Research Policy 42 (2013) 1378–1388

Contents lists available at SciVerse ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

Bridges or isolates? Investigating the social networks of academic inventors

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ARTICLE INFO

Article history:
Received 27 April 2012
Received in revised form 29 March 2013
Accepted 3 May 2013
Available online 14 June 2013

Keywords:
Academic patenting
Social networks
Knowledge generation
Brokerage
Cohesive networks
Technology transfer

ABSTRACT

We analyze the acquaintances of a sample of academic inventors and their paired controls to investigate the contribution of social networks to the generation of inventive ideas in academe. Prior to patenting, inventors work in networks of similar dimension and structure as those of their colleagues who do not invent. The ego-networks of the inventors are however more cohesive (denser), a circumstance that is often seen as associated to the exchange of more fine-grained information and to a greater climate of trust which facilitates long-term relationships and learning. Over time, both inventors and non-inventors extend their networks and become more central. In general, we found no evidence that after patenting inventors isolate or close their networks.

1. Introduction

In recent years academic patenting has become the subject of extensive academic investigation (Baldini et al., 2006, 2007; Stephan et al., 2007; Azoulay et al., 2007, 2009; Calderini et al., 2007, 2009; Fabrizio and Di Minin, 2008; Breschi et al., 2008; Crespi et al., 2011). In this paper we contribute to this debate by investigating the social network dimension behind academic inventorship (Allen, 1977; Etzkowitz, 1983; Balconi et al., 2004; Murray, 2004; Lissoni, 2010). The hypotheses that underlie this paper are grounded on the theories of socially constructed knowledge and on the power of weak ties (Granovetter, 1983; Lee, 2009). Networks channel the knowledge and information that each scientist receives and recombines into their research. The accomplishments of a scientist are therefore affected by the power of their network to convey rich information. Networks that are larger in size, keeping all other things constant, convey more ideas to exploit, more complementary knowledge to make research successful and a larger group of supporters of one's own ideas (Sobrero, 2000; Lissoni, 2010). Networks with denser or sparser nodes convey information of different quality and individuals may be more or less capable to benefit from this information, depending on the position they occupy within the network (Phelps et al., 2012).

The knowledge network of academic scientists can be investigated by means of co-authorship in articles. The large incidence of homonyms in publication databases, however, creates data reliability issues, since the number of records in need of name-matching scales up at the power law for social network analysis purposes. To the best of the authors' knowledge our work is unique in its kind because it takes advantage of recent developments in name disambiguation techniques to ensure reliability of the publication data. Thanks to cooperation with Elsevier–Scopus, we could perform a network analysis based on 9997 authors of 283,280 scientific articles with reasonable certainty of very limited homonyms bias.

The analysis offered herein investigates the potential impact of patented inventions on the network's structure and the ego's position within the network by comparing pre-event measures across inventors and controls. This comparison allows us to speculate on the characteristics of networks that are associated to the inventive activity. The latter part of the analysis is also relevant to uncovering potentially changing patterns of collaboration behaviour in the aftermath of academic patenting. In principle, closer proximity to the exploitation realm may alter the role of academic inventors within their scientific community, making them more secluded and distant from their non-patenting peers (Toole and Czarnitzki, 2010). For example, they may become more prone to relying on closer and more independent relational sets, ultimately

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http://dx.doi.org/10.1016/j.respol.2013.05.003

diminishing the overall social returns of their scientific discovery. Conversely, the inventive activity may stimulate new interests and/or expand and diversify their networks of co-authors in directions that comprise a more variegated setting.

The analysis is useful also to help disentangle team size effects from network effects. Prior works have taken team size (given by the average number of co-authors) into account, and found that inventors generally work in larger groups than non-inventors (Czarnitzki et al., 2009). Here we distinguish between individuals who repeatedly work with a large team and individuals who cooperate with many diverse co-authors in different studies.

The paper is organized as follows. In Section 2, we develop the hypotheses that will drive the empirical investigation. In Section 3, we describe the research design, the dataset, the matching procedure used to create the paired samples and the measures of social networks used in the analysis. Section 4 presents the empirical evidence and discusses the results. We conclude by highlighting the contributions of our paper and some open questions for future research in Section 5.

2. Academic patenting and social network effects

2.1. Explaining the research accomplishments of academic inventors

We have learned from recent works on academic patenting that inventors represent a small share of the population of academics. Even in the subfields in which patenting is relatively common, like biotech and chemistry academic inventors never seem to exceed 10–15% of the scholars (Agrawal and Henderson, 2002; Breschi et al., 2008). Several works have also consistently shown that the most productive and accomplished individuals in science are overrepresented within the sample of academic inventors (Fabrizio and Di Minin, 2008; Stephan et al., 2007). Furthermore, when data is analyzed on a longitudinal timespan, patents seem to be preceded by a burst of publications (Azoulay et al., 2007; Calderini et al., 2007) and tend to boost productivity in the years immediately after patenting (Azoulay et al., 2009; Breschi et al., 2008; Calderini et al., 2009).

The fact that a few productive authors in science are disproportionally responsible for a large share of the publications has been well documented since the early ’60s (de Solla Price, 1963; Allison and Stewart, 1974). Still, it is at first counterintuitive that an even smaller proportion of scholars seems to be capable of simultaneously producing advances in the scientific understanding of principles, phenomena and new technologies suitable for industrial application.

This circumstance has raised a question about what capabilities form the basis of academic patenting and if there are common drivers that explain the success of a scientist in the academic and industrial worlds. Although in the traditional view of science as a speculative activity, scientific inquiry and practical application are seen as antonyms, at a closer look several considerations suggest that this vision is oversimplified and obscures the true nature of research. Scholars have suggested multiple potential explanations for the positive correlation between publications and patents.

First, there are areas of investigation (the so-called “Pasteur’s Quadrant”) in which fundamental understanding and practical applications can be pursued at the same time and other areas of investigation in which this is not the case (Stokes, 1997). In the first case, the pursuit of scientific and technological goals can be combined, and the two activities can generate positive feedback for one another. This happened for instance in the early years of biotechnology, when many eminent scientists became famous for their technological advances while maintaining a leading position in science (see, for instance, Zucker et al., 1998; Davies, 2001; Feldman et al., 2005). A first possible explanation for the correlation between scientific and technical achievements is that we are observing areas in which the trade-off is less severe.

Second, success in research often requires the solution of technical problems that constrain scientific investigation. Scholars who study the creativity of scientists maintain that the rate-limiting factor for progress in science is not the pace at which new ideas come to researchers but the pace at which those ideas can be transformed into feasible operations on the bench (Holmes, 2004). Since a large proportion of the inventions that academic scientists produce relate to improved research technologies, the event of producing a patent precedes success in research (Franzoni, 2009).

Third, successful scientists are often described as individuals who are entrepreneurial by nature (Allen, 1977; Etzkowitz, 1983). Success in science requires extensive organizational skills as well as the capacity to raise funds to support a line of research. This is especially true in recent years, as proven by the steadily increasing sizes of research teams (Adams et al., 2005; Wuchty et al., 2007) and the enlarged budgets that need to equip fully functional research labs (Stephan, 2012). A successful scientist needs to be skilled at envisioning funding opportunities, establishing collaborations, brokering research scope and uncovering market needs. These abilities are also likely to underlie success in developing technologies for the market (Murray, 2004; Baldini et al., 2007; Franzoni and Lissoni, 2009).

2.2. The effect of social networks on inventive activities

In this paper we investigate the social network of inventors – prior and after patenting – in search of explanations for why scientific and market achievements are correlated. This explanation is grounded on the theory of socially constructed knowledge and hypothesizes that a larger and richer social network is the basis for superior performance by scientists in both research and inventive accomplishments.

Extensive studies on social network theory have emphasized the relevance of the social network dimension in the creation and diffusion of knowledge (Coleman, 1988; Freeman, 1991; Ahuja, 2000). The importance of relational capital depends on the circumstance that knowledge is only partially codifiable and remains largely tacit and bound to individuals (Nelson and Winter, 1982). This highlights the importance of face-to-face (or somehow socially-channelled) collaborations to enable the circulation and exchange of novel ideas in research. The characteristics and structure of the network of collaborations in which a person works and the position of a specific node within the network should therefore concur to explain the extent to which a single node would be productive of new ideas, such as those leading to innovation (Sobrero, 2000; Nerkar and Paruchuri, 2005).

In this section, we build on the contributions of the literature to formulate hypotheses regarding the correlation between a number of characteristics of one person’s network and her propensity to produce inventions. We focus on three elements: (i) network dimension; (ii) network position; and (iii) ego-network structure building hypotheses on how these features of relational capital may be associated to a greater propensity to become inventors.

Network dimension (*size*). Based on the theory of knowledge recombination, each individual at a given moment owns a certain endowment of knowledge accumulated during prior experience. When individuals interact with other individuals (for example they co-author a work), they exchange and recombine their respective knowledge sets, producing new combinations. Knowledge recombination may not always be easy or successful but when a successful recombination occurs, this generates a novel idea, solution or insight (Hargadon and Sutton, 1997; Fleming, 2001; Murray and O’Mahony, 2007). Collaboration enables a faster pace