Available online at www.sciencedirect.com
ScienceDirect
Research Policy 35 (2006) 1166–1199
research policy
www.elsevier.com/locate/respol

In search of complementary assets: The determinants of alliance formation of high-tech start-ups

Massimo G. Colombo *, Luca Grilli, Evila Piva

Politecnico di Milano, Department of Management, Economics and Industrial Engineering, P.za Leonardo da Vinci, 32, 20133 Milan, Italy

Available online 17 October 2006

Abstract

Why do new technology-based firms (NTBFs) cooperate? Starting from Teece's [Teece, D.J., 1986. Profiting from technological innovation: implications for integration, collaboration, licensing, and public policy. Research Policy 15, 285–305] conceptual framework and taking advantage of subsequent literature on alliance formation in the resource and competence-based tradition and in the social structure perspective, we derive an empirical model that aims at highlighting the inducements and obstacles that these firms face in alliance formation according to firm-specific characteristics and the nature of the alliance. In particular, a distinction is made between exploitative commercial alliances and explorative technological alliances. The econometric estimates, based on a large sample of Italian young high-tech firms that are observed from 1994 to 2003, provide strong evidence supporting two key intuitions of Teece's work. First, the "combination of specialized complementary assets" appears to be a key driver of the formation of exploitative commercial alliances by NTBFs. More specifically, patent holding affects positively the likelihood to establish commercial alliances, but this propensity is found to rapidly decrease with firm size, suggesting that as long as NTBFs become larger and possess specialized commercial assets their urge for commercial alliances diminishes. Second, following the parallelism set forth by Teece between search for alliance partners and access to external financing, the analysis indicates that potentially beneficial alliances may not take place because of the high transaction costs faced by smaller NTBFs. In this respect, our results clearly support the view that sponsor institutions as public research organizations, venture and corporate venture capitalists may sensibly reduce these costs and that their role crucially depends on both the identity of the sponsor and the type of alliance.

Keywords: Innovation; Alliances; New technology-based firms; Complementary assets; Teece

1. Introduction

How can firms profit from innovation? "The successful commercialization of innovations requires that the know-how in question be utilized in conjunction with other capabilities or assets. Services such as marketing, competing manufacturing, and after sales support are almost always needed. These services are often obtained from complementary assets which are specialized... In some cases, as when the innovation is systemic, the complementary assets may be other parts of a system" (Teece, 1986, p. 288).

Since the seminal work by Teece (1986), alliances have been regarded by scholars inspired by the resource- and competence-based views as an effective mechanism allowing to combine the technological capabilities of innovative firms with the *specialized complementary assets* possessed by other firms so as to obtain synergistic gains (see among others Kogut, 1988; Das and Teng, 2000; Grant and Baden Fuller, 2004).

* Corresponding author.
E-mail address: massimo.colombo@polimi.it (M.G. Colombo).

0048-7333/$ – see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.respol.2006.09.002

Following previous literature, in this work we use the term "alliance" quite comprehensively to refer to any formal collaborative relation between independent firms that constraints *ex ante* their future conducts and may pertain to any sphere of firm's activity (see among others Contractor and Lorange, 1988; Williamson, 1991; Hagedoorn, 1993; Hagedoorn and Schakenraad, 1994; Gulati, 1995; Oxley, 1997; Colombo, 2003). Accordingly, alliances include *technological agreements* (e.g. joint development agreements, research joint ventures, technology transfer and technology sharing agreements) and *commercial agreements* (e.g. licenses, joint distribution agreements, customer–supplier relations, and many others). Moreover, independently of the content of the collaboration (either technological or commercial), alliance partners may resort to an equity governance structure (i.e. equity joint ventures and acquisitions of a minority stake) or to a contractual one, either of bilateral (as in cross-licensing) or unilateral (as in a simple license) type.[1] Conversely, mergers and acquisitions are excluded from this definition.

The "combination of complementary assets" motive for alliance formation is particularly pertinent for new technology-based firms (NTBFs), especially if they have been founded to exploit commercially a major technological innovation (Eisenhardt and Schoonhoven, 1996; Cooper, 2002; Gans and Stern, 2003). In fact, these firms possess distinctive technological competencies relating to a new product, process or service idea, that need to be used in conjunction with other specialized assets in order to generate economic returns.

Nonetheless, Teece (1986) also emphasized the difficulties inherent in the use of alliances to combine the specialized complementary assets possessed by different firms. "Strategic contractual partnering... is exposed to certain hazards, particularly for the innovator... First it may be difficult to induce suppliers to make costly irreversible commitments which depend for their success on the success of the innovation... The innovator has incentives to overstate the value of the innovation, while the supplier has incentives to 'run with the technology' should the innovation be a success" (Teece, 1986, p. 294). Again, this reasoning perfectly applies to NTBFs. So, NTBFs have great inducements to but also face serious obstacles in establishing alliances with third parties.

In this paper, we will start from Teece's (1986) conceptual framework and taking advantage of subsequent work on alliance formation in the resource- and competence-based tradition and in the social structure perspective, we claim that the extent of these inducements and obstacles depends on the firm-specific characteristics of NTBFs. More importantly, we contend that the influence that these firm-specific characteristics exert on the likelihood of alliance formation by NTBFs differs according to the *type of alliance* under consideration. This will lead to the formulation of a series of hypotheses relating to the firm-specific factors that drive NTBFs to establish *exploitative commercial alliances* and *explorative technological alliances*.[2] In the empirical section of the paper we will provide evidence in support of these theoretical hypotheses through an econometric analysis of the cooperative behavior of a large sample of Italian NTBFs that are observed from 1994 to 2003.

Several previous empirical studies have analyzed the firm-specific determinants of alliance formation. They have highlighted that firm size, the intensity of R&D expenses and the prior outcome of the innovative activity of firms are positively associated with the likelihood of a firm being engaged in alliances (see among others Link and Bauer, 1987; Kleinknecht and Reijnen, 1992; Colombo, 1995; Röller et al., 1997; Sakakibara, 1997, 2002; Hagedoorn et al., 2000; Fritsch and Lukas, 2001; Tether, 2002; Belderbos et al., 2004). Moreover, the social capital of firms connected with their network of prior collaborative relations with other firms

[1] For a detailed discussion of the different alliance governance modes see Oxley (1997, pp. 389–392). According to the terms used by Teece (1986), the definition of alliance adopted in this paper includes: (i) contractual modes (e.g. licenses, supply or distribution agreements, R&D contracts), including "strategic partnering" (Teece, 1986, p. 293) and (ii) mixed modes "involving judicious blends of integrating and contracting" (Teece, 1986, p. 298). An example of the former category is provided by the alliance that IBM established with Microsoft to use MS DOS as the operating system of the IBM PC. An example of the latter category is offered by IBM's acquisition in 1982 of a minority stake in Intel to support the development of the IBM PC around Intel's microprocessor technology. Note also that properly speaking, while the *combination* of the specialized complementary assets and capabilities possessed by different firms is a crucial driver of alliance formation, only some types of alliances imply *access* by the innovator to the specialized complementary assets possessed by partner firms. Other alliance types (basically, all unilateral contractual alliances) can be considered as a substitute to accessing these assets. For instance, a license implies that the innovator (the licensor) sells to the other party (the licensee) the right to use under some specified conditions the technology it developed in combination with the assets this latter possesses. In this way the licensor directly profits from the innovation without getting access to specialized complementary assets. Nonetheless, it is noteworthy to stress that the specialized complementary assets of the partner firm play a key role also in this situation, as they determine the amount the licensee is ready to pay to obtain access to the innovator's technology.

[2] The differences between these two types of alliances will be discussed in detail in Section 2.1.