



Building up social support and epistemic status: the case of innovators in the French biotech industry

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Abstract:

Entrepreneurs' status may have an important effect on firm's performance. We explore the factors that may grant social status (as *friends*) and epistemic status (as *advisors*) to entrepreneurs in the French Biotechnology industry. In two waves and using a database with 138 and 126 biotech entrepreneurs respectively, we explore entrepreneur's status by measuring network centrality across time and in two impersonal exchange systems: friendship and advice. We draw on 3 dimensions through which entrepreneurs build their status: professional experience, inter-organizational engagement, and sociodemographic attributes. In terms of experience, we found that being the firm's founder is a predictor of epistemic and social status. As for engagement, we found that actors with presence in other firms' board have higher levels of centrality. Finally, we found that actors living in Paris and working in IPO companies are highly valued by their peers.

Keywords: status, centrality, innovation, advice network, friendship network

**Résumé :**

Le statut des entrepreneurs peut avoir un effet important sur la performance de l'entreprise. Nous explorons les facteurs qui peuvent accorder un statut social (en tant qu'amis) et un statut épistémique (en tant que conseillers) aux entrepreneurs de l'industrie française des biotechnologies. En deux vagues, et à partir d'une base de données regroupant respectivement 138 et 126 entrepreneurs biotech, nous explorons le statut d'entrepreneur en mesurant la centralité des individus dans le temps et dans deux systèmes d'échanges impersonnels : l'amitié et le conseil. Nous nous appuyons sur 3 dimensions à travers lesquelles les entrepreneurs construisent leur statut : l'expérience professionnelle, l'engagement inter-organisationnel et les attributs sociodémographiques. En termes d'expérience, nous avons constaté qu'être le fondateur de l'entreprise est un prédicteur du statut épistémique et social. En ce qui concerne l'engagement, nous avons constaté que les acteurs présents dans le conseil d'administration d'autres entreprises ont des niveaux de centralité plus élevés. Enfin, nous avons constaté que les acteurs vivant à Paris et travaillant dans des sociétés introduites en bourse sont très sollicités par leurs pairs.

Mots-clés : statut, centralité, innovation, réseau de conseil, réseau d'amitié



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INTRODUCTION

Biotechnology is a knowledge-intensive industry that relies on a fluid and dynamic collaboration network, including firms, universities, research laboratories, suppliers, and customers (Powell, 1990; Powell et al., 1996). In general, collaboration among organizations usually depends on their representative actors' status, for instance, as established and widely known partners (friends) or as experts (epistemic authorities) who can provide relevant counselling on crucial commercial or scientific matters. In this research, we claim that status, as friends and epistemic authorities, may be an important factor that could contribute to the exchange, specifically, of tacit knowledge, i.e., advice (Pina Stranger & Lazega, 2011).

Mainstream research, indeed, has been usually interested in the triggers favoring the spillover of informal knowledge, for example, in terms of proximity and clustering (Audretsch & Stephan, 1996). In this study, we assume that the possibility of exchanging tacit knowledge may be associated with entrepreneur's social and epistemic status within the collaboration network.

While maturing as innovators and obtaining experience in technology development and business, entrepreneurs claim expertise in important domains of biotechnology innovation in relation to scientific or financial topics. Such expertise is frequently subject to the scrutiny of the community of peers, who judge not only the quality of the claimed knowledge but also how trustworthy expert entrepreneurs are for collaboration. Thus, status as an expert and as a reliable stakeholder is a personal attribute obtained in a relational way. The members of the biotechnology ecosystem value and validate the 'credentials' that allow an entrepreneur to be 'credible' (words linked by the Latin word *credere*). In this context, we claim the necessity to explore the features that allow innovators to gain epistemic and social status from the community.



Recognition and legitimization of entrepreneurs' features are marked by socio-historical norms, values, beliefs, and definitions which underly a given milieu in a particular time (Suchman, 1995). Thus, some actors' attributes may be considered acceptable at different degrees in a particular social sphere. What is positively appreciated in a specific industry may trigger a negative assessment in another, for instance, being in possession of a PhD degree. In the case of engineering-based fields, for example, Roberts (1991) found that founders with a PhD were not positively regarded by their peers because they were considered to have a temperament, attitude, and orientation which were usually “out of line with those necessary for successful technical entrepreneurship” (p. 253). Similarly, in the technical industry of internet, Hsu (2007) found that having a PhD was significantly negative in relation to obtaining funding from VCs. These findings would lead us to question whether the PhD degree tends to be permeated with a negative connotation.

Socio-historical norms leading to epistemic or social status may work differently in knowledge-intensive fields, such as biotechnology. As in technology-based firms, where attributes, such as training in economics and management, may affect firms' growth (Colombo & Grilli, 2005), in the biotech sector entrepreneurs holding an MBA may be considered by their peers as more legitimate than those scientists claiming entrepreneurial experience only, thus affecting their position in the knowledge and social networks. While being in possession of 'credentials' signaling social capital and legitimacy, individuals are granted with a favorable status within a specific network that would potentially enhance or constraint their access to valued resources (Brass, 1984).

In this research, considering two observations (2008 and 2013) and drawing on network centrality as a proxy for status, we aim to identify and explain the attributes or 'credentials' that lead biotech entrepreneurs to be regarded as social and epistemic authorities. Indeed, our strategy mapping friendship and advice ties among entrepreneurs is grounded in the idea that an advice relationship may be also a friendship relationship (Ibarra, 1992), i.e., actors' homophily, in terms of entrepreneurs' experience (working in health sector, founding companies, studying abroad), inter-organizational engagement (participating in boards), and sociodemographic attributes (living in capital city, and working in IPO companies), would be correlated with the possibility of exchanging advice.



In our study, we have found that this claim is true, although with some variations. For example, our results suggest that homophily may have an influence in both networks and in both observations (e.g., participating in other companies' board); in one network and in both observations (e.g., studying in different countries was relevant for friendship, not for advice); or on any of the networks (e.g., studying an MBA).

Friendship and advice ties have been previously researched to explore its influence on firms' performance indicators (Gibbons, 2004), such as enhanced collaboration and better information exchange among competitors (e.g., Ingram & Roberts, 2000) or exchange of knowledge (e.g., (Pina Stranger & Lazega, 2011); yet little research has been conducted to explore the credentials (often referred also as social capital o signals) that allocate entrepreneurs in such a central power position within the biotechnology field.

In this article we first describe the theoretical framework, including research on centrality in both advice and friendship networks; subsequently, we describe our methodology, and we finalize with a description and a discussion of our main results.

1. THEORETICAL BACKGROUND

In this section, we describe the theoretical framework, including research on actors' attributes, and centrality through both personal and impersonal ties; then, we describe the set of attributes that will allow us to explain status via centrality measures, in both advice and friendship networks.

1.1 LINKING INDIVIDUAL ATTRIBUTES WITH PERFORMANCE

Individuals' attributes have been approached from at least two different theoretical perspectives. In the first approach, features, such as educational background or business experience, are seen as human capital if attributes represent sources of knowledge, or as social capital if attributes constitute valuable connections within the network. While human capital is created through 'changes in persons that bring about skills and capabilities that make them able to act in new ways' (Coleman, 1988, p.100), social capital is a resource available to actors as a function of their location in the structure of their social relations (e.g., market, social relations, education, etc.). In this regard, extensive research has accounted for the association between 'social capital' and companies' 'performance', such as access to loans and lower interests (Uzzi, 1999), access



to venture capital (Zhang, 2019), facilitation of resource exchange and product innovation (e.g., Tsai & Ghoshal, 1998) or strengthening supplier relations (e.g., Uzzi, 1997). Thus, it is possible to establish that social capital, emerging from the relations among actors, contributes directly to obtain 'social credentials' (Hsu, 2007) while human capital, which is developed from knowledge and skills', may contribute to the obtention of 'epistemic credentials'.

In the second approach, individuals' attributes are considered 'signals' or 'symbols of legitimacy' (Feldman & March, 1981). When there is not reliable information, investing organizations, for example, base their decisions on 'observable' features of information (Feldman & March, 1981), 'observable resources' (Hoenig & Henkel, 2015) or 'meaningful patterns' that help 'connecting the dots' (Baron & Ensley, 2006). The signaling effects may be benefited in different ways. For example, based on entrepreneurs' scientific background, VCs could take a wise decision over investing on an unexperienced biotech start-up, or entrepreneurs with appealing backgrounds might be strategically hired as CEOs to attract high investments.

Within the signaling approach, Higgins and Gulati (2006), in the field of biotech found that upper echelons' origin, specially from biopharma, allowed firms to receive the endorsement of prestigious investment banks.

In the next subsection, we describe some influential research on centrality using formal and informal ties.

1.2 CENTRALITY THROUGH FORMAL AND INFORMAL TIES

Centrality has been mostly researched as a variable to research performance indicators, specially through formal ties, such as patents and R&D contractual relations (Zhou et al., 2021; Gilding et al., 2020; Ahuja, 2000; Smith-Doerr et al., 1999), firm-to-firm and government-to-firm collaboration networks (Rojas et al., 2018), published articles (Chen et al., 2020), VC's prestige (Chou et al., 2013), and co-investment networks (Antretter et al. (2020)). It is also possible to find works in which companies' centrality position is explained through sets of values, instead. For example, based on social capital theory and considering 114 biotechnological start-ups, Walker et al. (2009) investigated companies' centrality by means of the number of relationships with new partners, number of relationships with incumbent partners in different periods, size, IPO, regional concentration, start-up experience, partner experience,



number of start-ups. More recently, Huggins et al. (2020) explained institutions' centrality through specific characteristics (e.g., involvement in funded research projects with external actors) and performance indicators (such as status, prestige, reputation, and size). Tsai et al. (2019) considered Chinese companies' centrality (in terms of political connections) by means of the number of patent applications in a year, the number of registered patent applications in a year, and type of patents, concluding that firms with stronger political connection innovate more. Thus, centrality has been explored through a wide, although conservative, number of firms' performance indicators, usually including patents, patent's applications, and specific types of commercial relationship.

In the case of interpersonal ties, a limited number of studies has been focused on the effect of interpersonal links between organizations and economic activities (Pina Stranger & Lazega, 2011), probably, due to the demanding resources needed by this type of research. Among interpersonal ties, advice and friendship have been extensively explored, mainly, because they are instantiated in different interactions, represent dissimilar relations, and serve diverse purposes (Gibbons, 2004). Despite its relevance, few studies have treated them as multiplex networks to explain social complexities. Among these efforts, it is possible to find that of Gibbons (2004)'s, who explored the attributes of the friendship and advice networks to hypothesize about their roles in maintaining or changing professional values at an organizational level. With the exception Gibbons (2004)'s (and other scholars, e.g., Ibarra, 1992), research including credentials has tended to rely on the advice and friendship exchange systems separately, as we will describe in the following subsection.

Advice has been a relevant exchange system used to explore how epistemic credentials may affect innovation. As highlighted by Galloway et al. (2019), entrepreneurs will be more likely to rely on advice from peers they believe possess valuable knowledge applicable to their business. One key aspect in measuring advice centrality is dyad's "reciprocity", where asymmetrical relationship among actors may account for prestige or power (Burt, 1982). Although advice can be used as a network system to explain firm's performance (e.g., Wolff et al., 1997), literature on the topic seems not to be as extensive as that using performance indicators to explain advice centrality, for example, through in terms of individual job performance (e.g., Sparrowe et al., 2001), and job benefits from colleagues (Cross et al., 2001).



Friendship ties, i.e., who is recognized as a friend in a network (see Krackhardt, 1992, to learn his theory on *philos*), is another interpersonal exchange system that can affect innovation, for example, in terms of benefits from competitors (Ingram & Roberts, 2000), and sales and employee growth (Sullivan et al., 2020).

1.3 TOWARDS SOCIAL AND EPISTEMIC CENTRALITY

As we have pointed out, entrepreneurs can be granted with social and epistemic status based on different 'credentials', 'measures of social capital' (Hsu, 2007) or, as put it by Nigam et al. (2020), 'quality signals'. Among the credentials often considered by the literature, we are particularly interested in experience, i.e., as academic, professional in the Biotech industry, and entrepreneur); inter-organizational and regulatory engagement (e.g., presence in venture boards and professional associations); and organization' features (e.g., IPO firm, and city location). Each of these dimensions correspond to a hypothesis to explain entrepreneurs' centrality in the social and epistemic networks.

1.3.1 Experience (professional in the biotech industry, as an academic or entrepreneur)

Experience of entrepreneurs is a well-known credential, specially, to attract VCs to invest. Indeed, investors often claim that “they bet on the jockey, not on the horse” when choosing which ventures to back, probably, because those with prior industry experience or technical skills related to the industry are aware of the industry norms, rules, and dynamics of every changing environment (Delmar & Shane, 2006). Higgins and Gulati (2006) analyzed which information about firms undertaking an initial public offering (IPO) could affect investor decisions, specially, when such young firms have limited track records (i.e., unavailable objective measures of quality) and face challenges associated with gaining legitimacy in their industries. The authors found that upper echelons' “origin” (i.e., work experience), specially from the bio-pharmaceutical sector, affected the capacity of a firm to receive the endorsement of prestigious investment banks, and its investments. Cohen and Dean (2005) studied the relation between top management team (TMT)' legitimacy and IPO investment valuation (i.e., under-pricing) in the context of asymmetry between investors and pre-IPO owners. The authors found that, unlike education, industrial experience, TMT experience, and age had a significant negative impact on under-pricing. Professional experience, however, is not always recognized as a significant credential. Hall and Hofer (1993) explored, using qualitative methodologies,



the criteria that venture capitalists use to make investment decisions. Interestingly, the authors found that entrepreneurs' features, such as age and industry experience, did not play a major role in go or no-to-go decisions. Based on the evidence related to VCs decision on investing in specific innovation firms, we contend the following hypothesis about entrepreneurs' centrality:

Hypothesis 1a: Industry experience (years in the biotech industry) may have an influence in actors' centrality network positions

Entrepreneurial experience has also been considered as a valuable credential in the innovation field. In general, it is possible to distinguish between novice, serial, and portfolio entrepreneurs, which, as Westhead et al. (2005) have found, may differ in terms of their decisions, actions, and performance (Parker, 2013). Among these three, particularly vast is the literature on serial entrepreneurs, also referred to as repeat and experienced entrepreneurs, as in Baron and Ensley (2006) or Zhang (2011). Research on entrepreneurial experience has found that prior start-up founding experience can serve as a powerful human capital signal (Hsu, 2007) and can increase the likelihood of obtaining VC funding. The possible reason, according to Zhang (2011), is that entrepreneurs with prior firm-founding experience are expected to have more skills and social connections than novice entrepreneurs. Based on this, we contend the following hypothesis:

Hypothesis 1b: Entrepreneurial experience in founding companies may have an influence in actors' centrality network positions

Frequently considered as a source of "power" (Saidu, 2019) or a "wealth effect" trigger (e.g., Colombo & Grilli, 2005), entrepreneurs' education is usually treated as a variable to explain firm's performance although with inconclusive results. While approaching education as an "accumulation of knowledge", the type of training (e.g., financial, or scientific), the number of years of a specific training and the educational level (MSc or PhD) have been the most common proxies in econometric-type research (Lindorff & Jonson, 2013; Colombo & Grilli, 2005; Cohen & Dean, 2005). With a broader approach, Saidu (2019) explored how CEO characteristics, such as education, ownership and origin, could influence firm performance (profitability), finding that education improved profitability, probably, because of the source of connections education provides to executives.



Beyond the accumulation-of-knowledge approach observed in the literature, it is possible to find some research considering education as a social prestigious attribute. Nigam et al. (2020), for example, have found that a degree from an elite educational institute and the breadth of the entrepreneurial team are positively associated with the likelihood of access to financing. Thus, we adapted a geographical perspective, i.e., we focus on the locus of entrepreneurs' education background. Given the fact that educational institutions are often considered as excellent sources for networking, it would be worth to consider whether an entrepreneur has studied in France only, in a foreign country or in several countries. Based on this, we contend the following hypothesis:

Hypothesis 1c: Educational experience may have an influence in actors' centrality network positions

1.3.2 Political engagement

In this research, political engagement refers to the participation of a firm's executive officer in another institution (i.e., to have a second business affiliation that could bring him or her some benefit). Literature on this topic, to our knowledge, is still scarce. Among the scholars working on this subject, we find Do et al. (2016), who explored the impact of the external networks of corporate directors (specifically, with winning politicians) on firms' value and decisions. In a different scenario, Rosenstein et al. (1993) analyzed the involvement of VCs on boards of directors. As main results, the authors found that CEOs evaluated VC board members as being useful in several areas, but principally in monitoring financial performance. These two studies, one related to corporate directors' network and the other one on VCs' participation in boards, refer to the social and epistemic relevance of actors involved in political activities. Thus, in our research we explore political engagement by identifying the presence of entrepreneurs in venture boards and professional associations. Based on this, we contend the following hypothesis:

Hypothesis 2. Political engagement may have an influence in actors' centrality network positions



1.3.3 Firms' sociodemographics: type of company and location

Type of firms, i.e., IPO (Initial Public Offering) or private companies, and firms' location are two factors that would allow entrepreneurs to be allocated with social or epistemic credentials. In the case of IPOs, working for this type of company can be seen as a good signal for partnership. Indeed, according to Kutsuna et al. (2016), non-public SMEs (private firms) can benefit indirectly when their supply-chain partners access public equity markets. This corresponds to the so called “IPO spillover hypothesis”. Among the benefits, IPOs firms transmit liquidity to private firms through their trade credit practices and/or by other means. IPO firms can also provide liquidity to suppliers by paying more quickly and to customers by allowing them to pay more slowly. Thus, given the positive spillover effect, it is expected that social status may be granted to a specific actor belonging to an IPO firm, specially, if the status-granting stakeholder has been, is or would be involved in the supply chain of the IPO company. Based on this, we contend the following hypothesis:

Hypothesis 3a: Working in a public company (IPO) may have an influence in actors' centrality network positions

Finally, firms' location, i.e., being currently based on a capital city, may be another factor that allocate entrepreneurs with social or epistemic credentials. Indeed, agglomerations, such as London, Berlin, and Paris are often identified as “prolific hubs” that foster the creation of start-ups. Research on capitals, as agglomerations favoring innovation, have aimed to explore the effects of geographic distance in developing business, yet with inconclusive results. Some studies, for example, have referred to the poor and “overestimated” effects of “spatial proximity” on performance, for example, in relation to growth (Grillitsch & Nilsson, 2017) and investment (Fritsch & Schilder, 2008). Most literature referring to the allegedly “overestimated” effects of proximity question the argument that tacit knowledge would trigger proximity among actors. The reason relies on the fact that knowledge-based industries would promote tangible knowledge (such as patents) rather than tacit knowledge, thus making co-location apparently unnecessary.

Contrarily, there is still vast evidence showing the relevance of geographic distance to boost innovation, specially, in terms of growth and investment (Audretsch & Dohse, 2007; Lutz et al., 2013), decreasing information asymmetry (Lutz et al., 2013), promoting mutual trust and



cooperative behavior (De Clercq & Sapienza, 2001), building communities around shared language, common norms and values, among others (Nahapiet & Ghoshal, 1998; Molina-Morales et al., 2014), promoting exchanging information and knowledge, avoiding misunderstanding (Inkpen & Tsang, 2005), allowing managing the flux of coded information and tacit information (Gertler, 2003); and increasing the ability to assess and evaluate external knowledge and information collectively within a cluster (Döring & Schnellenbach, 2006). Relying on the effects of networking withing an agglomeration, we contend that entrepreneurs based in Paris would be granted with a social or epistemic status in opposition to others based un a different region:

Hypothesis 3b: Working from the capital city (Paris) may have an influence in actors' centrality network positions

As we have described in this section, innovators can be granted with social and epistemic status based on different “credentials”, such as experience, inter-organizational and regulatory engagement, and organization' features. In the following section, we will describe the methodology, the results, and the discussion of our main findings.

2. METHODOLOGY

2.1 DATA COLLECTION

In this subsection, we describe our sample as well as the data, and we offer some precisions regarding the elaboration of our variables.

2.1.1 Sample and data

Our network analysis is based on two observations, in 2008 and 2013, of friendship and advice exchanges among entrepreneurs in the French biotech industry. The first observation included 138 entrepreneurs from 78 companies while the second one included 126 entrepreneurs from 92 firms. Of the total, 68 entrepreneurs were present in both observations. Approximately half of the companies are in Paris while the rest is in regional biotech clusters. The observed population of entrepreneurs from the 2008 dataset was carefully selected through preliminary ethnographic research. First, lists of biotech companies from biotech specific website were explored. As a first filter, companies self-defined as biotech, but providing service without



proprietary technology or providing advice only, were excluded as well as firms created as subsidiary companies, and the ones created in a non-French country. Then, only biotech companies working in “human health”, and which had raised more than 500K\$ at that time were kept conforming thus a more specific population. We identified 94 biotech companies with this profile and, from this selection, 1 to 4 entrepreneurs per company were selected to obtain a population of 220 entrepreneurs, of which 138 were interviewed for 9 months to obtain qualitative information about their potential relationship with other entrepreneurs of the industry.

In 2013, a second wave of interviews was performed, considering the same entrepreneurs, when possible, as well as the new entrepreneurs identified following the same approach. The entrepreneurs interviewed in 2008, who were no longer working in the biotech industry during the collection were removed from our population.

For the interviews, a survey was created to collect data and verify our hypotheses. We asked entrepreneurs to check the boxes next to the name of other entrepreneurs in our population when: 1) they consider the person like a friend” (a friend is someone with whom you would stay in contact even after changing your profession”); and 2) they asked advice “on a complex situation linked to: a) the management of relationships with an academic research Centre; b) the management of relationships with pharmaceutical companies; c) the management of relationships with investors”.

We used (1) to build friendship networks while all items in (2) were used to build the advice network.

2.1.2 Precisions

All centrality measures used as dependent variables in our model were directly taken from the respective networks. The other attributes on entrepreneurs used as independent variables were either collected in the survey, extracted from their resume, or calculated from the network and existing attributes. We have selected the attributes that were useful to test our hypothesis and we filtered those that did not fit our model. Finally, we have grouped the selected attributes in three dimensions: (1) experience, (2) activism/involvement and (3) financial status of the company.



Based on data collected from the survey, four different networks were created: Advice 2008, Friendship 2008, and Advice 2013, Friendship 2013. We used R software to perform our analysis and Python to process existing data and create meaningful variables for our multiple logistic regression models. Social Network Analysis (SNA) was used to get a proxy measure of centrality used in our model, such as degree centrality, which corresponds to our dependent variable, for both friendship and advice networks.

We use the “indegree attribute” to measure the centrality of an entrepreneur in advice and friendship networks. Other measures could have been used, such as “betweenness centrality” or “structural holes” but degree centrality has been considered as one of the main indicators of centrality in a network (e.g., Chen et al., 2020). Moreover, degree centrality and the other measures of centrality are usually correlated in mainstream research (e.g., Valente et al., 2008; Powell et al., 1996; Ahuja, 2000).

2.1.3 Dependent variables

We used degree centrality to quantify the importance of individuals in a network. More specifically, we used indegree to measure and identify the most “popular” entrepreneurs in our four exchange networks. Thus, the entrepreneurs who were asked for advice the most are considered as “epistemic authorities” in the biotech industry. As for friendship, the ones who were mostly selected as “friends” correspond to the most popular entrepreneurs of the ecosystem and can benefit from their social status.

We used multiple Poisson regression analysis with indegree measures as a count data (non-negative integer value) to analyze (1) epistemic authority within the advice network and (2) popularity in the friendship network. Since Poisson model is known for overdispersion, we use robust standard error, to control, according to Colin Cameron and Trivedi (2009), for mild violation of the distribution assumption in which the variance equals the mean.

2.1.4 Independent variables

Entrepreneurs' features have been associated with three dimensions: (1) experience, (2) political engagement, (3) company attributes. Each dimension contains one or several characteristics that we use as independent variables to build our regressions models. The first dimension



includes three independent variables related to academic and professional experience. The first variable (binary) corresponds to *scientificTraining*, where 1 is annotated if the entrepreneur has a background in natural science (PhD, Engineer, MSc) and 0 if otherwise. The second variable (binary) corresponds to *doubleDegree*, where 1 is annotated if the entrepreneur has studies in finance (MBA) after having obtained the science degree, and 0 if not. The third variable (binary) corresponds to *internationalStudies*, where 1 is annotated if the entrepreneur has studied in more than one country, and 0 if not. In the second dimension of experience, the variable (continuous) *ExpSante* includes the number of years that the entrepreneurs have worked in the healthcare industry. Finally, the third dimension has two variables. The first variable (continuous) corresponds to *FoundedCompanyinPast*, which accounts for the number of companies that the entrepreneur has created in the past (the current company does not count if the entrepreneur is the founder). The second variable (binary) corresponds to *Founder*, where 1 is annotated if the entrepreneur is the founder of the company is working in, and 0 if not.

In the second dimension, we observe activism or entrepreneurs' involvement in other companies' board as well as extra-professional activities, such as presence in associations. This dimension includes two independent variables. The first variable corresponds to *nCa*, i.e., the number of Boards of Administration related to the entrepreneur. The variable *nCa* is an index created to measure the importance of the entrepreneur in governance boards. The higher the index, the more popular the entrepreneur. The second variable corresponds to *nAssociations*, i.e., the number of associations in which the entrepreneur has a membership. Since external associations would allow entrepreneurs to learn, meet and work with others, actors participating in other firms are expected to be highly popular.

In the last dimension, we observe the status of the company represented by the entrepreneur. This dimension includes two variables. The first variable (z normalization) corresponds to *privateInvestments*, i.e., the private investment received by the company in the 5 years preceding the data collection. The second variable (binary) corresponds to *publicCompany*, i.e., if the firm correspond to a post IPO company. This variable equal 1 if the company where the entrepreneur is working is public, and 0 if not.



2.1.5 Control variables and network effects

We include control variables that covers demographic characteristics and well-known network effects. Regarding the demographic features, we controlled for age, corresponding to the age of the entrepreneur (continuous); the region where the entrepreneur was living (binary), where 1 was annotated if the person was living in Paris and 0 if somewhere else. Regarding network effects (Figure 2), we controlled for Reciprocity (Reciprocity_X*), i.e., the closure coefficient for reciprocity. This was calculated to measure the reciprocity of the links declared by the entrepreneur. Since the link is directed, it can also demonstrate the (direct) hierarchy in the network. The coefficient goes from 0 to 1, where higher values represent higher levels of reciprocity. We also controlled for Transitivity (Transitivity_X*), i.e., local clustering coefficient. A local clustering coefficient is calculated for each entrepreneurs' personal networks. The coefficient goes from 0 to 1. Higher value represents higher transitivity and can demonstrate the entrepreneur is connected to a cluster of entrepreneurs. Finally, we controlled for Solidarity_X*, i.e., Local “Solidarity” closure coefficient. A local (non-)closure coefficient is calculated to measure the hierarchic position of the entrepreneur in the network. The coefficient goes from 0 to 1, where higher values represent higher position in the hierarchy (n+1). It is worth noting that these coefficients were calculated for each network. To differentiate in our models, we replace *X* by *F* for the friendship network and by *A* for the advice network.

3. RESULTS AND DISCUSSION

Correlations between the variable of interest are presented for each year, 2008 in 2013. The model can be represented as follows, where NetworkT.20XX.IN_DEGREE corresponds to the indegree measure for either friendship or advice in 2008 or 2013:

$$\begin{aligned} \log(\text{NetworkT.20XX.IN_DEGREE}) &= \beta_0 + \beta_1 \text{ScientificTraining} + \beta_2 \text{doubleDegree} + \beta_3 \text{InternationalStudies} \\ &+ \beta_4 \text{ExpSante} + \beta_5 \text{foundedCompanyInPast} + \beta_6 \text{Founder} + \beta_7 \text{nCA} \\ &+ \beta_8 \text{nAssociations} + \beta_9 \text{coeffReciprocityT}_{20XX} + \beta_{10} \text{coeffSolidarityT}_{20XX} \\ &+ \beta_{11} \text{coeffTransitivityT}_{20XX} + \beta_{12} \text{privateInvestment}_{20XX} \\ &+ \beta_{13} \text{publiCompany} + \beta_{14} \text{Age} + \beta_{15} \text{Region_Paris} \end{aligned}$$



We use 0.05 as the level of significance with robust standard errors to tackle the problem of overdispersion which is often observed when using Poisson regression. All models were checked and are globally significant. We observed outliers in each network, yet they have been checked individually to avoid errors in our data. The model is divided in 8 to observe all the dimensions separately. However, in the result section, we used the last model (8), which is the most complete and better represents the data (the AIC value is lower) to interpretate our models. With the Poisson regression model, the exponents of coefficients are equal to the incidence rate ratio. It allows to give a percentage on the “relative risk” for entrepreneurs to be more central in the network in function of their attributes. For each model, we present the correlation matrix (Figure 1 and Figure 3), the Poisson regression models (Figure 3 and Figure 4), and the incidence rate ratios (Figure 5 and Figure 6), which were mainly used to present our results (specifically, through values corresponding to the *Estimate* column).

Figure 1. Correlation matrices for 2008 Friendship and 2008 Advice networks

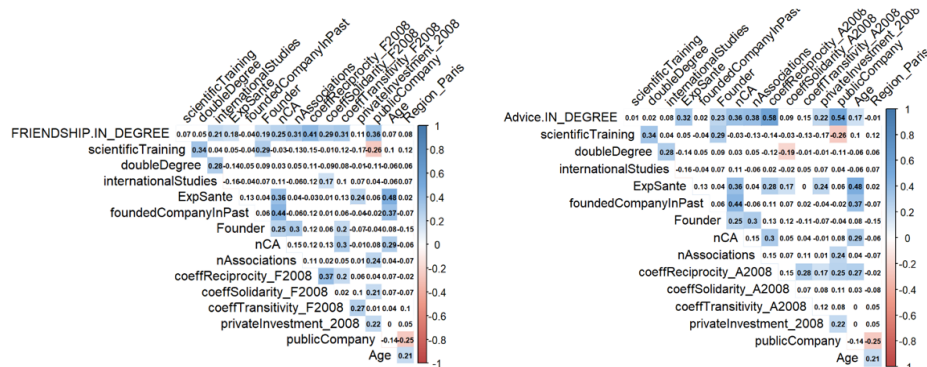




Figure 2. Regression models for 2008 Friendship and 2008 Advice networks

Friendship-network regressions								
	Dependent variable: FRIENDSHIP_IN_DEGREE							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
scientificTraining	0.41** (0.20)			0.12 (0.21)	0.35* (0.20)	0.11 (0.20)		
doubleDegree	-0.04 (0.21)			0.03 (0.22)	-0.12 (0.25)	0.04 (0.23)		
internationalStudies	0.43** (0.20)			0.44** (0.21)	0.47** (0.17)	0.38** (0.17)		
ExpSante		0.02* (0.01)		0.02** (0.01)	0.01 (0.01)	0.03*** (0.01)		
foundedCompanyInPast			-0.06 (0.04)	-0.05 (0.05)	-0.07 (0.05)	-0.06 (0.05)		
Founder			0.59*** (0.16)	0.50*** (0.16)	0.21 (0.19)	0.13 (0.18)		
nCA					0.14*** (0.05)	0.11 (0.07)	-0.01 (0.05)	
nAssociations					0.16*** (0.05)	0.17*** (0.06)	0.17*** (0.06)	
coeffReciprocity_F2008						0.85*** (0.18)	0.79*** (0.16)	
coeffSolidarity_F2008						1.00*** (0.31)	1.18*** (0.38)	
coeffTransitivity_F2008						1.91*** (0.43)	1.90*** (0.59)	
privateInvestment_2008	0.04 (0.05)	-0.01 (0.06)	0.03 (0.06)	-0.003 (0.07)	0.04 (0.06)	0.04 (0.07)	-0.06 (0.06)	-0.08 (0.08)
publicCompany	1.00*** (0.17)	0.94*** (0.23)	1.00*** (0.19)	0.92*** (0.19)	0.74*** (0.20)	0.73*** (0.19)	0.91*** (0.20)	0.69*** (0.19)
Age	0.01 (0.01)	0.004 (0.01)	0.01 (0.01)	0.003 (0.01)	0.002 (0.01)	-0.002 (0.01)	0.01 (0.01)	-0.004 (0.01)
Region_Paris	0.29 (0.18)	0.40** (0.20)	0.43** (0.20)	0.35* (0.20)	0.40** (0.19)	0.31* (0.18)	0.40** (0.19)	0.30* (0.17)
Constant	-0.27 (0.51)	0.33 (0.51)	-0.32 (0.50)	-0.21 (0.57)	0.28 (0.45)	-0.10 (0.50)	-0.97* (0.58)	-1.29* (0.69)
Observations	138	138	138	138	138	138	138	138
Log Likelihood	-362.58	-373.55	-361.24	-348.66	-356.26	-335.68	-309.57	-282.66
Akaike Inf. Crit.	741.16	759.10	736.48	719.32	726.52	697.36	635.15	597.31
Note: *p<0.1; **p<0.05; ***p<0.01								

Advice-Network regressions								
	Dependent variable: Advice-IN_DEGREE							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
scientificTraining	0.29 (0.20)			-0.12 (0.19)	0.11 (0.20)	0.32* (0.17)		
doubleDegree	0.09 (0.20)			0.16 (0.19)	0.05 (0.20)	0.08 (0.18)		
internationalStudies	0.13 (0.20)			0.14 (0.19)	0.12 (0.18)	0.16 (0.12)		
ExpSante		0.02** (0.01)		0.02*** (0.01)	0.01 (0.01)	0.02* (0.01)		
foundedCompanyInPast			-0.07 (0.05)	-0.07 (0.05)	-0.11*** (0.04)	-0.09 (0.06)		
Founder			0.73*** (0.17)	0.73*** (0.17)	0.44** (0.18)	0.37** (0.15)		
nCA					0.15*** (0.04)	0.14** (0.06)	0.05 (0.06)	
nAssociations					0.18*** (0.05)	0.13** (0.05)	0.09** (0.04)	
coeffReciprocity_A2008						1.47*** (0.20)	1.32*** (0.20)	
coeffSolidarity_A2008						-0.06 (0.20)	-0.02 (0.23)	
coeffTransitivity_A2008						-0.13 (0.29)	0.37 (0.23)	
privateInvestment_2008	0.10** (0.05)	0.06 (0.05)	0.09* (0.05)	0.05 (0.05)	0.11** (0.05)	0.10* (0.06)	0.04 (0.04)	0.02 (0.05)
publicCompany	1.40*** (0.17)	1.28*** (0.18)	1.37*** (0.16)	1.29*** (0.16)	1.07*** (0.15)	1.10*** (0.15)	1.11*** (0.15)	1.00*** (0.12)
Age	0.04*** (0.01)	0.03** (0.01)	0.04*** (0.01)	0.03** (0.01)	0.02** (0.01)	0.02* (0.01)	0.02** (0.01)	0.01 (0.01)
Region_Paris	0.18 (0.18)	0.24 (0.18)	0.28 (0.17)	0.26 (0.17)	0.26 (0.16)	0.21 (0.14)	0.31* (0.17)	0.16 (0.12)
Constant	-0.62 (0.51)	-0.03 (0.46)	-0.88* (0.45)	-0.68 (0.54)	-0.08 (0.39)	-0.48 (0.48)	0.01 (0.43)	-0.40 (0.54)
Observations	138	138	138	138	138	138	138	138
Log Likelihood	-521.63	-522.88	-486.98	-471.88	-480.65	-445.78	-439.37	-376.08
Akaike Inf. Crit.	1,059.25	1,057.76	987.96	965.76	975.29	917.56	894.74	784.17
Note: *p<0.1; **p<0.05; ***p<0.01								

Figure 3. Correlation matrices for 2013 Friendship and 2013 Advice networks

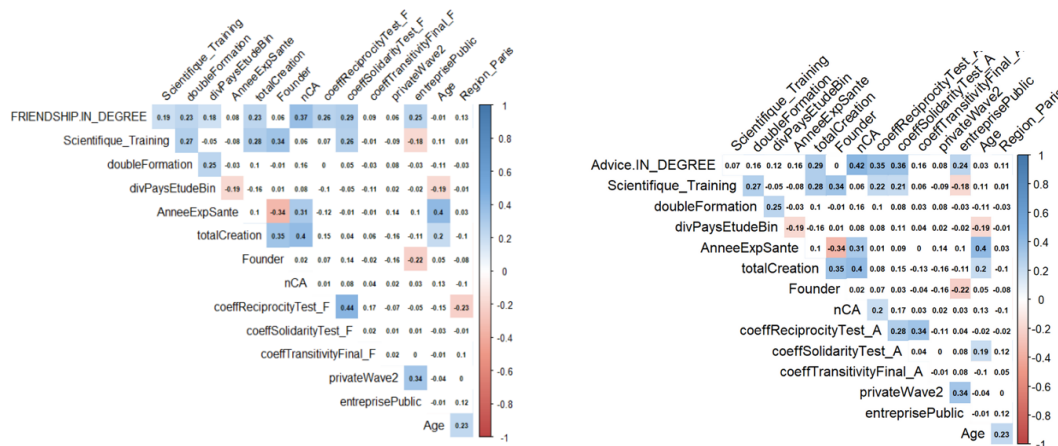




Figure 4. Regression models for 2013 Friendship and 2013 Advice networks

Friendship-Network regressions								Advice-Network regressions							
	Dependent variable:								Dependent variable:						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)		(1)	(2)	(3)	(4)	(5)	(6)	(7)
scientificTraining	0.57*** (0.22)			0.47** (0.19)		0.52*** (0.18)	0.46*** (0.17)	scientificTraining	0.26 (0.26)			0.17 (0.23)		0.24 (0.22)	-0.004 (0.20)
doubleDegree	0.25 (0.17)			0.22 (0.16)		0.14 (0.15)	0.19 (0.14)	doubleDegree	0.29 (0.23)			0.24 (0.22)		0.13 (0.20)	0.14 (0.17)
internationalStudies	0.35* (0.20)			0.55*** (0.21)		0.44** (0.21)	0.54*** (0.19)	internationalStudies	0.31 (0.24)			0.63*** (0.23)		0.47** (0.23)	0.34 (0.22)
ExpSante		0.01 (0.01)		0.02* (0.01)		0.01 (0.01)	0.01 (0.01)	ExpSante		0.02 (0.01)		0.03** (0.01)		0.02 (0.11)	0.01 (0.01)
foundedCompanyInPast			0.26*** (0.08)	0.25*** (0.08)		0.14 (0.09)	0.13 (0.09)	foundedCompanyInPast			0.40*** (0.11)	0.40*** (0.10)		0.25** (0.11)	0.25** (0.10)
Founder			0.39** (0.18)	0.42** (0.17)		0.34** (0.16)	0.35** (0.14)	Founder			0.38 (0.24)	0.52** (0.22)		0.41** (0.20)	0.39** (0.19)
nCA					0.31*** (0.06)	0.23*** (0.07)	0.21*** (0.06)	nCA					0.44*** (0.08)	0.31*** (0.09)	0.24*** (0.08)
coeffReciprocity_F2013							0.51** (0.20)	coeffReciprocity_A2013							0.93*** (0.33)
coeffSolidarity_F2013							0.97** (0.46)	coeffSolidarity_A2013							1.83*** (0.37)
coeffTransitivity_F2013							0.17 (0.26)	coeffTransitivity_A2013							0.25 (0.43)
privateInvestment_2013	-0.05 (0.06)	-0.03 (0.06)	0.01 (0.05)	-0.04 (0.05)	-0.02 (0.05)	-0.02 (0.04)	-0.02 (0.05)	privateInvestment_2013	-0.03 (0.07)	-0.02 (0.06)	0.04 (0.06)	-0.01 (0.07)	0.01 (0.05)	0.005 (0.06)	0.03 (0.06)
publicCompany	0.57*** (0.17)	0.44** (0.19)	0.50*** (0.18)	0.63*** (0.17)	0.42*** (0.16)	0.59*** (0.15)	0.48*** (0.18)	publicCompany	0.63*** (0.22)	0.52** (0.23)	0.57** (0.23)	0.68*** (0.23)	0.50** (0.20)	0.62*** (0.22)	0.43** (0.22)
Age	-0.001 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01* (0.01)	-0.01 (0.01)	-0.01* (0.01)	-0.01 (0.01)	Age	0.005 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.02* (0.01)	-0.003 (0.01)
Region_Paris	0.18 (0.14)	0.20 (0.16)	0.28* (0.17)	0.34** (0.15)	0.29** (0.14)	0.38*** (0.14)	0.27 (0.14)	Region_Paris	0.16 (0.19)	0.19 (0.19)	0.29 (0.21)	0.39** (0.18)	0.31* (0.18)	0.45** (0.19)	0.15 (0.17)
Constant	0.61 (0.42)	1.49*** (0.36)	1.24*** (0.33)	0.60 (0.38)	1.26*** (0.34)	0.53 (0.38)	-0.69 (0.56)	Constant	0.47 (0.53)	1.28*** (0.47)	0.93** (0.40)	0.49 (0.48)	0.83** (0.40)	0.40 (0.49)	-0.50 (0.57)
Observations	126	126	126	126	126	126	126	Observations	126	126	126	126	126	126	126
Log Likelihood	-341.88	-364.40	-348.36	-322.37	-334.06	-309.50	-335.11	Log Likelihood	-387.61	-394.86	-368.37	-345.25	-344.91	-324.09	-283.37
Akaike Inf. Crit.	699.77	740.81	710.71	666.75	680.12	643.00	686.21	Akaike Inf. Crit.	791.22	801.72	750.75	712.49	701.82	672.18	596.75
Note:	*p<0.1; **p<0.05; ***p<0.01							Note:	*p<0.1; **p<0.05; ***p<0.01						

Figure 5. Regression Odd ratios for 2008 Friendship (left) and Advice (right) networks

	Estimate	Robust SE	LL	UL		Estimate	Robust SE	LL	UL
(Intercept)	0.2747517	0.1889921	0.0713539	1.057945	(Intercept)	0.6540116	0.3566995	0.2245586	1.904765
scientificTraining	1.1212906	0.2295297	0.7507112	1.674802	scientificTraining	1.3477345	0.2428834	0.9466760	1.918701
doubleDegree	1.0378060	0.2401976	0.6593319	1.633534	doubleDegree	1.1391831	0.2213304	0.7784158	1.667153
internationalStudies	1.4606901	0.2464980	1.0493283	2.033316	internationalStudies	1.1574692	0.1439692	0.9070531	1.477019
ExpSante	1.0258699	0.1889921	1.0073544	1.044726	ExpSante	1.0158136	0.3566995	0.9997935	1.032090
foundedCompanyInPast	0.9408473	0.2295297	0.8456651	1.046742	foundedCompanyInPast	0.9142986	0.2428834	0.8197672	1.019731
Founder	1.1418416	0.2401976	0.7974151	1.635036	Founder	1.4641951	0.2213304	1.0832153	1.979170
nCA	0.9873670	0.2464980	0.8608148	1.132524	nCA	1.0483221	0.1439692	0.9202893	1.194167
nAssociations	1.1846466	0.1889921	1.0525621	1.333306	nAssociations	1.0943333	0.3566995	1.0078645	1.188220
coeffReciprocity_F2008	2.2019739	0.2295297	1.6198714	2.993255	coeffReciprocity_A2008	3.7510622	0.2428834	2.5497316	5.518411
coeffSolidarity_F2008	3.2706807	0.2401976	1.5650534	6.835136	coeffSolidarity_A2008	0.9910848	0.2213304	0.6318090	1.554662
coeffTransitivity_F2008	6.6703121	0.2464980	2.0955813	21.231848	coeffTransitivity_A2008	1.4574178	0.1439692	0.9339927	2.274179
privateInvestment_2008	0.9252973	0.1889921	0.7902978	1.083358	privateInvestment_2008	1.0207371	0.3566995	0.9234698	1.128249
publicCompany	2.0001862	0.2295297	1.3871479	2.884152	publicCompany	2.7323326	0.2428834	2.1280654	3.508182
Age	0.9958523	0.2401976	0.9742789	1.017903	Age	1.0090611	0.2213304	0.9864631	1.032177
Region_Paris	1.3461092	0.2464980	0.9576839	1.892075	Region_Paris	1.1774662	0.1439692	0.9207921	1.505689

Figure 6. Regression Odd ratios for 2013 Friendship (left) and Advice (right) network

	Estimate	Robust SE	LL	UL		Estimate	Robust SE	LL	UL
(Intercept)	0.5022254	1.718694	0.1737439	1.451737	(Intercept)	0.5039341	1.780013	0.1627588	1.5602819
scientificTraining	1.5917814	1.187789	1.1360412	2.230349	scientificTraining	0.9960964	1.222658	0.6717122	1.4771325
doubleDegree	1.2076379	1.145919	0.9246875	1.577170	doubleDegree	1.1485509	1.187803	0.8196928	1.6093459
internationalStudies	1.7083097	1.210888	1.1740399	2.455709	internationalStudies	1.4028328	1.244731	0.9133936	2.1545363
ExpSante	1.0126285	1.008792	0.9954037	1.030151	ExpSante	1.0147793	1.011187	0.9928911	1.0371499
foundedCompanyInPast	1.1338510	1.093776	0.9511663	1.351623	foundedCompanyInPast	1.2836690	1.105553	1.0544768	1.5626765
Founder	1.4198417	1.148653	1.0821056	1.862989	Founder	1.4809321	1.209773	1.0196134	2.1509718
nCA	1.2379356	1.066716	1.0907419	1.404993	nCA	1.2758147	1.085041	1.0872092	1.4971387
coeffReciprocity_F2013	1.9073194	1.162571	1.4197157	2.462391	coeffReciprocity_A2013	1.990681	1.291763	1.2048957	3.2868994
coeffSolidarity_F2013	2.2855241	1.589580	0.9214517	5.668904	coeffSolidarity_A2013	5.3826458	1.488104	2.4696449	11.7315958
coeffTransitivity_F2013	1.0792509	1.279247	0.6660273	1.748851	coeffTransitivity_A2013	1.3147191	1.634807	0.5016935	3.4453038
privateInvestment_2013	0.9637672	1.047010	0.8807829	1.054570	privateInvestment_2013	1.0307564	1.056021	0.9263130	1.1469761
publicCompany	1.8132162	1.187752	1.2941577	2.540458	publicCompany	1.5750765	1.240999	1.0315961	2.4048812
Age	0.9887654	1.007443	0.9744989	1.003241	Age	0.9806248	1.009140	0.9632928	0.9982687
Region_Paris	1.6295006	1.145532	1.2485338	2.126712	Region_Paris	1.5269818	1.190775	1.0844444	2.1501088

3.1 ENTREPRENEURS' EXPERIENCE

3.1.1 Industry experience in health sector

In relation to Hypothesis 1a, referring to a possible relation between industry experience (years in the biotech industry) and actors' centrality network position, in Figure 5 we found, as Hall and Hofer (1993), that experience in the biotech industry only has a light influence on indegree.



In 2008 networks, we observe that there is a 0.3% increase in the mean of friendship's indegree and a 0.2% increase in the mean of advice indegree for each extra year working in the healthcare industry. In Figure 6, a similar trend for 2013 is found. From these results, we can establish that experience in the healthcare industry, although significant, has less influence than expected in entrepreneur's centrality position, which could mean that it takes time to build status.

3.1.2 Entrepreneurial experience

In relation to Hypothesis 1b, which established a relation between entrepreneurial experience in founding companies and actors' centrality network positions, we observe that “serial entrepreneurs” were not recognized as epistemic authorities in 2008 (Figure 5). However, in 2013, the *serial* entrepreneurs were the main sources of advice, which confirms the notion that founding experience would be a powerful human capital sign (Hsu, 2007). In Figure 6, we observe that there is a 28% increase in the mean of advice's indegree for each extra company founded in the past. This validates the idea that “finance people” would not be well recognized as epistemic authorities, probably, because they are most likely to be the first right arms of venture capitalist firms going from one project to another. With the pass of time, perception on VC firms would improve among entrepreneurs, thus increasing their epistemic status.

Being a founder in a network of entrepreneurs is a good indicator for centrality in both waves. In 2008, Founders have higher means of advice indegree of 46% compared to others (Figure 5). In 2013, they have a higher means of advice indegree of 48% compared to others (Figure 6). Moreover, they are also chosen as friends by other entrepreneurs more often. We observe that founders have higher means of friendship indegree of 41% compared to others (Figure 6).

3.1.3 Educational experience

In relation to the Hypothesis 1c, establishing a relation between educational experience and actors' centrality network positions, we found that individuals with scientific training were recognized as epistemic authorities in 2008. As shown in Figure 5, our results show that an entrepreneur with scientific training has a higher mean of advice indegree of 35% compared to one who has not. In 2013, they are no longer the one who are sought for advice the most, but they are recognized as friends by their peers. In Figure 6, we observe that entrepreneurs with scientific training have a higher mean friendship indegree of 59% compared to the one who have not. This result confirms the notion that education is a source of connections (Saidu, 2018).



Interestingly, we observed that having a double degree (an MBA) does not seem to lead to centrality neither for advice nor friendship. Regarding having studies in different countries, this feature leads to good social status among entrepreneurs in the sense that they are recognized as friends by their peers. This result is consistent for both populations. We have found that entrepreneurs with international studies have, for 2008 and 2013 respectively, a higher mean of friendship's indegree of 46% (Figure 5) and 70% (Figure 6) compared to the ones who have studied in one single country.

3.2 PRESENCE IN OTHER COMPANIES' BOARDS

In relation to Hypothesis 2, relating political engagement and actors' centrality network positions, we identified, consistently with the literature (e.g., Rosenstein et al., 1993) that political engagement, defined as the entrepreneur presence in board of directors or associations, has an influence on centrality. Political activism (presence in boards) contributes to be recognized as epistemic authority and as a friend in 2013. As shown in Figure 6, there is 23% increase in the mean of friendship indegree and a 27% increase in the advice indegree for each extra board the entrepreneur is present in. In 2008, the presence in board has no visible effect; however, the more an entrepreneur is involved in associations (extra-professional but healthcare-related) the more she will be recognized as an epistemic authority and a social authority by their peers. In the case of associations, we observe in Figure 5 that there is a 9% increase in the advice indegree and a 18% friendship indegree for each extra association the entrepreneur is involved in. For 2013, data was not available.

3.3 WORKING IN IPO OR PRIVATE COMPANIES

In relation to Hypothesis 3a, relating working in a public company and actors' centrality network positions, we found that the amount of private investment received by the company represented by the entrepreneur in the 5 years preceding the year of data collection seems to not lead to epistemic authority or popularity. However, if working in a public company, the entrepreneur is very likely to be recognized as epistemic authority or as a friend among the other entrepreneurs in both populations. Consistently with the literature remarking the importance of IPO firms, specifically, in terms of access to benefits (e.g., Kutsuna et al. 2016), in Figure 5, we observe that in 2008 entrepreneurs working in an IPO company have a higher mean of friendship indegree of 100% and a higher mean of advice indegree of 170%. In Figure



6, we note that in 2013 entrepreneurs working in IPOs have a higher mean of friendship indegree of 81% and a higher mean of advice indegree of 57%.

3.4 CONTROL VARIABLES

Aligned with the literature (e.g., Audretsch & Dohse, 2007; Lutz et al., 2013, among others), we observed that living in Paris is an important factor to predict entrepreneurs' centrality. As we are looking at French entrepreneur population, we can assume that there is a "capital effect" and entrepreneurs working in Paris are more likely to meet their peers. It predicts centrality for all of our network except for advice 2008. As shown in Figure 5, in 2008 entrepreneurs living in Paris have a higher mean of friendship indegree of 35% compared to their peers. As observed in Figure 6, in 2013 they have a higher mean of friendship indegree of 62% and a higher mean of advice indegree of 52%.

In relation to our control variables (demography and structural coefficients), our results for 2008 show that age is not a factor predicting the epistemic authority. As observed in Figure 6, in 2013 age has a negative effect. In fact, we observe a 2% decrease in the mean of advice's indegree in 2013 (0.98).

In terms of reciprocity (i.e., if you are my friend, then I am also your friend), this coefficient is a good predictor of centrality in all our networks. As shown in Figure 5, in 2008 entrepreneurs that have reciprocal relationship have a higher mean of friendship indegree of 120% and a higher mean of advice indegree of 375% in 2008. As observed in Figure 6, in 2013, they have a higher mean of friendship indegree of 90% and a higher mean of advice indegree of 90%. In other terms, people that can manage to build reciprocal relationships are always more central in the network.

Regarding transitivity (i.e., my friends are friends too), this coefficient is used to see if the entrepreneur is in a cluster within the network. In Figure 5, we can observe that it is significant only for friendship 2008 network where entrepreneurs with higher coefficient have higher mean of friendship indegree of 567%. This result suggests that "the friendliest" entrepreneurs were in a strongly connected friendship cluster in 2008.



Finally, non-solidarity coefficient (i.e., the advisor of my advisor should not need my advice) is used to evaluate the hierarchy of entrepreneurs. We propose that there is a hierarchy between the entrepreneurs (in the advice network especially). Therefore, entrepreneurs with higher position should not have to ask advice to an entrepreneur that is advised by his advisee. To make up this coefficient, we count the times this relationship occurred, and we divide it by the total number of times in which it could have occurred. The coefficient is almost always significant except for Advice 2008. In 2008, the biotech industry was still emerging, which could explain why entrepreneurs exchanged a lot of advice with each other even though they were in a lower position (with no particular hierarchy). These results show that there is a hierarchy in the networks concerned because entrepreneurs in a higher position in the network will not select entrepreneurs in lower position as friends or ask them for advice. In Figure 5, we observe that in 2008 entrepreneurs with higher non-solidarity coefficient have a higher mean of friendship indegree of 227%. As shown in Figure 6, in 2013, they have a higher mean of friendship indegree of 129% and a higher mean of advice indegree of 438%.

4. CONCLUSIONS

In this research, we have aimed to identify and explain the attributes or 'credentials' that lead biotech entrepreneurs to a central status, either as social or epistemic authorities. Among our most prominent results, we have found that being the firm's founder is a predictor of advice and social status centrality, and that entrepreneurs with scientific training and studies abroad are better located in the friendship network. Also, we found that those actors with presence in other firm's boards have high levels of centrality, and that those living in the French capital city and working in public companies are highly valued by their peers.

Through this research, we have identified and described how entrepreneurs' status, as social or epistemic authorities, varies across time, i.e., as they "grow up" as innovators and obtain experience in technology development and business. Such expertise has been tested by the community of peers itself, who has judged not only the quality of their knowledge but also how trustworthy expert entrepreneurs are for collaboration. We expect that these results may contribute to better understand that attributes leading to legitimation are not only obtained in a relational way but also affected by norms, values, beliefs, and definitions which underly a given milieu in a particular time.



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