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The interaction between inter-firm and interlocking directorate networks on firm's new product development outcomes

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ABSTRACT

This paper explores the interaction between a prominent board of directors and the network of inter-firm relationships on new product development. Specifically, we posit a positive interaction effect between a prominent board and the inter-firm network and structural holes positions on the number of new products developed by the firm. We test the theoretical framework on a sample of 1758 agreements among 1890 biopharmaceutical firms over the period 2006–2010. We find that by filtering, complementing and legitimizing information coming from the inter-firm network, a prominent interlocking directorate network can improve the inter-firm network's effects on new product development. We discuss important implications for how inter-personal networks (such as the board interlock directorate network) help to develop the effectiveness of inter-firm relationship networks in achieving new product development outcomes.

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1. Introduction

Whilst we now understand more about how individual networks impact the firm's performance, a recent trend in network research has shifted to investigating network effects on business outcomes across multiple networks (Ozmel et al., 2013). More specifically, management literature has investigated—independently—the impact of inter-personal networks, such as the interlocking directorate networks, and the inter-firm relationship networks on firm performance. Interlocking directorate networks act as an inter-personal channel by which information and knowledge resources are exchanged (Pfeffer and Salancik, 1978) to the benefit of the firm. Literature in this field has mainly focused on examining how the interlocking directorate networks affect economic and financial performance (Dalton et al., 1999; Peng and Luo, 2000; Non and Franses, 2007; Pombo and Gutiérrez, 2011; Horton et al., 2012; Croci and Grassi, 2013; Larcker et al., 2013; Li et al., 2013; Kaczmarek et al., 2014), enhance superior innovation performance (Wincent et al., 2010), influence strategic alliance formation (Gulati and Westphal, 1999), contribute to the strategic decision making process (Carpenter and Westphal, 2001), and finally foster internal innovation or external innovation (Hoskisson et al., 2002). Similarly, a lot of research has highlighted the importance of inter-firm network structural positions on the firm's performance. Indeed, according to social capital literature, the inter-firm network is itself a source of valuable resources through which the firm can improve its performance (Ahuja, 2000;

Koka and Prescott, 2002; Soh, 2003; Salman and Saives, 2005; Zaheer and Bell, 2005; Maurer and Ebers, 2006; Acquaah, 2007; Schilling and Phelps, 2007; Wu, 2008; Gilsing et al., 2008; Padula, 2008; Vanhaverbeke et al., 2009; Phelps, 2010; Malik, 2011; Vanhaverbeke et al., 2012).

However, it remains unresolved how the benefits delivered through inter-personal networks can be channeled to improve the delivery of business outcomes in inter-firm level networks. A possible exception in literature is Wang et al. (2014). The study by Wang et al. (2014) investigates two different networks, i.e. social networks of researchers and networks of knowledge elements and their relation to the firm's propensity to patent. This study examines the impact of two different inter-personal networks (social network and knowledge network) on innovative performance.

Our study investigates the interaction effect of an important inter-personal network (interlocking directorate) and inter-firm network (inter-firm ties such as alliances) on the firm's innovative performance. To the best of our knowledge, no studies so far have investigated the interaction effect of these two kinds of networks on firm's innovation performance.

In exploring this issue we build on the notion of structural network position as the source of advantageous benefits such as information sources and exchange of knowledge and resources (Koka and Prescott, 2002). But we also note that advantageous structural network positions, such as prominent and structural hole positions, have possible drawbacks such as information redundancy (in the case of prominence) and lack of specialization and focus (in the case of structural holes) (Ahuja, 2000; Vanhaverbeke et al., 2009; Malik, 2011). These drawbacks

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limit the full potential of any positive impact that the aforementioned network positions have on the firm's innovation performance. Our intuition is that firms with two prominent networks can use the benefits derived from one network to counterweigh the drawbacks in another network and so realize full business outcomes. In our study, we argue that a firm having a prominent inter-personal network position (i.e. the interlocking directorate network) achieved through extensive direct and indirect board ties, can use information assets at its disposal at the board level to reduce potential drawbacks encountered in the firm's inter-firm network by filtering, complementing and legitimizing information that is used by the firm to achieve innovation outcomes (Pfeffer and Salancik, 1978; Hillman and Dalziel, 2003).

Thus, our research contributes to the recent social capital (SC) literature trend that explores multiple network effects on business outcomes (e.g. Ozmel et al., 2013) by developing a theoretical argument of how an inter-personal network (the board interlock directorate network) inter-acts with an inter-firm network (such as alliances) to enhance innovation outcomes. In addition, we empirically validate this framework.

In this study we specifically focus on new product development (NPD) performance as a measure of innovation outcome, because of its importance in our research context—the biopharmaceutical industry. Past research in this industry has considered NPD as a good proxy of innovation outcomes because developing new products provides successful firms with monopoly rents for 10–15 years (Rothaermel, 2001; George et al., 2001; Rothaermel, 2002; Rothaermel and Deeds, 2004; Lim et al., 2006). Hence, in the biopharmaceutical industry, NPD is increasingly a focal point of competition and often requires the development and successful implementation of novel process technologies that ensures firms achieve their ultimately economic objectives such as cash, market share and competitive advantages (Lieberman and Montgomery, 1998). As a result NPD has been considered a key variable in alliance studies and has been utilized to address the impact of alliances in the innovation performance of the firm (Rothaermel, 2001; Rothaermel and Deeds, 2004; Faems et al., 2005; Perks and Jeffery, 2006; Nieto and Santamaria, 2007). However, despite its importance in the biopharmaceutical industry and its relevance in alliance literature, past studies employing network theory to link network structural dimensions to innovation outcomes have mostly neglected NPD as a dependent variable by concentrating more on patents as the measure of innovation performance (Ahuja, 2000; Salman and Saives, 2005; Schilling and Phelps, 2007; Gilsing et al., 2008; Padula, 2008; Vanhaverbeke et al., 2009; Phelps, 2010; Karamanos, 2012; Vanhaverbeke et al., 2012). An important exception is the recent study of Mazzola et al. (2015), in which the authors hypothesize a positive effect of some structural embeddedness network positions of the firm in its inter-firm networks on firm's NPD performance in the biopharmaceutical industry. The paper's empirical analysis shows that a prominent position of the firm in its network positively affects NPD performance, while structural hole positions seem to not effect NPD performance. Similarly, Wincent et al. (2010) show how high levels of board interlocking directorates have positive effects on innovation performance related to new product development. These recent studies enforce the importance of the contribution of this research. Indeed, while literature has acknowledged the relevance of inter-personal and inter-firm networks on improving NPD performance, no studies have focused on the interaction effects of these two networks like we do in this paper.

We test our theoretical framework on a set of 300 public companies in the biopharmaceutical industry and we get a positive confirmation of our hypotheses. Indeed, our results show how a prominent position of the firm's board in the directorates network reinforces the positive impact on NPD performance that prominent and structural hole positions in the firm's inter-organizational network have on the same performance variable.

The paper is organized as follows: In the next section, we develop the theoretical framework and a set of hypotheses. Section 3 discusses

the research methodology and the dataset, and section 4 presents the model specification. In section 5 results of the empirical investigations are shown, while discussion about the contribution of this research and conclusions are presented in section 6.

2. Theory and hypotheses

In recent decades, SC theorists have elucidated why network benefits arise from the firm's structural positions—both theoretically and empirically. A firm can benefit from its network by accessing critical information in the network through multiple ties with many partners, i.e. through prominent positions (Koka and Prescott, 2008). First, firms pursuing prominence in the network have advantages arising from accessing key and valuable information available in the network. Indeed, a prominent position facilitates the exchange of a high volume of information and knowledge assets that the firm can use to its competitive advantage (Granovetter, 1973; Koka and Prescott, 2002). However, network prominence benefits go beyond access to include those based on affiliation; indeed such a position enables the firm to influence its partners in ways that enable it to pursue and establish its own strategic agenda, thus enhancing its own performance (Koka and Prescott, 2008). As Podolny (2001) points out, being included in several inter-firm relations is also a signaling device that denotes prominence and influence (Zamudio et al., 2014) and signals quality and status (Ozmel et al., 2013).

A prominent position depends on the prominence of firms connected to it (Ruhnau, 2000; Koka and Prescott, 2002; Koka and Prescott, 2008; Zamudio, et al., 2014). Prominent firms in networks benefit from accessing potentially valuable external information from all companies other than its immediate partners (Soh, 2003), from developing greater capacity to monitor their external environment and from finding new information and knowledge (Ahuja, 2000). Most of the empirical studies that examine the impact of network prominent positions employ a range of firm's innovation output types as the dependent variable. These studies include the positive predictions of network prominence on patenting frequency (Ahuja, 2000), number of product awards (Soh, 2003), patenting propensity (Salman and Saives, 2005), innovative output (Schilling and Phelps, 2007), non-core technology patent citations (Vanhaverbeke et al., 2012), and new product development (Mazzola et al., 2015). Indeed, the firm's prominence in its own industry has been positively associated with higher exploitative and explorative learning processes (Atuahene-Gima and Murray, 2007) that are acknowledged as highly influential in product development (Katila and Ahuja, 2002). Prominent firms develop capabilities in dealing with inter-firm relationships (Anand and Khanna, 2000; Kale and Singh, 2007; Wang and Zajac, 2007) that can be useful to improve collaborative product development processes. In addition, prominent firms, thanks to their reputation and status, can firstly and easily reach the most influential suppliers and hence access the best knowledge and capabilities for making the NPD process more successful (Primo and Amundson, 2002; Petersen et al., 2003; Ragatz et al., 2003; Oke et al., 2008; Mazzola and Perrone, 2013); finally, thanks to their experience and knowledge about the network, they can better select the most aligned patents or technologies that can trigger or strengthen the NPD process (Geum et al., 2013).

Structural holes represent the second key structural network position that affects the firm's innovation performance (Burt, 1992; Ahuja, 2000; Burt, 2004; Zaheer and Bell, 2005; Padula, 2008). Structural holes are gaps in information flows created when two unrelated firms are linked to the same ego firm but not to each other. The firm that bridges unconnected firms will be able to potentially access novel and diverse information that might positively affect the firm's innovation performance (Burt, 1992, 2004; Koka and Prescott, 2002). Structural holes provide connections with so-called weak ties which may be partners operating in different industries, markets or technologies (Gilsing and Nooteboom, 2005) or just simply diverse and non-redundant information from partners that help companies to increase the innovation

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