innovation of their products (Curry and George, 1983; Scherer and Ross, 1990). Empirically, studies have found different relationships between concentration and innovation. In this paper, market concentration is combined with market dynamism to understate how market scenario affects innovative activities.

Market dynamism refers to unpredictable and rapid changes in the environment where a new venture operates (Dess and Beard, 1984). Stable environments are characterised by minimal changes in customer preferences, technologies, and competitive dynamics, whereas highly dynamic industries are characterised by high rates of change, instability, and increasing uncertainty (Jansen et al., 2006; Rodrigo-Alarcón et al., 2017). Market concentration and market dynamism are combined to create a four-quadrant matrix (Figure 1).

Figure 1 Market scenarios matrix (see online version for colours)



Research shows that patenting propensity differs considerably among industries (Cohen et al., 2002; Mann and Sager, 2007). In highly competitive environments (i.e., highly dynamic and concentrated markets – 1st quadrant) protecting intellectual property rights is the only way to be safe from competitive attack. Patents act as an *offensive blockade* to prevent other firms from using an innovation, or as a *defensive blockade* to prevent the innovation from being patented by a competitor (Blind et al., 2006). In a low competitive environment (i.e., lowly dynamic and concentrated market – 3rd quadrant), investing in intellectual property protection is a waste of resources that could be exploited for marketing or manufacturing, to benefit a technological opportunity, and increase firm survival (Siegel et al., 2007). For these reasons, it is hypothesised that:

Hypothesis 1 (H_1) Start-ups' patenting activity is positively related to the market scenario; a higher level of market concentration and market dynamism increases the propensity to patent.

2.2 Internal determinants of start-ups' patenting activity

2.2.1 Start-up age

Looking at the role of firms' age in introducing innovations is likely to shed light on the dynamics of industries. Industries evolve according to the innovations introduced by new entrants, surviving and incumbent firms, and these innovations are one of the main sources of industry growth and changes in its structure (Huergo and Jaumandreu, 2004). In order to give its contribution to this literature and assess the relationship between innovation and age, this paper further explores this latter aspect. In this context, the word 'life cycle' describes the various stages in a start-up including decision-making and funding processes (Tzabbar and Margolis, 2017). Generally, start-ups experience four stages: bootstrapping, seed, creation, and maturity (Salamzadeh and Kawamorita Kesim, 2015). The bootstrapping stage (i.e., pre-start-up foundation and the first year after firm foundation) includes identification and validation of the idea, creation of a team, use of personal funds or funding from family members and friends to implement the initial production/provision of the product/service. Seed stage (i.e., the 18-month period after the year of foundation) is characterised by teamwork, prototype development, market entry, venture valuation, and search for support from accelerators and incubators. Creation (i.e., 3rd and 4th years after foundation) involves start-up growth and product sales. Maturity (i.e., from year 5 onwards) means that the start-up is able to make a profit and grow. If the firm does not achieve maturity, it will either exit or launch an initial public offering (IPO).

Most existing research focuses on the relationship between firm age and innovation quality, including patenting and patent quality (Balasubramanian and Lee, 2008; Huergo and Jaumandreu, 2004). Younger start-ups use patents to protect their ideas from competitors and to secure freedom to operate in the market (Blind et al., 2006); they give fundamental importance to patenting because it improves their reputation (e.g., improvement of technological image and increase in company value) (Holgersson, 2013). Moreover, they are also more likely to patent in order to convince investors and banks about the value of the invention, to obtain more funds (De Rassenfosse, 2012). On the contrary, older start-ups, even if they have better access to tangible and intangible resources, prefer to exploit patented innovations without making further investments in this area (Chabchoub and Niosi, 2005).

Thus, it is hypothesised that:

Hypothesis 2 (H_2) Start-ups' patenting activity is negatively related to start-up age; older age decreases the propensity to patent.

2.2.2 Entrepreneur narcissism

The entrepreneur is important for start-up management and growth. In the early stages, the entrepreneur has few collaborators and employees and tends to rely on a small group of trusted friends (Gilbert et al., 2006). Numerous studies focus on the relationship between entrepreneur and performance: some of them explore the relationship between age or education and financial performance (Baum and Locke, 2004; Baum et al., 2001; Sapienza and Grimm, 1997), while others analyse the impact that some personality traits have on financial performance (Hadi and Abdullah, 2018; Hopp and Sonderegger, 2015; Nag and Das, 2017; Piispanen et al., 2017). Other studies investigate the relationship

between entrepreneur characteristics and innovation (Kato et al., 2015; King et al., 1996; Patterson, 1999; Routamaa et al., 2016). In particular, Patterson (1999) argues that personality characteristics are related to the propensity to innovate in the workplace and describes the principal traits (i.e., charisma, creativity, and openness to experience) relevant to the generation and application of ideas in organisations. Routamaa et al. (2016) show the existence of a stable set of personality characteristics common to each entrepreneur personality type. For instance, they show that entrepreneurs who are extrovert, intuitive, feeling, and spontaneous are more likely to have more innovative ideas and approaches.

As stated before, focus is made on entrepreneur narcissism because it is a prevalent trait in top management positions and it strongly affects business performance (Campbell and Campbell, 2009; Engelen et al., 2016). Narcissism encompasses a broad range of negative characteristics and it is synonymous with self-absorbed and self-centred behaviour. In line with Ackerman et al. (2011), entrepreneur narcissism is explored according to three aspects: entitlement/exploitativeness (EE), grandiose exhibitionism (GE), and leadership/authority (LA). EE narcissists think they are unique, more capable, and extraordinary persons; they have a high level of self-awareness and self-esteem (Ames et al., 2006). GE entrepreneurs are self-absorbed, vain, and exhibitionist: they always need to be the centre of attention (Ackerman et al., 2011). Finally, LA narcissists are willing to manipulate and take advantage of others to reach their goals (Brown et al., 2009).

It is hypothesised that the propensity of narcissistic entrepreneurs to patent depends on their prevailing factors; entrepreneurs, in which the EE part is prevailing, are likely to protect their innovation to preserve their self-esteem and to show that their ideas are unique and unreachable at the same time. On the other hand, entrepreneurs in which the GE part is predominant will not be focusing on protecting their innovations because they consider them invaluable; in fact, they are so convinced of the superiority of their ideas that they do not bother to protect them. Finally, entrepreneurs in which the LA part prevails are likely to protect their innovation to impose and protect their status in the market. Hence, it is affirmed that:

Hypothesis 3a (H_{3a}) Narcissistic entrepreneurs in which the EE characteristics prevail have a positive impact on start-up patenting.

Hypothesis 3b (H_{3b}) Narcissistic entrepreneurs in which the GE characteristics prevail have a negative impact on start-up patenting.

Hypothesis 3c (H_{3c}) Narcissistic entrepreneurs in which the LA characteristics prevail have a positive impact on start-up patenting.

3 Methodology

3.1 Sample and procedure

The analysis is based on survey data and secondary information from a public database which increases external validity and avoids common method bias problems. This sample is composed of Italian and French start-ups. Survey data were collected via an online questionnaire. The first section included 16 questions to measure entrepreneur narcissism

(Ames et al., 2006). The original narcissistic personality inventory version is in English and a rigorous back-translation technique was employed to ensure accurate translation into Italian and French (Brislin, 1980). The second section asked respondents for personal details such as name, age, sex, and number of firms owned.

For the Italian sample, start-ups listed in the Italian Chambers of Commerce register and founded between 2012 and 2015 were selected. For the French sample, start-ups listed on the myFrenchStartup website, founded between 2009 and 2015, and located in the PACA Region (Provence-Alpes-Côte d'Azur) were selected.

Start-up entrepreneurs were contacted mainly via LinkedIn: entrepreneurs with no LinkedIn profile were contacted via Facebook or personal e-mail addresses. Researchers' personal profiles were used to introduce themselves and the study. Those who agreed to participate in the study were sent a link to the online survey which was administered in 2016 in Italian and French as relevant. In total, 1,055 start-up entrepreneurs agreed to participate, and 195 responses were obtained, with a response rate of 18.48%. In particular, this sample consisted in 65.64% Italian start-ups, representing 4.85% of the start-ups with the same characteristics in Italy in 2015, and 34.59% French start-ups, accounting for 9.22% of the start-ups located in the PACA region.

Regarding the reliability of the sample three factors were controlled: geographical distribution, industry, and size for each country. In Italy, start-ups are mainly located in Lombardia (21.8%), Emilia-Romagna (11.2%), and Lazio (9.7%); they are in the software industry (29.85%), business administration and consulting industry (25.96%), and manufacturing industry (19.00%); they have on average 2.76 employees (CCI, 2016). In this sample, Italian start-ups are mainly located in Lombardia (32,03%), Piemonte (12.6%), and Emilia-Romagna and Lazio (7.81%); they are in the business administration and consulting industry (39.06%), software industry (18.75%), and manufacturing industry (17.19%), and 78.91% of the start-ups have less than three employees. In the PACA region, start-ups are mainly located in Marseille (24%), Aix-En-Provence (11%), and Nice (11%); they are in the business administration and consulting industry (17.00%), ICT (16.00%), and software industry (13.00%); they have on average 2.5 employees (reference year 2015 – http://www.myfrenchstartup.fr). In this sample, French start-ups are mainly located in Marseille (20.90%), Aix-En-Provence (10.45%), and Nice (10.45%); they are in the software industry (59.70%), business administration and consulting industry (20.90%), and commerce (7.46%), and 83.58% of the start-ups have less than three employees.

Economic and financial information were collected from the Aida database for the Italian sample, and from Orbis database for the French sample. Aida and Orbis are Bureau Van Dijk databases that provide comprehensive information on firms around the world.

3.2 Measures

The dependent variable, start-up patenting, was derived from the Italian and French patent registers. A dummy variable was constructed and it takes the value 1 if the start-up owns at least one patent, and zero if it does not. It has been decided to use a dummy variable because start-ups generally have small numbers of patents. The three independent variables, market scenarios, start-up age, and entrepreneurs' narcissism, were constructed as follows.

As previously mentioned, to create the market scenarios variable a four-quadrant matrix was created combining market concentration and market dynamism. Market concentration was measured using the Herfindahl index. The common formula is $H = \sum_{i=1}^{I} S_i^2$, where S represents the revenue market share and i is the index for the individual firm. The Herfindahl index was calculated for each industry in the final sample ($\mu = 0.047$, $\sigma = 0.020$). Instead, market dynamism is calculated considering the standard deviation of the annual industry (two-digit ATECO code) sales growth rate (Barelds and Dijkstra, 2010). Also, for the market dynamism index, the values for each industry were calculated in the final sample ($\mu = 0.045$, $\sigma = 0.030$). For both indexes, data were gathered from Aida and Orbis and even though they were collected for the previous four years, only 2015 values were used. In fact, when analysing the values for different years, they were found to be constant over time.

Start-up age was measured as the number of years since the foundation. An ordinal variable listing the age following the four stages of the start-up life cycle of Salamzadeh and Kawamorita Kesim (2015) was constructed. In this sample, no start-ups were in the bootstrapping phase. Thus, start-ups were given the value 1 if they were in the seed phase, 2 if they were in the creation phase and 3 if they were in the maturity phase.

Table 1 Results of EFA

English items	*m*	*sd*	*Factor loading*	α
Entitlement exploitativeness (EE)				0.82
I think I am a special person.	3.287	1.184	0.655	
I am more capable than other people.	3.159	1.131	0.706	
I am an extraordinary person.	2.549	1.158	0.706	
Grandiose exhibitionism (GE)				0.77
I like to be the centre of attention.	2.441	1.070	0.782	
I am apt to show off if I get the chance.	2.015	1.110	0.642	
I really like to be the centre of attention.	2.272	1.071	0.843	
Leadership authority (LA)				0.61
I like having authority over people.	2.528	1.109	0.587	
I find it easy to manipulate people.	2.323	1.110	0.521	
People always seem to recognise my authority.	3.160	1.041	0.498	

Entrepreneurs' narcissism was measured using the five-point Likert scale version of the 16-item narcissistic personality inventory (NPI-16) developed by Ames et al. (2006) (see Gentile, 2013). The original NPI-16 is in English, see Appendix, and to ensure accurate translation to Italian and French, a rigorous back-translation technique was employed (Brislin, 1980). A first bilingual English-Italian speaker translated the questionnaire from English to Italian, then a second bilingual speaker translated the Italian back to English. The same happened for the French translation. After that, an exploratory factor analysis (EFA) on the NPI-16 was conducted, in agreement with the results of Ackerman et al.

(2011). Table 1 reports the mean, standard deviation, factor loading, and the Cronbach's alpha values of each factor. As it can be seen, Cronbach's alpha is equal to 0.82 for the EE variable and 0.77 for the GE variable, both values being above the widely accepted threshold of 0.70 (Nunnally and Bernstein, 1994), while the value of LA is equal to 0.61 which can also be considered as satisfactory (Aiken, 1997).

As control variables, a multilevel control was adopted. On an individual level, entrepreneur's education measured as a four-point ordinal scale (i.e., 1 = high school, 2 = bachelor's degree, 3 = master's degree and 4 = PhD) and gender, measured as dummy variable that took the value 1 if the entrepreneur was a man, and zero if he was not, were controlled. Entrepreneurs with longer/higher education are more likely to patent than entrepreneurs with a shorter/lower education path (Lee et al., 2010). Instead, male entrepreneurs are more likely to patent than female entrepreneurs (Allen et al., 2007). At the firm level, start-up number of employees was controlled as a proxy for firm size, measured as a three-point ordinal scale (i.e., 1 = 0 to 4 employees, 2 = 5 to 9 employees, and 3 = more than 10 employees), and firm size, measured as the effective number of entrepreneurs in the entrepreneurial team. Firm size is important because firms of different size may exhibit different organisational and environmental characteristics (Engelen et al., 2016). On the other hand, start-up number of founders can directly impact on the start-up's propensity to innovate and on the entrepreneur decision-making process (Zhang et al., 2017). Finally, at the environmental level, the industrial sector which refers to the start-up main activity and which is captured by the industry dummies as the two-digit ATECO code (classification of economic activities adopted by the Italian Institute of Statistics), and the location captured through national dummies (i.e., Italy or France) were controlled. Industrial sectors influence entrepreneurs decision to patent because entrepreneurs in high technology industries are obligated to patent if they want to be competitive (Blind et al., 2006). The nation in which the firm is located can create a different cultural milieu that might affect entrepreneur patenting propensity (Kreiser et al., 2010).

3.3 Model specifications

To identify the features of the market scenarios in which start-ups operate, industries related to the firms in this sample were distinguished using the two-digit ATECO code. Market concentration and market dynamism levels were calculated for each industry. Then, cluster analysis was used to construct the four quadrants, characterised by different levels of market dynamism and market concentration. The mean was used as a similarity measure and the complete linkage method was employed to form the clusters.

The first stage in the cluster analysis identified and minimised the impact of outliers (Menor et al., 2001); outliers were indeed present in this sample. Clusters were then formed following the pseudo-F statistic (Milligan and Cooper, 1985) and managerial interpretability of clustering criteria (Ketchen and Shook, 1996). Table 2 presents sample distribution across the various sectors showing also frequencies and percentages for each quadrant.

Table 2 Industries in the sample

Quadrant	*Description*	*Full sample*		
		# start-ups	*% total*	*% patenting*
1st	Software	64		9.38%
	1st quadrant total	*64*	*32.82%*	*32.82*
2nd	Commerce	9		22.22%
2nd	Financial activities	1		0.00%
2nd	Professional, scientific, and technical activities	1		0.00%
	2nd quadrant total	*11*	*5.64%*	
3rd	Manufacturing	24		54.17%
3rd	Construction	4		0.00%
3rd	Services	9		22.22%
	3rd quadrant total	*37*	*18.97%*	
4th	Communication and information	17		17.65%
4th	Business administration and consulting	64		31.25%
4th	Research and development	2		0.00%
	4th quadrant total	*83*	*42.56%*	
	Total	195		23.59%

In order to explain the relationship between variables, and since the dependent variable was a dummy variable, logistic regression was employed. Logistic regression tests the probability of a dichotomous event happening, in this case related to start-ups' patenting activity. The predicted proportion of activities follows the logistic model of $P / (1 - P_i) = \beta X_i$, where P_i is the probability of start-ups' patenting (Hosmer and Lemeshow, 2000). The logarithmic odds of these events are held to be linearly affected by a vector of covariates X_i with coefficient vector β_j. A one-unit change in covariate X_i alters the probability that start-ups will engage in the patenting activity by $\beta_j P_i (1 - P_i)$ (Hosmer and Lemeshow, 2000). The STATA statistical package was used for all statistical analyses. Four different models were run; the first contained all the control variables:

$$\text{Startup}_{\text{patenting}} = \alpha + \beta_1 * \text{Startup}_{\text{size}} + \beta_2 * \text{Startup}_{\text{nfounders}} + \beta_3 * \text{Entrepreneur}_{\text{education}} + \beta_3 * \text{Entrepreneur}_{\text{gender}}$$

The second comprised the variable for the control of market scenario influence:

$$\text{Startup}_{\text{patenting}} = \alpha + \beta_1 * \text{Startup}_{\text{size}} + \beta_2 * \text{Startup}_{\text{nfounders}} + \beta_3 * \text{Entrepreneur}_{\text{education}} + \beta_3 * \text{Entrepreneur}_{\text{gender}} + \beta_4 * \text{Market}_{\text{scenario}}$$

The third included the variable for start-up age:

$$\text{Startup}_{\text{patenting}} = \alpha + \beta_1 * \text{Startup}_{\text{size}} + \beta_2 * \text{Startup}_{\text{nfounders}} + \beta_3 * \text{Entrepreneur}_{\text{education}} + \beta_3 * \text{Entrepreneur}_{\text{gender}} + \beta_5 * \text{Startup}_{\text{age}}$$

And finally, the fourth model included the factors related to the entrepreneurs' narcissism:

$$\text{Startup}_{\text{patenting}} = \alpha + \beta_1 * \text{Startup}_{\text{size}} + \beta_2 * \text{Startup}_{\text{nfounders}} + \beta_3 * \text{Entrepreneur}_{\text{education}} + \beta_3 * \text{Entrepreneur}_{\text{gender}} + \beta_6 * \text{EE} + \beta_7 * \text{GE} + \beta_8 * \text{LA}$$

4 Results and discussion

Table 3 summarises means, standard deviations, min, max, and Spearman's correlations. Spearman's rank-order correlation is useful to measure the strength and direction of association between continuous and categorical variables. Results show a strong positive correlation between the number of entrepreneurs in the entrepreneurial team and market scenario ($r_s = 0.270$, $p < 0.001$), entrepreneurs education and market scenario ($r_s = 0.325$, $p < 0.001$), number of entrepreneurs in the entrepreneurial team and entrepreneurs education ($r_s = 0.259$, $p < 0.001$), and between the three factors that represent narcissism, EE and GE ($r_s = 0.397$, $p < 0.001$), EE and LA ($r_s = 0.359$, $p < 0.001$), and GE and LA ($r_s = 0.581$, $p < 0.001$), respectively. There is also a negative correlation between start-up age and market scenario ($r_s = –0.464$, $p < 0.001$), start-up size and age ($r_s = –0.173$, $p < 0.05$), and the number of entrepreneurs in the entrepreneurial team and start-up age ($r_s = –0.282$, $p < 0.001$). Additionally, no multicollinearity is indicated by observing VIF. Table 4 presents the findings from the logistic regression.

Model 2 illustrates that market scenarios positively influence start-up entrepreneurs' propensity to patent ($\beta = 0.428$, $p < 0.05$), supporting Hypothesis 1 (start-ups' patenting activity is positively related to the market scenario; a higher level of market concentration and market dynamism increases the propensity to patent). This suggests that market scenarios with particular dynamics push the entrepreneurs to patent their ideas. These findings indicate that with increases in market concentration and dynamism, start-ups are more likely to patent. Thus, this study both clarifies the importance of external conditions for innovation and empirically demonstrates how the market scenario shapes start-ups' wiliness to patent. Whereas previous research focused on the direct effect market concentration has on innovation (e.g., De Vries et al., 2017), previous studies are extended by analysing the combined effect of market concentration and dynamisms on innovation.

Model 3, which includes the variable for start-up age, shows that patenting propensity decreases with increasing start-up age ($\beta = –0.766$, $p < 0.05$), confirming Hypothesis 2 (start-ups' patenting activity is negatively related to start-up age; older age decreases the propensity to patent). Thus, younger firms have been detected to present a high probability of innovating. This result provides an important prediction concerning innovation: youngest firms are prone to innovate more. These results do not confirm the results of Sørensen and Stuart (2000) who, using data from the semiconductor and biotech industries, examine the impact of firm age on patenting and patent quality, and provide evidence that older firms generate more innovations.

Table 3 Descriptive statistics and correlation

	Variable	*N*	*Mean*	*Std. dev.*	*Min*	*Max*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1	Market scenario	195	2.713	1.312	1	4	1						
2	Start-up age	195	2.164	0.541	1	3	–0.464***	1					
3	EE	195	0.000	0.833	–1.721	1.755	0.073	0.009	1				
4	GE	195	–0.000	0.890	–1.120	2.557	0.037	–0.039	0.397***	1			
5	LA	195	0.000	0.717	–1.457	2.056	0.018	–0.005	0.356***	0.581**	1		
6	Start-up size	195	1.246	0.538	1	3	0.003	–0.173*	–0.086	–0.004	0.081	1	
7	Start-up number of founders	195	1.964	1.258	1	7	0.270***	–0.282***	0.033	–0.059	–0.021	0.126	1
8	Entrepreneur education	195	2.739	0.930	1	4	0.325***	–0.123	–0.017	–0.006	0.042	0.021	0.259***

Notes: *$p < 0.05$, **$p < 0.01$ and ***$p < 0.001$.

Table 4 Results of regression analyses (N = 195)

Start-up patenting	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Control variables				
Start-up size	0.186 (0.301)	0.216 (0.167)	0.116 (0.373)	0.373 (0.302)
Start-up number of founders	0.105 (0.145)	0.094 (0.147)	0.123 (0.147)	0.186 (0.177)
Entrepreneur education	0.048 (0.194)	–0.163 (0.209)	0.017 (0.197)	0.144 (0.157)
Entrepreneur gender	0.192 (0.593)	0.198 (0.438)	0.356 (0.609)	-0.290 (0.607)
Main effects				
Market scenario		0.428** (0.166)		
Start-up age			–0.766** (0.373)	
EE				0.697** (0.286)
GE				–0.990*** (0.326)
LA				0.444 (0.382)
Constant	–1.461* (0.899)	–2.623*** (0.965)	0.029 (1.146)	–1.329 (1.344)
Log-likelihood	–104.535	–101.416	–91.813	–84.031
LR chi2	3.99	10.23	25.02***	38.59***
Pseudo R^2	0.019	0.048	0.120	0.185

Notes: *$p < 0.1$, **$p < 0.05$ and ***$p < 0.01$. Standard errors are shown in parentheses.

Finally, model 4 includes the three factors related to entrepreneurs' narcissism and shows that EE has a significant positive effect on the ownership of patents ($\beta = 0.697$, $p < 0.05$), GE has a negative influence on patenting propensity ($\beta = –0.990$, $p < 0.001$), while LA is not significant ($\beta = 0.444$, $p > 0.1$). Thus, Hypotheses 3a (narcissistic entrepreneurs in which the EE characteristics prevail have a positive impact on start-up patenting) and 3b (narcissistic entrepreneurs in which the GE characteristics prevail have a negative impact on start-up patenting) should be accepted, but Hypothesis 3c (narcissistic entrepreneurs in which the LA characteristics prevail have a positive impact on start-up patenting) should be rejected. This suggests that entrepreneurs' personality, in this case narcissism, stimulates or not the entrepreneurs to patent their ideas. In particular, considering EE, results show that a higher level of EE increases the propensity to patent; on the other hand, considering GE, results show that a higher level of GE decreases the propensity to patent. Thus, the personality of an entrepreneur, who is the decision-maker in a start-up, strictly impacts on the start-up decision to patent. As mentioned above, no previous works investigated the direct relationship between entrepreneurs' narcissism and patent propensity. However, a recent paper by Munshaw et al. (2019) investigates the relationship between personality traits and patenting activity. They focus on the

relationship between entrepreneurial self-efficacy of academics and patent applications of spin-offs, but their hypothesis is not supported.

Table 5 summarises the results of the paper.

Table 5 Summary of the hypotheses accepted

Dependent variable: start-up patenting activity					
Independent variable	*Hp*	*Hypothesised sign*	*Standardised coefficient*		*Accepted*
Market scenario	H_1	+	0.428	**	√
Start-up age	H_2	–	–0.766	**	√
EE	H_{3a}	+	0.697	**	√
GE	H_{3b}	–	–0.990	***	√
LA	H_{3c}	+	0.444		X

Notes: *$p < 0.1$, **$p < 0.05$ and ***$p < 0.01$.

5 Conclusions

This study investigated external and internal start-up conditions affecting the decision to patent. It is shown that start-up patenting is affected by the market scenario and start-up age, and by some factors of the entrepreneurs' narcissism. Using sample Italian and French start-up entrepreneurs, it was examined whether and how some internal or external conditions influenced patenting behaviour. Unlike previous studies, the patenting propensity was considered as an innovation output and the determinants of innovation outcomes were estimated by employing a logit model.

This study finds that a higher level of market concentration and market dynamism increases the propensity to patent, start-up older age decreases it, while entrepreneur personality has controversial results; two out of three factors in the narcissistic personality such as EE and GE, impact on the start-up decision to patent. In particular, EE increases the propensity to patent while GE decreases it.

These results give an important contribution to the literature on innovation by providing a comprehensive view of the determinants of patenting by start-ups (Helmers and Rogers, 2011). It is believed that this comprehensive vision compared to a single factor study, offers a complete and universal visualisation. Moreover, the results shed light on the direct effects of entrepreneurs' personality on patent propensity meeting the request by Kato et al. (2015) about the need for more studies in this field. Considered the controversial trait of narcissism, prior knowledge in the literature was pushed forward since previous studies suggest that narcissism is strongly correlated to self-reported creativity and innovation ideas (Dahmen-Wassenberg et al., 2016; Goncalo et al., 2010), but find no relationship to objective measures of innovation and patenting propensity.

The findings in the present paper have some practical implications for entrepreneurs, investors, academics and the educational system in general, and policymakers. Entrepreneurs need to understand the importance of both external and internal conditions in promoting start-up patenting activities. In particular, they should be aware that their personality traits affect choices related to innovation and the protection of the innovation. Thus, in order to increase innovation in start-ups, they should compensate for the personal characteristics they lack by recruiting appropriate complementary people.

Investors – venture capitalists, bankers, public agencies, and other investors – could incorporate measures to assess personality traits such as narcissism when screening candidates and entrepreneurial projects. In the case of universities and the education system more generally, course programmes should adopt an overall view of the environment, including the different market environments in which start-ups will be located, the main characteristics of these start-ups and entrepreneur personality traits. Finally, regarding policymakers, this study provides useful information about the sectors and conditions under which patents can be beneficial to protect ideas and to improve performance, in the second place. This information can be used to design and improve initiatives intended to strengthen start-ups' patent usage, which is one of the main goals of policymakers aiming to foster innovative entrepreneurship and the evolution of innovative start-ups.

This study has some limitations which suggest avenues for further research. The sample used included Italian and French entrepreneurs, which are relatively similar from a cultural point of view. The study could be replicated using samples from different cultures. Also, different external and internal variables (i.e., start-up's initial capital, entrepreneur's locus of control) could be used to investigate the relationship between these variables and start-up patenting.

References

Abdullah, N., Hadi, N.U. and Dana, L-P. (2018) 'The nexus between entrepreneur skills and successful business: a decompositional analysis', *International Journal of Entrepreneurship and Small Business*, Vol. 34, No. 2, pp.249–265.

Ackerman, R.A., Witt, E.A., Donnellan, M.B., Trzesniewski, K.H., Robins, R.W. and Kashy, D.A. (2011) 'What does the narcissistic personality inventory really measure?', *Assessment*, Vol. 18, No. 1, pp.67–87.

Aiken, L.R. (1997) *Psychological Testing and Assessment*, 9th ed., Allyn & Bacon, Needham Heights, MA, USA.

Allen, S.D., Link, A.N. and Rosenbaum, D.T. (2007) 'Entrepreneurship and human capital: evidence of patenting activity from the academic sector', *Entrepreneurship Theory and Practice*, Vol. 31, No. 6, pp.937–951.

Ames, D.R., Rose, P. and Anderson, C.P. (2006) 'The NPI-16 as a short measure of narcissism', *Journal of Research in Personality*, Vol. 40, No. 4, pp.440–450.

Balasubramanian, N. and Lee, J. (2008) 'Firm age and innovation', *Industrial and Corporate Change*, Vol. 17, No. 5, pp.1019–1047.

Bamiatzi, V., Bozos, K., Cavusgil, S.T. and Hult, G.T.M. (2016) 'Revisiting the firm, industry, and country effects on profitability under recessionary and expansion periods: a multilevel analysis', *Strategic Management Journal*, Vol. 37, No. 7, pp.1448–1471.

Barelds, D.P. and Dijkstra, P. (2010) 'Narcissistic personality inventory: structure of the adapted Dutch version', *Scandinavian Journal of Psychology*, Vol. 51, No. 2, pp.132–138.

Baum, J.R. and Locke, E.A. (2004) 'The relationship of entrepreneurial traits, skill, and motivation to subsequent venture growth', *Journal of Applied Psychology*, Vol. 89, No. 4, pp.587–598.

Baum, J.R., Locke, E.A. and Smith, K.G. (2001) 'A multidimensional model of venture growth', *Academy of Management Journal*, Vol. 44, No. 2, pp.292–303.

Blazsek, S. and Escribano, A. (2016) 'Patent propensity, R&D and market competition: dynamic spillovers of innovation leaders and followers', *Journal of Econometrics*, Vol. 191, No. 1, pp.145–163.

Blind, K., Edler, J., Frietsch, R. and Schmoch, U. (2006) 'Motives to patent: empirical evidence from Germany', *Research Policy*, Vol. 35, No. 5, pp.655–672.

Brislin, R.W. (1980) 'Translation and content analysis of oral and written material', in Triandis, H.C. and Berry, J.W. (Eds.): *Handbook of Cross-Cultural Psychology: Methodology*, pp.349–444, Allyn and Bacon, Boston, MA.

Brown, R.P., Budzek, K. and Tamborski, M. (2009) 'On the meaning and measure of narcissism', *Personality and Social Psychology Bulletin*, Vol. 35, No. 7, pp.951–964.

Campbell, W.K. and Campbell, S.M. (2009) 'On the self-regulatory dynamics created by the peculiar benefits and costs of narcissism: a contextual reinforcement model and examination of leadership', *Self and Identity*, Vol. 8, Nos. 2–3, pp.214–232.

Campbell, W.K., Goodie, A.S. and Foster, J.D. (2004) 'Narcissism, confidence, and risk attitude', *Journal of Behavioral Decision Making*, Vol. 17, No. 4, pp.297–311.

Carlson, J. (2017) *Medical Device Executive Pleads Guilty to Stealing Trade Secrets* [online] http://www.startribune.com/medical-device-executive-pleads-guilty-to-stealing-trade-secrets/421793043/ (accessed August 2019).

CCI (2016) *Report 4° Trimestre 2015 – Startup*, Roma.

Chabchoub, N. and Niosi, J. (2005) 'Explaining the propensity to patent computer software', *Technovation*, Vol. 25, No. 9, pp.971–978.

Chatterjee, A. and Hambrick, D.C. (2007) It's all about me: narcissistic chief executive officers and their effects on company strategy and performance', *Administrative Science Quarterly*, Vol. 52, No. 3, pp.351–386.

Cohen, W.M., Goto, A., Nagata, A., Nelson, R.R. and Walsh, J.P. (2002) 'R&D spillovers, patents and the incentives to innovate in Japan and the United States', *Research Policy*, Vol. 31, Nos. 8-9, pp.1349–1367.

Criscuolo, P., Nicolaou, N. and Salter, A. (2012) 'The elixir (or burden) of youth? Exploring differences in innovation between start-ups and established firms', *Research Policy*, Vol. 41, No. 2, pp.319–333.

Curry, B. and George, K.D. (1983) 'Industrial concentration: a survey', *The Journal of Industrial Economics*, Vol. 31, No. 3, pp.203–255.

Dahlqvist, J. and Wiklund, J. (2012) 'Measuring the market newness of new ventures', *Journal of Business Venturing*, Vol. 27, No. 2, pp.185–196 [online] http://www.sciencedirect.com/science/article/pii/S0883902610001011 (accessed January 2019).

Dahmen-Wassenberg, P., Kämmerle, M., Unterrainer, H-F. and Fink, A. (2016) 'The relation between different facets of creativity and the dark side of personality', *Creativity Research Journal*, Vol. 28, No. 1, pp.60–66.

De Rassenfosse, G. (2012) 'How SMEs exploit their intellectual property assets: evidence from survey data', *Small Business Economics*, Vol. 39, No. 2, pp.437–452.

De Vries, G., Pennings, E., Block, J.H. and Fisch, C. (2017) 'Trademark or patent? The effects of market concentration, customer type and venture capital financing on start-ups' initial IP applications', *Industry and Innovation*, Vol. 24, No. 4, pp.325–345.

Dess, G.G. and Beard, D.W. (1984) 'Dimensions of organizational task environments', *Administrative Science Quarterly*, Vol. 29, No. 1, pp.52–73.

Engelen, A., Neumann, C. and Schmidt, S. (2016) 'Should entrepreneurially oriented firms have narcissistic CEOs?', *Journal of Management*, Vol. 42, No. 3, pp.698–721.

EPO (2018) *Annual Report 2018*, Munich [online] https://www.epo.org/about-us/annual-reports-statistics/annual-report/2018.html (accessed September 2019).

Gayle, P.G. (2001) *Market Concentration and Innovation: New Empirical Evidence on the Schumpeterian Hypothesis*, Unpublished Paper, University of Colorado at Boulder.

Gentile, B. (2013) *Investigating Alternative Response Sets with the Narcissistic Personality Inventory: Validation of a New Likert Version*, Doctoral dissertation, University of Georgia.

Gilbert, B.A., McDougall, P.P. and Audretsch, D.B. (2006) 'New venture growth: a review and extension', *Journal of Management*, Vol. 32, No. 6, pp.926–950.

Goncalo, J.A., Flynn, F.J. and Kim, S.H. (2010) 'Are two narcissists better than one? The link between narcissism, perceived creativity, and creative performance', *Personality and Social Psychology Bulletin*, Vol. 36, No. 11, pp.1484–1495.

Grant, R.M. (1991) 'The resource-based theory of competitive advantage: implications for strategy formulation', *California Management Review*, Vol. 33, No. 3, pp.114–135.

Hadi, N.U. and Abdullah, N. (2018) 'The leverage of entrepreneur skills and entrepreneur traits to business success: a case study of Pakistan's marble industry', *International Journal of Entrepreneurship and Small Business*, Vol. 33, No. 3, pp.315–334.

Helmers, C. and Rogers, M. (2011) 'Does patenting help high-tech start-ups?', *Research Policy*, Vol. 40, No. 7, pp.1016–1027.

Holgersson, M. (2013) 'Patent management in entrepreneurial SMEs: a literature review and an empirical study of innovation appropriation, patent propensity, and motives', *R&D Management*, Vol. 43, No. 1, pp.21–36.

Hopp, C. and Sonderegger, R. (2015) 'Understanding the dynamics of nascent entrepreneurship – prestart-up experience, intentions, and entrepreneurial success', *Journal of Small Business Management*, Vol. 53, No. 4, pp.1076–1096.

Hosmer, D.W. and Lemeshow, S. (2000) *Applied Logistic Regression*, Wiley, New York.

Hsu, D.H. and Ziedonis, R.H. (2008) 'Patents as quality signals for entrepreneurial ventures', Paper presented at the *Academy of Management Proceedings*.

Huergo, E. and Jaumandreu, J. (2004) 'How does probability of innovation change with firm age?', *Small Business Economics*, Vol. 22, Nos. 3–4, pp.193–207.

Im, H.J., Park, Y.J. and Shon, J. (2015) 'Product market competition and the value of innovation: evidence from US patent data', *Economics Letters*, Vol. 137, pp.78–82.

Jansen, J.J., Van Den Bosch, F.A. and Volberda, H.W. (2006) 'Exploratory innovation, exploitative innovation, and performance: effects of organizational antecedents and environmental moderators', *Management Science*, Vol. 52, No. 11, pp.1661–1674.

Judge, T.A. and LePine, J.A. (2007) 'The bright and dark sides of personality: implications for personnel selection in individual and team contexts', in Legan-Fox, J. and Klimoski, R.J. (Eds.): *Research Companion to the Dysfunctional Workplace: Management Challenges and Symptoms*, pp.332–355, Edward Elgar Publishing, Northampton, MA, USA.

Kamien, M.I. and Schwartz, N.L. (1982) *Market Structure and Innovation*, Cambridge University Press, London.

Kato, M., Okamuro, H. and Honjo, Y. (2015) 'Does founders' human capital matter for innovation? Evidence from Japanese start-ups', *Journal of Small Business Management*, Vol. 53, No. 1, pp.114–128.

Ketchen, D.J. and Shook, C.L. (1996) 'The application of cluster analysis in strategic management research: an analysis and critique', *Strategic Management Journal*, Vol. 17, No. 6, pp.441–458.

King, L.A., Walker, L.M. and Broyles, S.J. (1996) 'Creativity and the five-factor model', *Journal of Research in Personality*, Vol. 30, No. 2, pp.189–203.

Kreiser, P.M., Marino, L.D., Dickson, P. and Weaver, K.M. (2010) 'Cultural influences on entrepreneurial orientation: the impact of national culture on risk taking and proactiveness in SMEs', *Entrepreneurship Theory and Practice*, Vol. 34, No. 5, pp.959–983.

Lee, S.Y., Florida, R. and Gates, G. (2010) 'Innovation, human capital, and creativity', *International Review of Public Administration*, Vol. 14, No. 3, pp.13–24.

Leonelli, S., Ceci, F. and Masciarelli, F. (2016) 'The importance of entrepreneurs' traits in explaining start-ups' innovativeness', *Sinergie Italian Journal of Management*, Vol. 34, No. 101, pp.71–85.

Levine, D.S. and Sichelman, T. (2019) 'Why do startups use trade secrets', *Notre Dame L. Rev.*, Vol. 94, No. 2, pp.751–820.

Maccoby, M. (2003) *The Productive Narcissist: the Promise and Peril of Visionary Leadership*, Broadway Books, New York, NY.

Mann, R.J. and Sager, T.W. (2007) 'Patents, venture capital, and software start-ups', *Research Policy*, Vol. 36, No. 2, pp.193–208.

Menor, L.J., Roth, A.V. and Mason, C.H. (2001) 'Agility in retail banking: a numerical taxonomy of strategic service groups', *Manufacturing & Service Operations Management*, Vol. 3, No. 4, pp.273–292.

Miller, D. (1987) 'The structural and environmental correlates of business strategy', *Strategic Management Journal*, Vol. 8, No. 1, pp.55–76.

Milligan, G.W. and Cooper, M.C. (1985) 'An examination of procedures for determining the number of clusters in a data set', *Psychometrika*, Vol. 50, No. 2, pp.159–179.

Munshaw, S., Lee, S-H., Phan, P.H. and Marr, K.A. (2019) 'The influence of human capital and perceived university support on patent applications of biomedical investigators', *The Journal of Technology Transfer*, Vol. 44, No. 4, pp.1216–1235.

Nag, D. and Das, N. (2017) 'The influence of entrepreneurial traits on success of microenterprises in India: a mediator analysis', *International Journal of Entrepreneurship and Small Business*, Vol. 32, No. 4, pp.493–514.

Nunnally, J.C. and Bernstein, I.H. (1994) *Psychometric Theory*, 3rd ed., McGraw-Hill, New York, NY.

Olander, H., Hurmelinna-Laukkanen, P. and Mähönen, J. (2009) 'What's small size got to do with it? Protection of intellectual assets in SMEs', *International Journal of Innovation Management*, Vol. 13, No. 3, pp.349–370.

Patterson, F. (1999) *The Innovation Potential Indicator. Manual and User's Guide*, OPP Ltd., Oxford.

Piispanen, V-V., Paloniemi, K. and Simonen, J. (2017) 'Entrepreneurs' business skills and growth orientation in business development', *International Journal of Entrepreneurship and Small Business*, Vol. 32, No. 4, pp.515–536.

Rodrigo-Alarcón, J., García-Villaverde, P.M., Parra-Requena, G. and Ruiz-Ortega, M.J. (2017) 'Innovativeness in the context of technological and market dynamism: the conflicting effects of network density', *Journal of Organizational Change Management*, Vol. 30, No. 4, pp.548–568.

Rosenbusch, N., Brinckmann, J. and Bausch, A. (2011) 'Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs', *Journal of Business Venturing*, Vol. 26, No. 4, pp.441–457.

Rosenthal, S.A. and Pittinsky, T.L. (2006) 'Narcissistic leadership', *The Leadership Quarterly*, Vol. 17, No. 6, pp.617–633.

Routamaa, V., Brandt, T. and Uusi-Kakkuri, P. (2016) 'Personality of Finnish innovative entrepreneurs', *International Journal of Entrepreneurship and Small Business*, Vol. 29, No. 1, pp.133–148.

Salamzadeh, A. and Kawamorita Kesim, H. (2015) 'Startup companies: life cycle and challenges', Paper presented at *the 4th International Conference on Employment, Education and Entrepreneurship (EEE)*, Belgrade, Serbia.

Sapienza, H.J. and Grimm, C.M. (1997) 'Founder characteristics, start-up process, and strategy/structure variables as predictors of shortline railroad performance', *Entrepreneurship: Theory and Practice*, Vol. 22, No. 1, pp.5–25.

Sazvar, A. and Yahyazadehfar, M. (2019) 'Exploring the effect of venture capital development on innovation performance of knowledge-based companies', *International Journal of Entrepreneurship and Small Business*, Vol. 36, No. 4, pp.359–377.

Scherer, F.M. (1992) *International High-Technology Competition*, Harvard University Press, Cambridge, MA.

Scherer, F.M. and Ross, D. (1990) *Industrial Market Structure and Economic Performance*, Houghton Mifflin, Boston, MA.

Schumpeter, J.A. (1950) *Capitalism, Socialism and Democracy*, Harpers and Brothers Publishers, New York, NY.

Siegel, D.S., Veugelers, R. and Wright, M. (2007) 'Technology transfer offices and commercialization of university intellectual property: performance and policy implications', *Oxford Review of Economic Policy*, Vol. 23, No. 4, pp.640–660.

Sine, W.D., Mitsuhashi, H. and Kirsch, D.A. (2006) 'Revisiting burns and stalker: formal structure and new venture performance in emerging economic sectors', *Academy of Management Journal*, Vol. 49, No. 1, pp.121–132.

Song, M., Podoynitsyna, K., Van Der Bij, H. and Halman, J.I. (2008) 'Success factors in new ventures: a meta-analysis', *Journal of Product Innovation Management*, Vol. 25, No. 1, pp.7–27.

Sørensen, J.B. and Stuart, T.E. (2000) 'Aging, obsolescence, and organizational innovation', *Administrative Science Quarterly*, Vol. 45, No. 1, pp.81–112.

Talaulicar, T., Grundei, J. and Werder, A.v. (2005) 'Strategic decision making in start-ups: the effect of top management team organization and processes on speed and comprehensiveness', *Journal of Business Venturing*, Vol. 20, No. 4, pp.519–541.

Turner, S.F., Mitchell, W. and Bettis, R.A. (2010) 'Responding to rivals and complements: how market concentration shapes generational product innovation strategy', *Organization Science*, Vol. 21, No. 4, pp.854–872.

Tzabbar, D. and Margolis, J. (2017) 'Beyond the startup stage: the founding team's human capital, new venture's stage of life, founder-CEO duality, and breakthrough innovation', *Organization Science*, Vol. 28, No. 5, pp.857–872.

Wales, W.J., Patel, P.C. and Lumpkin, G.T. (2013) 'In pursuit of greatness: CEO narcissism, entrepreneurial orientation, and firm performance variance', *Journal of Management Studies*, Vol. 50, No. 6, pp.1041–1069.

WIPO (2018) *World Intellectual Property Indicators*, Geneva [online] https://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2018.pdf (accessed September 2019).

Zhang, H., Ou, A.Y., Tsui, A.S. and Wang, H. (2017) 'CEO humility, narcissism and firm innovation: a paradox perspective on CEO traits', *The Leadership Quarterly*, Vol. 28, pp.585–604.

Appendix

	NPI-16 (English)	*NPI-16 (Italian)*	*NPI-16 (French)*
1	I know that I am good because everybody keeps telling me so.	So che valgo perché gli altri non fanno altro che dirmelo.	Je sais que je suis bon parce que tout le monde me le répète sans cesse.
2	I like to be the centre of attention.	Amo essere il centro dell'attenzione.	J'aime être le centre de l'attention.
3	I think I am a special person.	Penso di essere una persona speciale.	Je pense être quelqu'un de spécial.
4	I like having authority over people.	Amo avere l'autorità sugli altri.	J'aime avoir de l'autorité sur les autres.
5	I find it easy to manipulate people.	Trovo semplice manipolare le persone.	Je trouve qu'il est facile de manipuler les gens.
6	I insist upon getting the respect that is due me.	Di solito ho il rispetto che merito.	Je tiens à obtenir le respect qui m'est dû.
7	I am apt to show off if I get the chance.	Di solito cerco di essere esibizionista, se ne ho l'opportunità.	Je suis prêt à me donner en spectacle si j'en ai la chance.
8	I always know what I am doing.	So sempre quello che sto facendo.	Je sais toujours ce que je fais.
9	Everybody likes to hear my stories.	Tutti adorano ascoltare i miei racconti.	Tout le monde aime écouter mes histoires.
10	I expect a great deal from other people.	Mi aspetto molto dalle altre persone.	J'attends beaucoup de la part d'autrui.
11	I really like to be the centre of attention.	Mi piace molto essere al centro dell'attenzione.	J'aime vraiment être le centre de l'attention.
12	People always seem to recognise my authority.	La gente riconosce sempre la mia autorità.	Les gens semblent toujours reconnaître mon autorité.
13	I am going to be a great person.	Diventerò una persona famosa.	Je deviendrai quelqu'un d'important.
14	I can make anybody believe anything I want them to.	Posso far credere a chiunque quello che voglio.	Je peux faire croire n'importe quoi à n'importe qui.
15	I am more capable than other people.	Ho maggiori capacità rispetto alle altre persone.	J'ai plus de capacité que les autres.
16	I am an extraordinary person.	Sono una persona straordinaria.	Je suis une personne extraordinaire.