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Open innovation and within-industry diversification in small and medium enterprises: The case of open source software firms

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ABSTRACT

This paper examines the within-industry diversification of software small and medium enterprises that collaborate with the open source software community (OSS SMEs). In doing so, it offers new insights into the association between open innovation and diversification. We rely on arguments inspired by the literature and evidence collected through interviews with OSS SMEs' top managers to investigate factors that favor or hinder within-industry diversification. First, in line with the mainstream diversification literature, we focus attention on the role of firm size. Second, in the spirit of the open innovation research, we concentrate on the mechanisms that OSS SMEs put in place to get access to the external resources of the OSS community. Econometric evidence on 100 European OSS SMEs shows that firm size is negatively associated to within-industry diversification, while OSS SMEs that have contributed to a larger number of OSS projects have a more diversified portfolio of software products. Furthermore, we provide preliminary evidence that the practice of authorizing firm programmers to contribute autonomously to OSS projects of their own choice during working hours may be positively associated to within-industry diversification only if OSS SMEs possess adequate internal technological resources.

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1. Introduction

Ten years after the publication of Chesbrough's seminal book (2003), research in the field of open innovation has grown steadily and scholarly interest in the theme is far from being exhausted (see, e.g., Bogers and West, 2013; Dahlander and Gann, 2010; Gassmann et al., 2010; Huizingh, 2011 for recent reviews of the open innovation literature). Although open innovation studies have traditionally analyzed large companies (e.g., Chesbrough et al., 2006; Fey and Birkinshaw, 2005), an emerging research strand has focused on small and medium enterprises (SMEs; see, e.g., Cosh and Zhang, 2012 for a recent review). Open innovation is of paramount importance for SMEs. These firms usually lack the full set of internal resources and competences to effectively develop, produce, and commercialize their innovations. Hence, SMEs intensely draw on external collaborations to access missing innovation inputs (Van de Vrande et al., 2009, p. 426). Moreover, SMEs and large firms differ in the ways in which they implement open innovation (Lee et al., 2010). Accordingly, findings on open innovation in large firms can hardly be generalized to SMEs, which instead require ad hoc investigations. Scholars have examined the antecedents (e.g., Schroll and Mild, 2011; Van de Vrande et al., 2009) and the performance

consequences of open innovation in SMEs (e.g., Börjesson and Löfsten, 2012; Colombo et al., 2012; Parida et al., 2012). It has also been noted that open innovation affects SMEs' capabilities and strategies (Huizingh, 2011). For instance, through external collaborations, SMEs learn how to master new technologies (Huang, 2011) and enter international markets (Colombo et al., 2009).

To the best of our knowledge, the relation between SMEs' open innovation and diversification has been so far largely neglected. This is a promising research direction. The resource-based theory (RBT), which is the dominant theoretical paradigm in the diversification literature (see Wan et al., 2011 for a review), argues that firms diversify when they possess *internal excess fungible resources* which are difficult to sell in the market (Barney, 1997; Penrose, 1959; Rumelt, 1974; Teece, 1982). As was noted above, most SMEs are resource-constrained and "... do not have adequate resources to develop diversification" (Lynn, 1998, p. 39). It is often argued that these firms, while suffering from the liability of smallness (Stinchcombe, 1965), should better commit their limited resources to their existing business, in order to achieve greater efficiency. Nevertheless, the (scarce) available evidence on SMEs' diversification suggests that it is rather common for SMEs to have more than one product line (e.g., Robson et al., 1993). The open innovation perspective may help solve this puzzle. SMEs that are involved in open innovation have the opportunity to leverage the *external excess fungible resources* possessed by their open innovation partners and use these resources for diversification purposes. However, under what circumstances SMEs are willing and able to capture this

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opportunity is an important open issue, which, to date, has gone unexplored. The aim of this paper is to contribute to fill this gap in the literature through the analysis of factors that favor or hinder the *within-industry diversification* of SMEs involved in open innovation, as is reflected by their presence in more than one product line within a single industry (Li and Greenwood, 2004; Tanriverdi and Lee, 2008).

For this purpose, we focus on a form of open innovation that has recently attracted scholarly attention: the collaboration of software SMEs with the open source software (OSS) community (Dahlander and Gann, 2010; West and Lakhani, 2008). The OSS community is a large common pool of external free-of-charge resources that are fungible in different software product lines (Bonaccorsi and Rossi, 2006; Dahlander and Magnusson, 2008; Von Hippel and von Krogh, 2003). As explained in next section, the software SMEs that collaborate with the OSS community by contributing to OSS projects (thereafter, OSS SMEs) are in an ideal position to leverage these resources for diversification purposes. In this study, we investigate factors that are (positively or negatively) associated with the within-industry diversification of these firms. First, in line with the mainstream diversification literature, we focus attention on the role of firm size. Second, in the spirit of the open innovation research, we concentrate on the mechanisms that OSS SMEs put in place to get access to the external resources of the OSS community. Specifically, we consider the breadth of firms' collaboration with the OSS community, as measured by the number of OSS projects to which firms contribute on their own behalf, and the adoption of the practice of authorizing firm programmers to contribute autonomously to OSS projects of their own choice during working hours, a practice which is widely diffused among OSS firms (Colombo et al., 2013). In order to explore the relation between these factors and within-industry diversification, we adopt a mixed-methods approach that combines qualitative and quantitative analyses. We first enrich arguments inspired by the literature with qualitative evidence collected through interviews with the top managers of 6 Italian OSS SMEs. Second, we provide quantitative evidence obtained through econometric estimates on a sample of 100 European OSS SMEs extracted from the ELISS II directory (Bonaccorsi et al., 2005), an authoritative information source on software firms' collaborations with the OSS community.

The remainder of the paper is organized as follows. In Section 2 we discuss the relation between open innovation and the within-industry diversification of OSS SMEs. In Section 3 we consider factors that influence this relation and illustrate the qualitative evidence collected through the interviews. Section 4 presents the data and methodology of the quantitative analysis and reports the results of the econometric estimates. Section 5 concludes the paper by summarizing its main findings, highlighting its contribution to the open innovation and diversification literatures, discussing its limitations and possible avenues for further research, and illustrating its managerial implications.

2. Open innovation and the within-industry diversification of OSS SMEs

Within-industry diversification is of paramount importance for software SMEs (Tanriverdi and Lee, 2008). Similar to every high-tech firm, software SMEs face rapid technological changes that continuously create new and diverse market opportunities (Eisenhardt, 1989). The ability to capture these opportunities by diversifying into new product lines is crucial for firm success (Kim and Kogut, 1996).¹ Many market segments in the software industry

are dominated by large firms (Torrise, 1998). Hence, enlarging the product portfolio to tap demand in different product lines across many market niches is fundamental for software SMEs to escape incumbents' dominance. Furthermore, within-industry diversification by software SMEs is made easier by modularity and reusability, which are the hallmarks of software production (Baldwin and Clark, 2000). A software module developed for program X can be easily "ported" and used in program Y, despite the fact that the two programs target distinct product segments. These economies of scope are enhanced by learning economies. When developing program X, firm programmers acquire programming competences and techniques that can be used to develop other software programs in different product lines (West, 1994).

Numerous software SMEs in-source knowledge from the OSS community. Some SMEs simply download OSS code and adapt it to the needs of their customers. Other SMEs go a step further and contribute to OSS projects (Lerner and Schankerman, 2010). Namely, they pay their programmers to write and/or debug code on OSS projects, to write documentation and to answer technical questions raised by other members of the OSS community through the projects' mailing lists.

In compliance with the values of the OSS movement, the OSS community offers software SMEs access to abundant, free-of-charge and potentially valuable external resources (Bonaccorsi and Rossi, 2006). No license fee is required to use, copy, and modify the open code and modules created by OSS developers (Lerner and Tirole, 2005). Programming competences also are abundant. OSS developers, including individual volunteers and other firms, freely offer suggestions on OSS programs, debug code, write complementary modules, and provide user assistance (Lakhani and von Hippel, 2003). Beyond these technical resources, the OSS community offers software SMEs commercial resources such as marketing and distribution channels, contacts with potential customers, and opportunities to build a reputation as a high quality software producer (West and O'Mahony, 2008).

The resources made available by the OSS community are *fungible* to the development of diverse software products. At the OSS bazaar (Raymond, 2001), SMEs can find operating systems, Web servers, e-mail clients, and software for computer games or for managing computer security. Likewise, OSS developers can write and maintain various types of software (Hars and Ou, 2002). In addition the OSS community is highly connected (Gandal and Fershtman, 2011): a relationship with one OSS developer creates a bridge for establishing further links with other developers working on OSS projects that produce other types of software. Finally, any type of software can be successfully advertised through the OSS community.

The fungible OSS resources to which SMEs may obtain access are not possessed by SMEs and consequently cannot be contracted out by these firms. SMEs cannot earn money by licensing OSS programs to third parties. Likewise, OSS developers with whom SMEs collaborate are not firm employees (O'Mahony, 2003). SMEs can neither resell their services to other parties nor pay them to market firm products. Accordingly, within-industry diversification may be a valuable way to leverage these fungible external resources.

In order for software SMEs to be able to use OSS resources for diversification, contributing to OSS projects is essential (Henkel, 2009). By reciprocating their own code and employees' working time to the OSS community, OSS SMEs achieve an "insider" status that allows them to drive the software development process within OSS projects toward their desired directions (Capra et al., 2011). Moreover, contributing to OSS projects is a valuable

¹ Embedded systems, components designed to have specific controlling functions within larger devices such as a car or a mobile telephone, are one case in point.

Because these systems are equipped with specific software, their increasing diffusion has created new market opportunities for software firms (Henkel, 2006; Henkel et al., 2012).

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