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Creating innovative opportunities through research collaboration: An evolutionary framework and empirical illustration in engineering



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ABSTRACT

This paper analyses the creation of innovative opportunities through research collaborations. It contributes by (i) providing an evolutionary conceptual framework for the formation and exploitation of innovative opportunities through research collaboration; and by (ii) providing an empirical illustration of this framework by applying it to a case study of firms' research collaboration taking place in university–industry research centers in engineering. The evolutionary framework developed specifically focuses on the generation of novelty and variety and on selection pressures as key for the creation of opportunities. It also emphasizes the differences between small and large firms when it comes to role of research collaboration for opportunity creation. Empirically, we illustrate that firms in general focus more on the generation of variety in the form of (fundamental) knowledge, than on research collaboration leading directly to the formation and exploitation of opportunities. For large firms, the focus is rather to transfer this created variety back to the firm, to use for inputs into the in-house creation of opportunities. In contrast, small firms focus instead on using research collaboration to generate and develop knowledge about customer needs in order to create market opportunities, especially through networking with large firms participating in the collaboration.

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1. Introduction

Although there is a long-running scientific debate focusing around the question of whether opportunities are “created” or “discovered”, many interesting research topics focus upon understanding more concrete and context-specific cases of the formation and exploitation of opportunities. This paper contributes by providing an evolutionary conceptual framework for the formation and exploitation of innovative opportunities through research collaboration, as well as an empirical illustration of this framework through case study methodology.

Much existing research about how technical and scientific research and the university can contribute to entrepreneurship examines issues related to regional development, and often of high tech firms. The Cambridge Phenomenon is one setting that has been used to study the dynamics of high tech start-ups and clustering of firms (Druihle and Garnsey, 2000; Garnsey et al., 2008). While the university plays one role in stimulating new opportunities, this stream of research also shows that the founders may start multiple firms and develop relationships across those

firms, and that this drives regional clustering in particular industries. Theoretically, Garnsey and colleagues argue that the dynamics of the entrepreneurial process involves a series of relationships and decisions, which affect the configuration of resources and the exploitation of opportunities at the regional level (Garnsey and Heffernan, 2005; Garnsey et al., 2006). These types of questions relating to regional dynamics, as well as to the dynamics of high-tech sectors, are quite relevant to the understanding of opportunities. In this paper, we instead focus on a specific phenomenon, namely the creation of opportunities through research collaboration. This includes the configuration of resources and exploitation of opportunities at the level of the firms involved. This contributes to our understanding from the perspective of the role of research collaboration and specifically the role of universities.

To understand the formation and exploitation of opportunities we take our point of departure in evolutionary and Schumpeterian economics. The paper therefore provides a general discussion of the relationship between opportunities and evolutionary thinking. Evolutionary economics focus upon dynamics and emergent systems as well as the peculiar role of knowledge and the appropriation of value of innovation (Foster and Metcalfe, 2012). In these theories, developments in science and technology help create technological opportunities, and these opportunities are then selected at the firm level through aspects such as

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mobilization of resources and the appropriability of invention, which turns knowledge into business innovations (McKelvey, 2013).

External sources of knowledge and innovation – and thereby collaboration with external actors – are deemed especially important for technology development in the current “open innovation paradigm” (see Dahlander and Gann, 2010; West and Bogers, 2014). While the majority of studies within the open innovation literature have focused on how firms “obtain, integrate, and commercialize innovation from external sources”, we instead focus on “those interactive paths beyond the stylized linear model that incorporate feedback mechanisms and ongoing interactions with external sources” (West and Bogers, 2014, p. 2). This focus follows from our proposed evolutionary conceptual framework for the formation and exploitation of innovative opportunities. This paper thereby focuses on explaining the ways in which firms choose to use research collaborations for creating and exploiting opportunities.

The main purpose of the paper is to develop a framework, for explaining why firms interact with universities and individual academics over longer periods of times around specific research collaboration. We will also illustrate the relevance and usefulness of the evolutionary framework by applying it to case studies of firms’ research collaboration with universities in university–industry centers in engineering. A main finding of studies of university–industry centers is that they provide a context that in turn provides participants with benefits in terms of financial, social, and human capital (Boardman, 2008; Lin and Bozeman, 2006), thus the chosen empirical setting provides a rich environment through which to study how firms make choices about and use relationships to form and exploit innovative opportunities.

Section 2 presents an analysis of relevant literature leading to the formulation of our conceptual framework, particularly in relation to the debate about creating versus discovering opportunities. Section 3 motivates the research design of this study and details the methodology. Our derived framework is then empirically explored in Section 4 to analyzing firms’ perceptions of how research collaboration specifically aids in the processes that form and exploit opportunities. Section 5 presents the conclusions and implications.

2. Conceptual framework

This paper proposes an evolutionary and Schumpeterian view of formation of opportunities, by deriving a conceptual framework. Empirically, the main focus of this paper is upon the creation of innovative opportunities by firms through participation in research collaboration in engineering. Therefore, the proposed framework needs to specify the definition and formation of opportunities, as well as the specific role of research collaboration in relation to the formation and exploitation of opportunities by firms.

2.1. Formation and exploitation of opportunities

Within entrepreneurship literature, the focus upon opportunities as being either created or discovered has been the subject of heated debates (see e.g. Alvarez and Barney, 2007; Alvarez et al., 2013). There are two sides to the debate. One view is that opportunities are “real” so that the opportunities objectively exist and can be discovered or recognized (Kirzner, 1973, 1982). In that case, the opportunities are “out there” and can be objectively identified, and one of the main questions is whether some individuals or teams are better prepared, and better able, to quickly identify and act upon them. The second view is that the opportunities are deliberately created (Schumpeter, 1934). In this

second view, business opportunities are more subjective and they must be “created” through the bringing together of resources and competencies into a new venture focused upon turning ideas into products and services. It should be noted that while there have indeed been debates about whether opportunities are discovered or created, some have also contested that they are two different types of opportunities (see e.g. Alvarez et al., 2013).

Based upon a review of existing literature, Alvarez and Barney (2007) and Alvarez et al. (2013) propose that the key differences in assumptions between these two views – discovery theory and creation theory – can be summarized as follows. In the discovery theory within entrepreneurship literature (e.g. Shane, 2000; Shane and Venkataraman, 2000), the nature of opportunities entails that they exist objectively, independent of the entrepreneur, as a consequence of exogenous shocks such as changes to technology, or consumer preferences. Given that everyone could potentially “discover” these opportunities, the theory assumes that entrepreneurs are different, *ex ante*, from non-entrepreneurs, either in terms of identifying or of exploiting opportunities. This leads to a focus upon the differential characteristics and traits of entrepreneurs, commonly treated under the concept of alertness (Kirzner, 1973). Finally, the nature of the decision-making context can be characterized as risky, in the sense that decision-makers can collect and analyze data, based for example on their own previous entrepreneurial experiences to predict feasible outcomes and their associated probabilities.

In the creation theory within entrepreneurship literature (e.g. Buenstorf, 2007; Sarasvathy, 2001), the nature of opportunities means that the actions of the entrepreneurs create opportunities, as compared to the situation where opportunities exist and are simply uncovered. *ex ante*, the persons who become entrepreneurs and those who do not may not be significantly different – but the process of having been entrepreneurs probably does change them, *ex post*. Finally, the decision-making context is uncertain, in the Knight (1921) meaning of not being able to predict or assess the probability of potential outcomes.

Alvarez and Barney (2007, p. 15) note the proximate epistemological relationships between creation theory and evolutionary theories of entrepreneurial action. Evolutionary economics theory, drawing not the least upon the work of Campbell (1960) for the understanding of the development of knowledge, stresses processes of variation, selection and retention. Variation, be it blind or intentional, is the foundation of change, potentially leading to opportunity creation (Alvarez and Barney, 2007; Alvarez et al., 2013). While blind variation stems from non-conscious actions, i.e. emerging from serendipity and chance, intentional variation emerges from deliberate actions of the involved actors. Selection processes then allow some specific variations to survive, while eliminating others. Therefore, we can state that the creation process unfolds through this selective elimination and retention across the population, creating the opportunity.

While the opportunity concept is closely tied to a modern understanding of the entrepreneurship literature, it is also a relevant concept to be used within related literature, especially Schumpeterian and evolutionary economics and in the Penrosian theory of the firm (see Holmén et al., 2007). While, according to Alvarez et al. (2013), entrepreneurial opportunities are ones that arise from competitive imperfections, we can distinguish other types of opportunities in these related literatures.

In Schumpeterian literature related to innovations, opportunities are also closely related to the development of science, technology and other types of knowledge. Buenstorf (2007) points out that “the vast majority of entrepreneurial opportunities are created by human activity”, e.g. those which are “created outside the market sphere (for example, opportunities based on new inventions and scientific discoveries)” (p. 328). Hence, technological opportunities – which

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